

Assessment of Student Competencies for a Second-year Operating System Course

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ABSTRACT

This research aims to produce a more structured approach for assessment/evaluation under POPBL learning model. The systematic philosophy makes POPBL a suitable choice for a life long learning process as it provides a platform for learning through problem solving. POPBL is relatively new teaching philosophy and research presented here makes comparative analyses regarding assessment/evaluation of undergraduate students for a 3 ECTS non project supporting course “Operating System”.

Keywords: POPBL – Evaluation – Learning Philosophy – Model – Assessment.

INTRODUCTION

POPBL is a diversion from traditional scope of teaching. The essential elements of Problem Based Learning “PBL” are working with real world problems, peer collaboration, focusing on critical questions that frame the problem. Problems drive learning and development of analytical skills. PBL is an instructional methodology probing students to have deeper understanding of the subjects. Based on similar thoughts Project Organized Problem Based Learning “POPBL” is a concept conceived about 30 years ago at Roskilde University Centre and Aalborg University, Denmark. The POPBL curriculum includes project supporting as well as non project supporting courses in each semester, both of which are designed and included in the study curriculum along side with the project to enhance learning on knowledge and comprehension level, Bloom’s taxonomy (Bloom, B.S., 1956). This learning has to be developed further to reach higher learning levels (application, analysis, synthesis, and judgement (Bloom’s taxonomy) through work with the project. From experience with using true/false questions and multiple choice questions at the end of the lectures as feed back to the students as well as to the lecturers we suggest this to be followed by a more structured approach of assessment of the course using a structured questionnaire as a supplement to an oral examination. Doing so will give the possibility of getting around more aspects of the curriculum at the level of knowledge and comprehension (Bloom’s taxonomy objectives through the written questions (Bloom et al. 1956)), whereas the oral part is used to cover the methodology of the discipline and deeper learning level in depth for one particular topic drawn by the student from a number of questions.

INFORMATION TRANSFER

Typically, Bloom taxonomy is used to describe the expected learning levels for a subject or domain (Bloom, 1956). However, there are different ways how the transfer of information/knowledge takes place between the students and teachers e.g., *Instructor Based*: in which case Teacher/Tutor selects a delivery strategy and follows that line of action, *Student Based*: Teacher/Tutor provides hands on notes, focuses on concepts and mixed with couple of sessions dealing with problem solving activities. Similarly, in the case of *Content Based*: the emphasis is not only on the factual knowledge but also how various things can be implemented based on factual learning, teacher and student takes little bit more responsibility and the goals and objectives are more clearly defined. *Workshops* provide interactive approach to learning. Learning is not only based on theoretical concepts but also on some practical hands on developed for that particular subject. *Projects (PBL/POPBL)*: learning is through a real world problem. In our case study the project is to build a fingerprint matching system which individual highway patrol police officers can use to check the criminal record of any suspect stopped by them.

ASSESSMENT & EVALUATION

Fair assessment in university educations is a challenge. The scope of the assessment covers a wide range of different aspects to be achieved such as giving a clear picture of the students' learning compared with the defined goals for the education to the students and to the surrounding society. The results of the assessment must also serve as input to the university's quality assurance system. (Hansen I. L. & Rosenørn T. 2005). Further the assessment should be relevant to the way the teaching has been performed and to the way feedback has been given to the students throughout the course to be assessed. Consequently the way to assess problem based project work must be different from e.g. the way to assess a 3 ECTS course like Operating System in computer science/electronics. Currently the course is evaluated through a standard oral examination where the student draws a question and talks about this question for 15 minutes whereupon the examiner and/or the external examiner ask questions about the topic for another 15 minutes. This way of testing the students' learning usually only covers a fraction of the course curriculum and can be compared to participation in a lottery. A reasonably fair and just assessment in an examination requires, careful planning of examination in order to cover all subjects for all students, good balance between the weight of the oral presentation, discussion and in the case of project, the report. It is of utmost important that *what* is assessed and *how* it is assessed must be known by all involved parties – students, examiners, and external examiners (Hansen & Rosenørn, 2005).

Evaluation/Assessment has following scopes:

- Proof of the student's learning level within a well defined area (also for accreditation purposes).
- Document that the student has acquired the competences demanded by the labour market.

- Document that the student has acquired the qualifications demanded by the authorities (the state).
- Be a part of the university's quality development and quality control.
- Contribute to the student's motivation and self recognition.

Donald R. Woods et al., (2002) describes assessment in an article in Chemical Engineering Education as: "a judgement based on the degree to which goals have been achieved using measurable criteria and pertinent data". This statement is operationalized through the following principles:

1. Assessment is a judgement based on performance, not personalities.
2. Assessment is a judgement based on evidence, not feelings.
3. Assessment should be done for clearly identified purpose and with clearly identified performance conditions.
4. Assessment is a judgement done in context of published goals, measurable criteria, and pertinent, agreed upon forms of evidence.
5. Assessment should be based on multidimensional evidence.

SCHEME OF ASSESSMENT

There could as described above be many reasons to justify the assessment of students; however, typically *formative* and *summative* assessments are the two most important elements driving the idea of assessment. In the former case outcome is used for feedback to both students and teachers to realize how learning is progressing and in the later case outcome is used to give grade/marks to the students at the end of a semester/course/program. The students and teachers see assessment from two different perspectives however, if curriculum is reflected in the assessment then both (student & tutor) are working towards the same goal as shown in figure 1. For the tutor assessment is placed at the end of the teaching sequence road whereas assessment is placed right in front of the student sequence learning road (Ramsden, 1992). Our structured based approach to evaluate this non project supporting course is based these two key criterion of assessment described above.

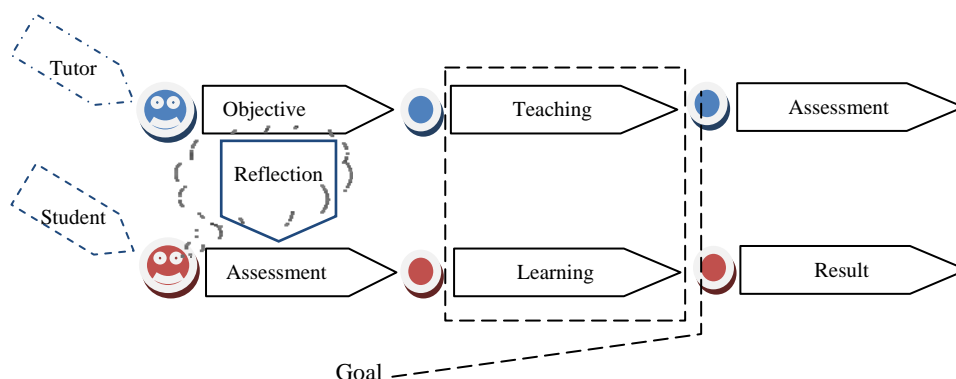


Figure 1: Two Perspectives

The new structured assessment scheme has 2 parts:

- First part of the assessment is the same as the traditional oral examination meaning presentation of topic. However, questions by the examiner and censor should be restricted to the topic presented. This way the student can be tested / challenged about that particular topic.
- Second, part is fundamentally different from traditional oral exam. In the second part to test the student competencies of their understanding of the subject a true/false and multiple choice questions sheets are prepared. The sensor and the examiner are given copies of these sheets before the start of the exam.

The topics selected are based on teaching after William Stallings, 2005:

- Discuss seven state suspended process model and describe its transitions among these states.
- What is concurrency, why it is important in a multi-programming environment? Discuss Dekker's attempts to achieve mutual exclusion.
- What is a page and frame? Give an example for an address translation considering a 16 bit processor with a page size of 1 K. Show how o/s manage page table and translate a given logical address to a physical address.
- Discuss the following scheduling policies: FCFS, RR, SPN, SRT, HRRN and Feed Back.
- Discuss TCP/IP protocol layers, its operation and also the header detail.
- Discuss Data link layer of OSI in context of Flow and Error control mechanism.

The student draws (picks) blindly a number out of these topics and present the topic in the allotted time of 10 minutes remaining 5 minutes are used for questions by the examiner and censor.

In the second part censor and the examiner by their mutual consultation selects a question sheet for the student from an already prepared sheets of questions which have True/False and multiple choice options. A portion of such sheet is shown in figure 2.

Now the student is given 15 minute to submit back this sheet to the examiner. It can be argued why to use such standard way of question/answer format. The reason is that these true/false and multiple choice questions are not standard questions. The student will use his understanding of the subject to answer those showing his comprehension and reflection on the subject.

1. T / F – The principal responsibility of the operating system is to control the execution of processes.
2. T / F – The Process Image refers to the binary form of the program code.
3. T / F – The less-privileged processor execution mode is often referred to as kernel mode.
4. T / F – A typical UNIX system employs two Running states, to indicate whether the process is executing in user mode or kernel mode.
5. T / F – The concept of thread synchronization is required in multithreaded systems because threads of a single process share the process's process control block (PCB).
6. T / F – Windows 2000 is an object-oriented O/S, but only processes (not threads) are implemented as objects in the WIN2K O/S.
7. T / F – Concurrency issues are a concern on multiprocessor systems, but do not impact uni-processor systems.
8. T / F – The major difficulty with semaphores is that wait and signal operations may be scattered throughout a program and it is difficult to see the overall effect of these operations on the semaphores they affect.
9. T / F – One problem with a pure priority scheduling scheme is that lower-priority processes may suffer deadlock.
10. The scheduling strategy where each process in the queue is given a certain amount of time, in turn, to execute and then returned to the queue, unless blocked is referred to as:
 - a. Prioritization
 - b. Round-Robin
 - c. LIFO
 - d. All of the above
11. In a typical UNIX system, the element of the process image that contains the processor status information is the:
 - a. System-level context
 - b. Register context
 - c. User-level context
 - d. All of the above
12. Key issues involved in the design of multiprocessor operating systems include:
 - a. Scheduling
 - b. Synchronization
 - c. Reliability and fault tolerance
 - d. All of the above
13. In a Linux system, when a new process is cloned, the two processes share the same:
 - a. Process identifier
 - b. Virtual memory
 - c. task_struct data structure
 - d. All of the above
14. The Reader/Writer problem requires that certain conditions be satisfied, such as:
 - a. Readers may read from the file while writers are writing to it
 - b. Multiple writers may write to the file simultaneously
 - c. Any number of readers may simultaneously read from the file
 - d. None of the above

Figure 2: Example Sheet for true/false & multiple choice questions

DISCUSSION

Historically, evaluation of students in contemporary PBL is not properly structured (Reis & Renzulli, 1991). Typically, formal assessment is often not aligned suitably with the objectives of the problem-based learning that preceded it. However, the evaluation of products produced by students (Reis & Renzulli, 1991; Treffinger, 1989; Westberg, 1991) and recent assessment/evaluation literature provides a fascinating insight for this subject (Hansen & Rosenørn, 2005; Rosenørn, 2003; Woods, 2002). Our motivation of developing this structured procedure is inspired by these references. In our proposed procedure some tough and time consuming hard work is required to prepare detailed exam sheets and questions. Also, informing students and the censor about the structure of the exam and how it will be assessed is the responsibility of the examiner.

CONCLUSION

We have shown here that a structured approach for the assessment of students is necessary under POPBL/PBL teaching philosophy to evaluate the true competencies achieved by the students. One could argue that these true/false and multiple choice questions can be asked orally as well by the examiner & censor. However, we feel student get more chance of reflecting on his learning when a physical structure is in front of him/her which is not possible in the oral conversation. Literature about assessment is very comprehensive. Many good ideas and advice can be found on how an assessment can be fair and showing the truth when cognitive and psycho-motor learning is being assessed.

Another, important point is that the examination duration is not altered in our scheme, as the first part is to be completed in 15 minutes and the second part is finished in the remaining 15 minutes. However, there will be a short break of 10 minutes after each exam for deciding the grades. The time spent on the examinations will increase slightly due to checking the written assignment, but we suggest the reward of having a better and fairer exam by far will outweigh this extra effort from the examiners.

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