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Written exams: How effectively are we using them?

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Abstract

In an outcomes-based education model, syllabi, learning activities and assessment tasks have to be aligned with the intended learning outcomes. This approach is known as Constructive Alignment. One of the major challenges in constructive alignment is the design of assessment tasks that are manageable, authentic, multi-dimensional, inclusive, equitable, valid and reliable. Trade-offs are inevitable; hence assessment tasks usually focus on particular aspects of the expected learning outcomes, while ignoring others. There is no such thing as the “silver bullet” assessment task. In this paper the use and format of assessments will be analysed and some ideas on how to design their effectiveness will be presented. The intention is to engage readers into reflecting on the effectiveness of the assessment methods they use, in particular: written exams.

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Nomenclature

Unit	The collection of structured learning activities students do over a fixed period of time (semester, trimester, etc.) to learn about one particular subject. Also known as class, subject and course in different institutions.
Course	Collection of units students need to complete in order to graduate. Also known as program, degree or syllabus in different institutions.

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Unit Coordinator	Person responsible for the design of a unit and, in most cases the delivery of lectures. Unit coordinators are accountable for the quality and effectiveness of a unit, as well as the students' experience in it.
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1. Introduction

Curtin University in Western Australia follows an outcomes-based educational model. The design of new courses and units starts with the declaration of what students will be able to demonstrate at the point of completion in terms of knowledge and skills, and at what level. These statements become the course and unit learning outcomes (CLOs and ULOs). Learning outcomes inform the selection of content, learning activities and assessments in every unit. This way of designing courses and units is known as Constructive Alignment (Biggs & Tang, 2011). In constructive alignment all learning experiences must be related to at least one learning outcome, and the objective of assessment items is to determine to what extent students have achieved each one of them. At Curtin University the principles of assessment are (Curtin, 2013):

1. Assessment practices will be subject to quality processes.
2. Assessment aligns with intended learning outcomes.
3. Assessment addresses Curtin graduate attributes.
4. Assessment practices have a substantial impact on student learning.
5. Assessment provides high quality and timely feedback to students.
6. Courses and units include a variety of assessment types
7. Assessment is inclusive and equitable.
8. Assessment is valid and reliable.
9. Information about assessment is readily available.
10. The amount of assessed work is manageable.

Some of these principles are relatively easy to demonstrate by counting or mapping activities to learning outcomes and graduate attributes. However, others are less intuitive. How can we demonstrate that assessment practices have a substantial impact on student learning (principle 4)? How can we measure the extent to which an assessment is valid and reliable (principle 8)? And ultimately, how can we demonstrate that assessments effectively measure students' attainment of the learning outcomes? These questions have been the subject of much research, and no definitive answers have been proposed (Race, 2014)(James et al., 2002).

2. The Purpose of Assessment

In a Constructive Alignment framework, the sole purpose of all assessment tasks is to verify the students' achievement of learning outcomes (Biggs & Tang, 2011). One of the complexities in designing assessment tasks comes from the different categories we use to classify them. Assessments can be formative (for feedback) or summative (for marks); continuous (multiple instances in a period of time) or unique (happening only once), individual or in teams. Blooms Taxonomy is commonly used to classify learning outcomes and teaching activities according to the level of thinking (LoT) students need to demonstrate. Figure 1 shows Bloom's taxonomy and a description of each level of thinking.

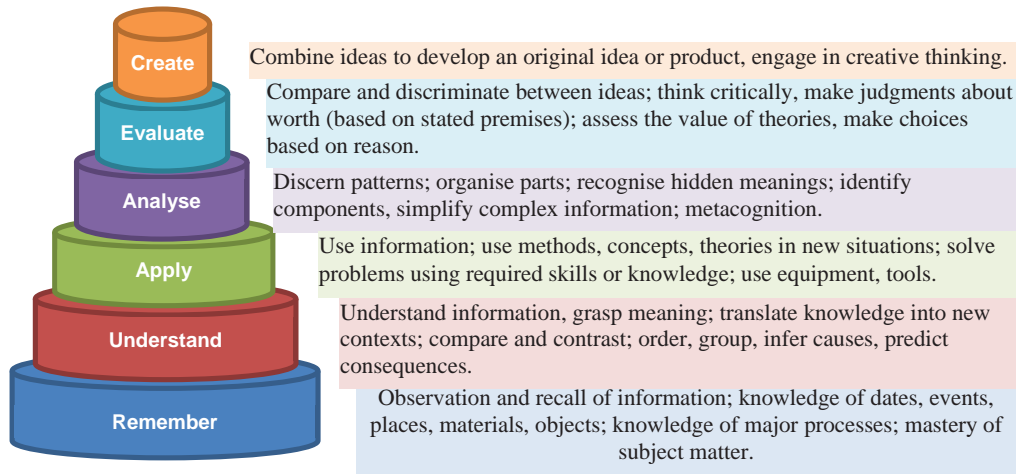


Fig. 1. Levels of thinking in Bloom's taxonomy.

3. Assessment activities

Traditionally, engineering subjects are assessed with mid-term tests, final exams and practical work. However, there are other activities that can be used to evaluate the attainment of learning outcomes, for example: Written work (essays, reports, reflective journals, online postings, annotated bibliographies, logbooks), fieldwork, simulations and gaming, peer and self-review, presentations (oral, posters, mini conference), portfolios, inquiry and project-based projects, and group work. Even for exams there are options; e.g. short-form tests, electronic quizzes, and group exam (Curtin T&L, 2015).

Effective assessment activities should provide students with opportunities to demonstrate what they know and can do; as opposed to exclusively showing them how much they ignore and need to achieve. However, it is very difficult to design assessments that can clearly discriminate between weak and strong students. Focusing on fundamentals usually results in very easy exams for which most students get good marks; while focusing on transfer of knowledge to unknown situations usually results in difficult exams that can be tackled only by the best students, with consequential high failure rates.

4. Designing Exams

Given that Engineering is a highly technical discipline, it is expected that written exams will keep playing a big part in the overall assessment of students; hence it makes sense to spend time designing exams with the following characteristics:

- Provide students with fair opportunities to demonstrate their level of achievement.
- Discriminate weak from strong students.
- Test different levels of thinking.
- Identify students who have not achieved a minimum, required level of attainment of learning outcomes; i.e. students who should fail the unit.

To achieve these objectives unit coordinators should be able to purposely balance the level of difficulty of each exam; i.e. start with basic questions and gradually increase the level of difficulty (i.e. LoT) as the exam progresses. The same could be applied to the design of questions with multiple sections. Use the initial sections to assess basic understanding of important concepts, and gradually increase the level of difficulty as the question progresses. Figure 2 shows these ideas in a graphical way.

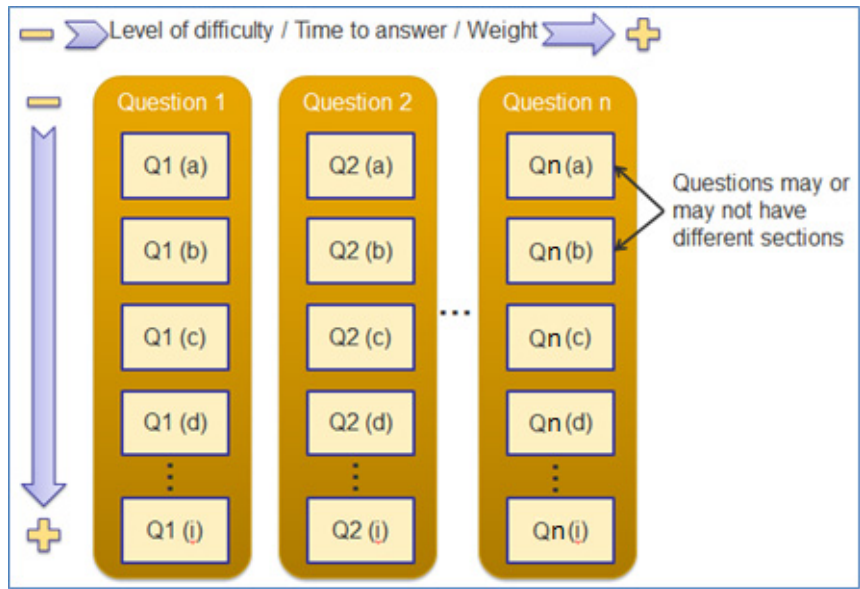


Fig. 2. Template to support the design written exams.

Exams that already have questions with different levels of difficulty could be improved by simply reordering questions such that the first question of the exam and the first section of every question are easier to answer compared to the last question and the last section of every question.

Table 1 presents the design of a final exam where different types of knowledge are assessed. Numbers in the table assume there is one question for every type of knowledge. Weights could be altered to reflect levels of difficulty. Ranges in the third column may be used as an indicator of the level of difficulty for each question; i.e. if upon completion the percentage of students who answer the question incorrectly is lower than the first number, then the question may be considered too difficult. Correspondingly, if the percentage of students who answer the question correctly is higher than the second number, then the question may be considered too easy. This information could be used in the design of future exams.

Table 1. Example of how to design a written exam.

Question	Types of knowledge	Percentage of students who are expected to answer correctly	Weight in the exam	Types of questions that can be used sorted by level of difficulty
1	Essential knowledge	90 - 100	10 %	True/False, Multiple Choice, Column Matching
2	Basic knowledge	75 - 90	20 %	Short answer, Spot the error, Complete the sentence
3	Intermediate knowledge	50 - 75	40 %	Choose formula, Explain how to solve, Long answer, Apply formula, Solve seen-before problems
4	Advanced knowledge	25 - 50	20%	Obtain formula Solve not-seen-before problems
5	Transfer of knowledge	10 - 25	10%	Apply knowledge to solve problems in different contexts

Designing final exams according to Table 1 could potentially solve one currently occurring problem, namely: A high percentage of students fail units because they achieve less than 40% in the final exam, which is a requirement to pass Curtin Engineering Foundation Year core units. By having questions with different levels of difficulty assessing different levels of knowledge, it is possible to define a more rational threshold. For example, to pass a unit, students could be required to achieve 50% out of 70% in the first three questions of Table 1. This is consistent with a Constructive Alignment framework, according to which students should fail only when they cannot demonstrate a minimum attainment of the learning outcomes.

Table 1 could be used as a template to design written exams. Templates for exams in different units could be used to compare units' level of difficulty. Templates for different exams in the same unit could be used to study the effectiveness of the exam at accurately assessing the attainment of learning outcomes by students.

5. Conclusions

With a little bit of creativity, it is possible to design written exams that accurately discriminate weak from strong students and, most importantly, correctly identify students who have not achieved an acceptable attainment of the learning outcomes.

Although written exams are likely to remain an important assessment component in engineering subjects, it must be acknowledged that even the most difficult questions only assess low levels of thinking. A holistic assessment scheme should combine written exams with other assessment activities that explicitly address high levels of thinking. Furthermore, in some subjects the final written exam could be replaced with more authentic problem-solving activities without compromising the quality and rigour of the unit.

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References

- Biggs, J., & Tang, C. (2011). *Teaching for quality learning at university: What the student does* (4th ed.). Maidenhead: Open University Press
- Curtin Teaching and Learning. (2015). Assessment design online support materials. Retrieved from: http://ctl.curtin.edu.au/teaching_learning_practice/assessment/
- Curtin University. (2013). *Assessment and Student Progression Manual, Consolidated Policies and Procedures*, Retrieved from Curtin Policies Website: <http://policies.curtin.edu.au/findapolicy/>
- James R., McInnis C., & Devlin M. (2002). *Assessing Learning in Australian Universities*. Centre for the Study of Higher Education. The University of Melbourne.
- Race, P (2014). *Making Learning Happen- Chapter 4: Assessment driving learning*. 3rd edition, London: Sage.