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BASICS: Building a System to Ingrain Core Competencies within Students

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Abstract

The aim of the project is to develop a system which will promote a solid knowledge of programmes' "core competencies" amongst students. This will be achieved by building a set of online quizzes which students will undertake on a regular basis throughout the delivery of programme modules. Quizzes will include feedback with links to web-based activities/information to help students develop their understanding.

Keywords: core competences, online quizzes, feedback

Introduction

Educators preparing for the delivery of a module/subject do so with the assumption that the students undertaking the module have developed certain competencies beforehand. With this in mind, programmes/courses of study are generally designed so that the competencies required in one module are either developed in previous modules or, particularly in the case of introductory modules, are prerequisites for entry to a programme. This programme design methodology should ensure that students are well prepared for modules they undertake from Semester 2 of their first year until they complete their programme of study, typically 3–4 years later. However, the reality is quite different for a multitude of reasons, such as:

- Exams are often structured in such a way as to allow sections of modules to be omitted, i.e. a student can pass a module without knowing the entire content of the module

- A certain amount of surface learning can occur with the result that knowledge is quickly lost after initial assessment

If the expected level of understanding of a module's prerequisite competencies does not already exist, students can quickly become inundated with "new" concepts leading to cognitive overload and a reduction in the student's ability to digest module concepts effectively. In addition, if the educator recognizes the lack of prerequisite competencies within the students, as would be desired, the delivery of the module would have to be altered to deal with the issues that arise, thereby further increasing the educator's workload.

It is clear that students who are comfortable with the prerequisite competencies will have an easier route to meeting the learning outcomes of the programme, with the added benefit that the educator's task will be more straightforward.

The above discussion leads to a desire to provide a support mechanism which will encourage students to develop module prerequisite competencies. One way to achieve this is to ensure that all the assessment of all modules was such that students must know the entire content of each module at a sufficiently deep level in order to progress. This suggestion, while appealing in certain ways, would require significant changes to established module assessment structures and, perhaps more importantly, is likely to be overly excessive since certain module content may not form the prerequisite competencies for any future modules. Another possible approach is for each module coordinator to identify a set of prerequisite competencies for their module and assess these competencies at the start of module delivery, thereby refreshing students' understanding of the competencies before commencement of the module. This approach is highly focused but may result

in certain competencies being overly assessed for the case where the same competencies form prerequisites for a number of modules. Acknowledging this likely possibility leads to an alternative programme level approach to deal with the issue more effectively in which programme "core competencies' are first identified in order to make best use of resources.

By initially focusing on the identification of a programme's "core competencies" (defined here as prerequisite module competencies which occur in a number of programme modules) a wider range of modules will benefit from any support mechanism developed to promote the understanding of these competencies. In addition, these competencies could be continually reinforced throughout the programme so that assessments would not be specifically required at the commencement of any particular module. This approach was adopted in an Honours Degree Electric/Electronic Engineering undergraduate programme in Dublin Institute of Technology.

The remainder of this paper outlines the logistics associated with implementing a system to promote students' understanding of programme core competencies; justification for the use of unsupervised online quizzes as the means to engage students; and findings resulting from an evaluation of the approach

Outline of Project

System Development Considerations
When considering the development of a system to promote students' understanding of core competencies at a programme level, in addition to applying sound learning theory, both the perspectives of the students and faculty staff must be considered. In particular, the rationale for the quizzes should be made clear to students, and staff, who may feel resentful, with some justification, of the work and scheduling involved with additional assessments. This point is highlighted as students may feel they are being overly assessed on a particular topic. In order for the system to be embraced by both parties it should be reasonably time flexible and require a minimum effort to coordinate. These considerations resulted in the following desirable features in the system:

- The system should be flexible enough to be implemented a number of times over the duration of a semester.
- Feedback should be prompt, i.e. students should quickly know if they have grasped the core competency.

Such features can be readily accommodated using online quizzes. The next section outlines issues associated with the use of unsupervised online quizzes.

Use of Unsupervised Online Quizzes
Online quizzes have been utilised in a broad range of disciplines to support student learning (Johnson, 2006; Kibble, 2007; Peat and Franklin, 2003). In Johnson (2006) it is noted that, amongst educational psychology students, higher use of optional online quizzes correlated with better academic performance, while an analysis of a survey of first year biology students found that 90% of students found weekly online quizzes to be either useful or very useful (Peat and Franklin, 2003). Online quizzes offer many benefits over their paper-based counterparts (EdTech); some key ones are listed below:

- Easy/wide access
- Facility to provide quick feedback
- Easy reuse of quizzes
- Allow multiple attempts
- Automatic corrections

The use of unsupervised online quizzes was explored in Kibble (2007) as means to provide formative assessment in a medical psychology programme. The paper explored the impact of offering "course credit" to students as an incentive to utilise the quizzes. In the first instance no credit was offered and it was observed that there was a high correlation between optional participation and higher end of semester summative assessment grades. Subsequently credit between 0.5% and 2% was offered as an incentive; Kibble (2007) fnotes that while the participation increased as a result there was evidence of widespread inappropriate use of the unsupervised quizzes.

From this review of the literature online quizzes appear to be very useful to both students and lecturing staff. The use of unsupervised quizzes is appealing due to the flexibility they offer to students and the low-cost of their implementation after initial setup. The difficulties with inappropriate use of such quizzes is acknowledged with the result that particular focus will be placed on quizzes which require a basic process to be applied; one in which it would be easier for a student to simply learn the process rather than copy from a colleague. It was also felt that the quizzes should generally contain a number of variables which could easily be randomised to allow for a large amount of variability in each question's answer; although the process to determine the answer would be the same, or similar, in each case to promote sharing of knowledge between students. With this in mind multiple-choice style questions would be avoided except where a large amount of variability could be maintained.

Implementation: Student Perspective

Having identified unsupervised online quizzes as being a potentially effective means to support students' understanding of core competencies at a programme level, the next step was to implement the system. This section outlines how the quizzes were implemented from a student's perspective.

Students were required to complete six quizzes over a 13 week semester. The quizzes were frontloaded so that all the quizzes were completed by the end of Week 7; this was done so that students would gain benefit from completing the quizzes at an early stage. Quizzes were available for a period of one week, with students being allowed an unlimited number of attempts; all quizzes were unsupervised. The quizzes comprised of mainly calculation based questions, for reasons outlined above, related to four areas associated with electrical/electronic engineering, i.e. Electrical Systems, Electronic Systems, Mathematics, Programming. It was expected that students would be able to achieve a grade of 80% or more within 30 minutes.

Three faculty staff agreed to use the results of the quizzes as part of the continuous assessment component of their module; this meant that the results of two quizzes would be used in each of the three modules. As an incentive to students the results of the quizzes would contribute to 5% of the continuous assessment component of each module; it was agreed that the full 5% would be awarded to students who achieved an average of 80% in the quizzes and 0% otherwise.

Methodology and Key Findings

Students' experience of the online "core competency" quizzes were evaluated via three focus groups which were facilitated by three members of the Institute's staff separately; each facilitator had prior experience in facilitating such discussions. Two of the focus groups were recorded (audio only) and each focus group involved six students. The facilitators were provided with a set of questions by the system coordinator in advance of the focus groups to act as a guide for the discussion. The questions are available for download from http://eleceng.dit.ie/dorran/basics.

On completion of the focus groups the facilitator met with the system coordinator to discuss main findings. For the case in which the focus groups were recorded, the two facilitators and the

coordinator were present at the meeting and the coordinator noted the main findings. Following this the coordinator analysed the recordings and used this data together with the meeting's findings to generate a report which was reviewed and agreed upon by the facilitators. The report is available for download at http://eleceng.dit.ie/dorran/basics. The report was also distributed to all students for comment via email. One response was received which stated "I have read through the document and found it be exactly how we all feel about the core assessments".

For the case in which students were not recorded, a brief meeting between the facilitator and coordinator took place in which the main advantages and disadvantages were discussed. The facilitator then wrote a report on his key findings; the report is available for download at http://eleceng.dit.ie/dorran/basics.

The key findings from the reports are similar and are summarised below:

1. Students' attitude towards the quizzes were largely positive, and the purpose and rationale for their introduction was understood. It should be noted that the feeling towards the quizzes when they were first proposed was generally negative and somewhat resentful in some cases.

2. Students felt the quizzes were beneficial as they help motivate revision.

3. They felt that quizzes which related more strongly to material they were currently studying would also be useful.

4. Quizzes were time consuming – up to two hours in some cases – the coordinator had an expectation that each quiz would require 20–30 minutes.

5. 5% of CA mark was enough to motivate them; as did the 80% pass mark.

6. A certain amount of copying occurred (approx 10% of questions completed without any real understanding – mainly multiple choice).

7. Students felt they benefitted from having multiple attempts and being able to work together.

Lessons Learned

This work investigates a method to support students' understanding of "core competencies" within an engineering programme. From an analysis of system requirements unsupervised online quizzes were identified as being suitable for further investigation.

A set of quizzes were developed and students' experiences of utilising these quizzes in an unsupervised environment were explored. In general students found the unsupervised core competency quizzes to be of benefit to their studies, although it is acknowledged that it is possible to complete the quizzes without any significant learning taking place. It is felt that the use of unsupervised quizzes are most appropriate to support the development of "short time-frame analytical skills" which are reinforced effectively through repetition. In mathematics an example of such a skill is the division of complex numbers; in electrical engineering one example is determining the equivalent resistance of resistors in series and parallel.

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