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Creating Diagnostic Tools to Improve Learning in Diverse Student Groups

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Abstract:

Today, most lecturers at UK universities face a diverse student body. Widening participation initiatives, the modularisation of programmes, alternative articulation routes into programmes and internationalisation have led to a diversity among the student population that can pose challenges to individual lecturers. These include a level of uncertainty over students' prior knowledge and experience relevant to a specific module. Despite controlled access to higher education (HE) and instruments to measure prior learning, the remaining differences among students can have a negative impact on teaching and learning. This workshop introduces the use of diagnostic tools, which are intended for the students to diagnose and address their weaknesses, as one possible way of responding to this challenge. It will outline the use of a diagnostic tool in a level 3 engineering module at Glasgow Caledonian University (GCU) attended by students from a range of different programmes and backgrounds. The workshop will conceptualise the different steps involved in creating this tool and will give participants the chance to begin planning such a tool for their own modules. Data gained from the evaluation of the diagnostic tool at GCU can provide insights into the specific benefits and challenges participants are likely to face in introducing such a tool to their own teaching.

Participants are therefore kindly requested to bring along descriptors of modules they might want to discuss in the workshop.

Background and Rationale

The student body of the School of Engineering and the Built Environment at GCU includes school leavers that bring Scottish, British or international secondary education qualifications, mature students and direct entrants who completed the first 1 or 2 years at further education (FE) colleges. In addition, undergraduate students from a wide variety of programmes share core modules. This situation creates a challenge for lecturers who need to ensure that modules, such as *Communications and the Internet* (Scottish Credit and Qualifications Framework – SCQF - level 9) are 'working for the full spectrum of students enrolled' (QAA. 2007, 18). Although the module is designed to cover basic principles of communications, the diversity of students' previous experience of assessment methods, related subject content, specifically in the field of mathematics, high student numbers (between 160 and 220) and considerable differences with regard to their expectations (students from over 10 different programmes) mean that adapting the teaching content in a way that allows individual learners to build on their existing knowledge (Ausubel. 1968 cited in Nicholls. 2002) is almost impossible for a lecturer. Teaching that does not allow learners to construct these connections, on the other hand, risks alienating them, either because the distance between previous learning and new content is too big, leaving them unable to construct meaningful knowledge, or because an 'insufficient challenge [...] produc[es] boredom' (Pekrun et al. 2007, 21).

In order to address this problem, a twofold approach is needed. On the one hand, a more detailed profile of students' existing knowledge in problematic areas can enable lecturers to fine tune their teaching materials to a specific group. The extent of the differences between students and the class size, on the other hand, mean that a successful solution needs to be more individualised; given the

limitations on lecturers' time and resources, it is therefore necessary to enable students to understand the requirements better and work independently on bridging some of the gap between their current and expected knowledge and skills. Emphasising students' responsibility is not only a necessary step in a situation that does not allow further individualisation of learning materials, but also offers them an important opportunity to develop as self-directed learners who are able to 'take the initiative [...] in diagnosing their learning needs, formulating learning goals, identifying human and material resources for learning, choosing and implementing appropriate learning strategies and evaluating their learning outcomes' (Knowles. 1970, 95). A diagnostic tool that allows both students and lecturer to act on differences between existing and expected knowledge can thus not only improve their learning on this module, but can also be beneficial for their general development as learners. In order to do this, it needs to deliver both individual results and a more detailed profile of the student cohort.

As Miller et al. (1998, 28) point out, diagnostic assessment is a typical example of criterion-based measurement, as it aims at identifying students' weaknesses in relation to the knowledge needed for future learning. The first step in designing a useful diagnostic tool thus consists in identifying relevant areas of previous knowledge and experience for the module and formulating these in the form of specific criteria. Following this, assessment methods and tasks that allow students to establish whether their current performance fulfils these criteria need to be chosen. Feedback on their performance needs to be coupled with advice for students on how to bridge potential gaps in performance. In addition, the results can be used to identify necessary changes to teaching materials.

The workshop presents the rationale for the design of our diagnostic tool and allows participants to apply these steps to a module of their own choice to develop a first version of their own diagnostic tool.

Activity 1: Participants are invited to identify a module with similar conditions where a diagnostic assessment could be an appropriate teaching tool.

Designing the Diagnostic Tool

Analysing and prioritising prerequisite knowledge and experience for a module

Anecdotal evidence, analysis of teaching outcomes and assessment structure of the module and an initial questionnaire were used to determine which areas of previous knowledge and experience were essential to allow successful student learning in it. The first two suggested that students often struggle with the mathematical content and fail modules, not because of technical content, but because of their poor numeracy skills when they enter university. Furthermore, it seemed that direct entrants unfamiliar with report writing, with the way exams are conducted in HE, and with the forms of assessment used in the module, struggled, because they were not able to present their understanding of engineering content in the required format. These three areas also featured prominently in the answers to a short questionnaire given to a previous student cohort to corroborate the result of the lecturer's perception. All of them were deemed to be of high priority, as they either made it impossible for students to follow the engineering content (maths) of the module or meant that they could fail the module despite their technical understanding.

Activity 2: Participants are encouraged to analyse the requirements of their chosen module.

Considering which type(s) of assessment are best suited to establish students' current knowledge in these areas

Speedy feedback is generally necessary in order to create a forward oriented feedback loop (QAA 2007b. 10), but is particularly important in this context. Prompt feedback can be delivered in a variety of formats, however, and the decision to combine different formats within the diagnostic tool was based on the wish to harness the different advantages they can bring.

The most common form of assessment used in Higher Education is tutor assessment in which the teacher evaluates students' performance. It is most effective, according to Weaver, if it is given in a constructive manner, is accompanied by guidance on how to improve performance and, most importantly, if it 'relate[s] to assessment criteria' (Weaver.2006 cited in Butcher et al. 2006, 113). These advantages are made possible by the teacher's expert knowledge in the subject area, which allows him or her to judge the gap between the expected performance and that of individual students, an aspect particularly important with regard to maths related problems, as students' current lack of familiarity within this field means that they are unlikely to rate their own performance adequately.

The biggest disadvantage of teacher assessment, on the other hand, is that it does not encourage independent learning, as successful independent learners not only need to know 'how to close the gap' between expectations and their current performance; they also need to know 'what good performance is' and be able to 'compare the current and the desired performance' (Nichol and MacFarlane. 2006, 6). This is particularly relevant here, as the diagnostic tool is partly designed as a basis for independent learning. Therefore, we took the decision to combine tutor-lead assessment on mathematical components with self-assessment, which allows students to 'monitor their own performance', in order to underline 'dual responsibility of both teacher and student in the learning process' (Boud. 1995, 14). In order to minimise potential problems arising from uncertainty over assessment criteria for their own performance (Falchikov. 2005), the self-assessment component was applied to the section on report writing skills, where students could be given a model answer and explanations.

Similar to self-assessment, peer assessment maintains the element of students' responsibility for their learning, independence from the teacher (cf. Lindblom-Yläne et al. 2006, 51) and practice of self-evaluation (Boud 1995, Sadler 1989). At the same time, it adds an element of dialogue that can 'develop insights and enhance student understanding through the process of articulating assessment comments' (Brown and Knight cited in Miller et al. 1998, 164). This potential was harnessed for the tasks on exam preparation, where students bring a wealth of previous experience.

Activity 3: Participants are encouraged to match appropriate assessment methods to the areas in which students are likely to experience difficulties.

Developing short tasks for the diagnostic tools

Specific tasks were developed to help students and the lecturer identify the gap between current and necessary performance in each of the three areas.

The following table gives an overview of the decisions taken:

Academic and Learning Skills	Tasks	Feedback used in diagnostic assessment
Report writing skills: finding sources and information	Students prepare lists of possible sources and evaluate them together according to criteria provided by the lecturer.	Peers
Report writing skills: style of Writing	Students identify mistakes in a text (provided by the lecturer) written in an inappropriate style and compare their solution to a model answer.	Self
Mathematical Skills: numeracy skills required to solve technical problems.	Students solve a small number of mathematical problems (each one related to a particular numeracy	Lecturer

	skill) and compare their solutions to the ones provided by the lecturer.	
Exam Preparation	Students compare their answers to two short questions about their exam revision habits according to criteria for successful preparation.	Peers

Table 1: Areas of knowledge, specific tasks and assessment methods chosen

Activity 4: Participants are invited to experiment with different ways of designing a task for their diagnostic tool.

Providing Guidance for Independent Learning

Students were given written advice on ways in which they could close the gap between the knowledge expected for this module and their current knowledge in each of these areas through support available at GCU, tips for independent study, including a bibliography on helpful publications and online materials and short lists of specific tips, for example on exam revision.

Activity 5: Participants identify suitable sources of support and tools for independent learning relevant to their own module.

Adapting Teaching Content and Materials

The discussion of self-assessment and peer-assessed tasks and the collected answers also allowed the lecturer to identify in which of these areas the current cohort was least prepared for the module. Apart from small adaptations to teaching content, such as inclusions of definitions or revision of key mathematical operations in examples, however, this mainly led to increased references to the advice provided after the diagnostic test. The main emphasis was thus on enabling students to close gaps independently.

Evaluation of the Diagnostic Tool

At the end of the semester, a short, anonymous questionnaire was used to evaluate how helpful students found the diagnostic tool and its different components, which measure they took to address any gaps they identified between existing and required prior learning, and whether further support would have been necessary to follow up the diagnostic assessment. Mostly students found the tool useful, an impression confirmed by a marked increase in the passing rate. *The Communications & The Internet module*, which has been running since 2004, had a passing rate of only 46% when it was assigned to one of the authors. It currently has passing rates of over 80% after adopting measures such as the diagnostic tools. The effectiveness of the diagnostic tool has also been confirmed through its application to another module (*Data Communications & Transmission Systems*, SCQF level 8).

A particularly positive result was that this evaluation was based on a high degree of willingness and ability to make use of suggestions for independent learning.

Learning Outcomes

At the end of this workshop, participants will be better able to

- understand in which context a diagnostic tool can provide useful support for teaching on a specific module

- understand and apply the different steps involved in the design of a diagnostic tool
- identify and evaluate the benefits and limitations of its use
- reflect on the link between diagnostic tools and independent learning and to identify appropriate sources of support for students

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