

Use of an objective assessment tool to evaluate students' basic electrical engineering skills

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This case study has been developed from data gathered through a demonstration of the teaching and learning materials available, interviews with the tutor and a student focus group.

Background

This report concerns the use of Objective Structured Technical Examinations (OSTEs) to assess engineering students' core practical and theoretical skills. OSTEs are based on similar type of assessment widely used in medical and health care courses (where they are Clinical Examinations, OSCEs) and involve students performing a series of short tasks in a fixed time that are individually assessed by a lecturer. Examples of the tasks used are soldering a component onto a circuit, reading the code on a resistor giving its resistance, simple calculations, setting up an oscilloscope to display a signal effectively and fault-finding in an electronic circuit. Practical tasks are observed one-to-one by an examiner who records whether the student fulfils objective criteria (e.g. health and safety guidelines while soldering, certain adjustments to the oscilloscope or turning off the power to a circuit before re-wiring it) and other observations on a mark sheet. Theoretical tasks involve the completion of an answer sheet by the student that can be marked later. The student is given five minutes per task, and has to complete 16 tasks in series, with one minute between tasks during which feedback may be given and the student moves to the next task. A more detailed description of OSTEs and their development is given in Reference 1.

32 students in the second semester of their first-year completed the 16-station OSTEs in two sessions on the same afternoon. Students were typical for a post-92 University and were studying a general electronic and electrical engineering curriculum leading to a BEng with specialisation possible in the final year.

Reasons

The tutor had acted as an assessor in OSCEs and so was familiar with their widely acknowledged role in medical education since their introduction in the mid-70's. She was aware of a possible lack of practical skills in many of the first year students at her institution and felt that OSTE sessions would help the students familiarise themselves with a range of equipment and allow staff and students to become aware of any weaknesses in the students, thus allowing them to know which skills they needed to improve.

Lecturer's perspective

The tutor received mini-project funding from the Engineering Subject Centre which allowed her to develop, pilot and refine the OSTE tasks. First she had to decide on the range of tasks that would test a complete and varied set of skills, which she described as *"very time consuming, I had to speak to lots of people in the department and gather ideas from them"*. Then, for each task it was necessary to formulate objective assessment criteria which *"wasn't easy either"*. Running the sessions required recruiting and training members of staff to observe and assess the students on the practical tasks, informing the students what was expected of them and setting up the lab. The OSTEs were piloted on second year students in order to confirm that the level of difficulty and time per task was reasonable—these pilots resulted in a fair number of changes being made. In summary *"if you're starting from scratch, then a lot of work has to go in before you actually run the session"* but *"once you've got your session ... it's fairly easy to do"*. Although the session requires intensive input of staff time for the practical tasks the assessment is made during the tasks, so once these are complete no further marking is required.

The tutor believed that students would benefit since:

- working through a fairly large number of varied tasks can highlight the students strengths and weaknesses, letting them know which skills they need to develop further.
- whereas most practical work is done in groups or pairs and so students are able to avoid certain aspects of practical work, for the OSTEs the student was on their own and therefore had to participate.

- being assessment-driven, the OSTE's would encourage students to participate.
- Students are able to receive feedback individually.

Her main concern on behalf of the students was that being intensively assessed for the best part of two hours might be overly stressful for some.

Students' perspective

Student questionnaires were returned by 25 of the students who completed the OSTE's. These were generally very positive in their tone, for example only one person disagreed with the statement "the OSTE session will help my studies" (11 agreed and 9 agreed strongly). On the whole, the students did not think that the tasks in the session were too difficult, no one found the session boring and only two students thought it unnecessary.

The main advantage of the OSTE session in the eyes of the students was in helping them identify their strengths and weaknesses. According to the survey, most students relied on whether they understood lectures for monitoring their own progress against what they thought was expected of them and nearly all wanted more information on their progress. 22 students agreed (six of them strongly) that *"the OSTE session helped clarify what I was supposed to be able to achieve"*, and after the OSTE's students were on average more confident that they had learnt as much as was expected of them. As one of the students interviewed after the session said *"I know my weaknesses, and what I need to know"*.

Students also felt that they had learnt some skills during the OSTE, as a result of the immediate feedback from the assessors, and that the OSTE's had addressed areas that wouldn't have been picked up by other forms of lab work. In interview, students remarked that when marking course work or lab books the lecturer might assume competence (e.g. in setting up an oscilloscope) when the student had only just coped or had allowed their partner to do that part of the experiment, however the OSTE would show whether they could achieve the task effectively (getting the best settings, not just something usable) and efficiently (because of the tight time limit).

The students did not report finding the exercise stressful, though this may be because they recognised the benefit of learning their weaknesses as well as showing their strengths (*"some people get a bit stressed before exams, whereas this is more informal, you don't get so worried"*). For a similar reason they were also against the idea of summative OSTE's, when they would probably attempt to cram specifically for the exam: *"if we're assessed for it we're all going to prepare for it ... rather than be tested on what we know"*.

Issues

Developing the OSTE's takes time: *"the first stage is developing the stations themselves, and that is very time consuming"*, *"once we had the idea of what task we wanted them to do we had to come up with very objective assessment criteria, and that wasn't easy either"*.

"One of the difficult things is getting people involved to be examiners of the session ... it's very human resource intensive."

Benefits

OSTE's Assess specific key competencies that may be missed by other broader assessments. *"Your lab skills are not always assessed, they just check your log book and see your final result. This OSTE, it checks your method ... how you're connecting equipment ... not everyone uses [the equipment] properly in the right way."* They let students know what is expected of them and what their strengths and weaknesses are and provide an opportunity for students to learn core skills, allowing students to focus on deeper aspects of experimental work during practical sessions.

Reflections

Although time consuming to set up in the first place, both lecturer and students felt that OSTE's were a valuable tool in assessing core skills and highlighting deficiencies that otherwise might go unaddressed. They provide an opportunity on focussed one-to-one teaching that can have a knock-on benefit of increasing the effectiveness of practical classes. The students interviewed thought that OSTE's should be used formatively in every module they studied.

References

1. *"Engineering Subject Centre mini-project report : Design of an objective assessment tool to evaluate students' basic electrical engineering skills"*, Alinier, N. and Alinier, G. Higher Education Academy Engineering Subject Centre, 2005 available online: <http://www.engsc.ac.uk/downloads/miniproject/oste.pdf> (accessed May 2006)