[O23] Assessment of practical skills – 'I do and I learn'

Peter Klappa
Department of Biosciences
University of Kent
P.Klappa@kent.ac.uk

'Learning by doing' is one of the most powerful forms of education, because various senses are involved. There is no doubt that practical classes have a pivotal role in the under-standing of basic concepts in Biosciences and in the employability of students. However, despite the importance of practical classes, the intended learning outcomes, i.e. practical skills, are very often not adequately assessed: The emphasis of the assessment is often placed on the practical write-up and pays only little attention to the manual competency of the student.

We investigated how practical classes can be designed such that an assessment of practical skills and manual competency of Bioscience students is achieved. To this aim we designed and conducted practical classes for under-graduate students such that subject specific and practical skills were developed. Students' manual competency was monitored throughout the course and formally assessed at the end of the module.

To give every student the opportunity to obtain the required practical skills, students worked individually, being supervised at all times by qualified demonstrators. Students received extensive theoretical background knowledge in lectures and workshops prior to the practical classes and also got a brief introduction to the specific laboratory tasks in 'pre-lab' sessions. We noticed a rather wide-spread range of skills, e.g. some students were very able to achieve accurate data while others clearly struggled. After students carried out a specific task, they were asked to produce a short write-up to summarize their results. This write-up, together with a 'comprehension sheet', which linked theory with practice, served as an 'aide memoir'. It was checked and corrected by the demonstrators, but not assessed.

To ensure that students obtained the relevant practical skills, an assessed practical was timetabled and students were informed in advance about the nature of the assessment. In a workshop prior to the assessment a manual for the assessed practical was handed out (see below) and potential problems and methodical errors, as well as health and safety aspects were discussed with the students.

In the assessed practical students repeated one of the previous experiments with sub-sequent marking of their results. For example, students had to produce a standard curve and determine the concentration of a given protein solution. The marking was mainly based on accuracy, but other factors, e.g. safety, following good laboratory practice, etc. were taken into account. Students who were outside a set error margin and therefore failed the assessment were asked to repeat it. In this case, students were shown again how to use the equipment and potential methodical errors were discussed. On average between 6 and 16 % of the students had to resit the practical, but so far no student failed the assessment.

To evaluate the success of this scheme, students were asked about the usefulness of the practical classes and assessments through questionnaires. In general students commented positively on the organisation of the practical classes and their embedding into the lectures. They thought that the aims were very well achieved and that they now feel more comfortable with the techniques and the equipment.

CONCLUSIONS

From our analysis of the evaluation forms and informal discussion with students we concluded that the project was successful in that it enabled us to assess objectively the manual skills of students. However, we noticed some points that need to be taken into account when this form or assessment is used:

- *Suitability of the practical class* - Assessed practical classes are a powerful tool in the assessment of manual competence, however, not all practical classes are equally suitable for this approach. The learning outcomes of the chosen practical classes, being of numerical nature were comparatively easy to assess. However, a practical class the main learning outcome of which is the cloning of a gene or the identification of a microbiological specimen cannot be easily assessed in the same way. Careful design of the practical classes and their assessment according to the learning outcomes is therefore mandatory.

- *Link between practical classes and theory* – Lectures/workshops and practical classes must be closely interlinked. A careful curriculum design and detailed plan of work is very important.

- *Differential learning* – We observed a widespread range of manual competency. It is therefore important to address this issue and to provide support for weaker students. This can be done by closer supervision of those students or by giving extra help in the use of equipment.

Assessed practical BI301 – Enzymes and Metabolism

The aim of this practical is to determine the specific activity of the enzyme Fumarase.

Pipette 3ml of Phosphate-malate buffer (0.05M) into a silica (quartz) spectrophotometer cuvette (glass or plastic is UV opaque). Place the cuvette in the spectrophotometer (wavelength setting = 250nm) and zero the instrument. Pipette 10 ml of enzyme solution into the cuvette and mix well. Record the changes in extinction every 10 sec over a 60-180 sec period or use the recorder. Calculate the average extinction increment per min arithmetically or from the slope of the graph of E vs time. Convert your rate (extinction/min) to mM/min (extinction coefficient 1450 1.mol-1 cm-1). Repeat the determination three times and calculate an average rate. Calculate the specific activity value (the concentration of fumarase in your stock will be given to you on the day).

Example calculation (your calculation will be different, since you use a different enzyme concentration):

1. Determine the initial rates (the difference in OD/min) using the tangent on the chart recorder printout:
   enzyme (0.010 ml): 0.02 / 15 sec = <u>0.08/min</u>

2. Calculate the amount of µmoles / litre /min:
   E = e x c x d
   0.08 / min = 1450 mol^{-1} cm^{-1} l x c x 1 cm
   c = 0.08 /1450 mol/l min = <u>55.2 µmol/l min</u>

3. Production of nmol / min:
   You produce 55.2 µmol/l min, how many moles are in 3 ml?
   55.2 µmol/l min x 0.003 l = <u>165.5 nmol / min.</u>

4. Specific activity (µmol/ min mg):
   Enzyme concentration is 180 µg / ml and you used 0.01 ml, therefore you have got
   180 µg/ ml x 0.01 ml = 1.8 µg of enzyme,
   which give you a change of <u>165.5 nmol / min.</u>

The specific activity therefore is:
165.5 nmol / min / 1.8 µg = <u>0.092 mol / min g (= 92 µmol / min mg).</u>

COSHH Regulations 1988. This instruction sheet has been subjected to a formal risk assessment.
<u>**Safety specs and gloves must be worn at all times.**</u>

Signed: Date: