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Better Practical Classes

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Laboratory classes

These days undergraduates receive rather limited exposure to laboratory science.

It is time-consuming and expensive to put on good experimental courses using modern techniques and equipment.

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Are the students confused?

Practical classes have many functions:

....illustrating the lecture course, handling biological materials, demonstrating equipment, developing manual and observational skills, analyzing data, understanding the process of scientific enquiry...

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It is not surprising that students are sometimes confused about what they should be learning.

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Progression in the laboratory

The novice:

New to the laboratory, follows recipes, unfamiliar with equipment, does not know how to make solutions.

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The trained worker – capable of independent scientific work:

Can design and carry out experiments, analyse data and communicate results

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Projects

- Represent the last stage in the under-graduate lab training
- Mentioned in the **Benchmark** statements
- Most students enjoy, are stimulated and challenged
- Rewarding to have the experience of working in a modern lab

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Research Projects

How can we make the initial classes more like the research project?

Levels of experiments:

- Demonstration
- Exercise
- Structured enquiry
- Open-ended enquiry

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Some purposes of lab. classes – 1

Learning by seeing:

- Illustrating material learned in the lecture
- Illustrating techniques mentioned in the lecture
- Illustrating equipment mentioned in the lecture

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Some purposes of lab. classes – 2

Learning by doing:

- Learning manual skills
- Following protocols
- Learning about instruments
- Learning how to handle biological materials

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Some purposes of lab. classes – 3

Learning about communicating science:

- Drawing graphs and diagrams
- Preparing tables
- Statistical analysis
- Preparing posters
- Writing scientific papers

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Some purposes of lab. classes – 4

Learning intellectual skills:

- Proposing hypotheses
- Designing experiments to test hypotheses
- Writing protocols, finding methods
- Writing up and analysing data
- Reaching conclusions

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Skills taught in a lab-based course

- Planning and carrying out an investigation

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- Planning and carrying out an investigation
- Selecting an experimental procedure

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NOTE

These are difficult to do in other than a one-to-one situation

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- Designing/choosing appropriate apparatus

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Skills taught in a lab-based course

- Planning and carrying out an investigation
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- Designing/choosing appropriate apparatus
- Working safely

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- Working safely
- Drawing conclusions from results

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DO EMPLOYERS VALUE THESE?

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DO WE ASSESS THESE?

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What are the aims of your lab class?

(Economic arguments)

- Is it worth doing?
- Can it be done on paper?
- Do students have to do it individually?
- Can it be done outside the lab?
- Should they do it all or only part?
- Can it be simulated?
- Does it need to be supervised?

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What motivates students?
(Redesigning experiments to stimulate students)

- Is the experiment dull?
- Is it likely to be successful?
- Is it open-ended, unpredictable?
- Does it involve competition?
- Does it involve team work?
- Does it involve novelty or discovery?

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Achieving aims

- Do we monitor attendance and contribution to the class?
- Which skills do we assess?
- Which skills can we assess?

Achieving aims separately

If the objective of the lab class is (*a*) to obtain good experimental data and then (*b*) to processing the data – ask if these two processes can be separated?

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Example: for an enzyme assay, can (*a*) the assays, and (*b*) the processing of data (e.g. determination of K_m, V_{max}), be carried out (and assessed) separately?

Conclusions

- We should be clear about the objectives to be achieved in laboratory practical classes

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- We should make sure that the students understand what it is that they are supposed to be learning

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Conclusions

- We should be clear about the objectives to be achieved in laboratory practical classes
- We should make sure that the students understand what it is that they are supposed to be learning
- We should try to separate the various things to be learned and deal with them separately

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Achieving aims

- Are the students trained in the skills they are expected to demonstrate?
- Are the achievements of aims by students assessed?
- Do students do the experiment sufficiently often to achieve the aims?
- Are the aims made explicit to the students?