



Abstract

The opportunity for students to engage in laboratory activities is an essential component of degree programmes in science-related courses. It is one of the few opportunities students will have to practice in a similar way that professionals do.

However, developing and teaching an effective laboratory session requires as much skill, creativity, and hard work as proposing and executing a first-rate research project. In addition, in order for laboratory sessions to be effective, students need to understand not only how to deliver the experiment, but why the experiment is worth doing, and what purpose it serves for improving students' understanding of a concept, relationship, or process.



Introduction

The role and benefits of laboratory-based teaching are to:

Motivate students and stimulate their interest in the subject;

Help them to deepen their understanding through relating theory to practice;

Provide opportunities for students to work together on analysing and solving problems;

Develop skills and attitudes that enable graduates to operate effectively and professionally in challenging workplaces.

Five types of objectives that may be achieved through the use of the laboratory classes:

Skills: manipulative, inquiry, investigative, organizational, communicative;

Concepts: hypothesis, theoretical model, taxonomic category;

Cognitive abilities: critical thinking, problem solving, application, analysis, synthesis;

Understanding of the nature of science: scientific enterprise, scientists and how they work, existence of a multiplicity of scientific methods, interrelationships between science and technology and among the various disciplines of science;

Attitudes: curiosity, interest, risk taking, objectivity, precision, confidence, perseverance, satisfaction, responsibility, consensus, collaboration, and liking science.

Lab-Based Teaching Strategies

Developing and teaching an effective laboratory session requires:

- Research and technical skills;
- Creativity;
- Hard work;
- Professionalism
- Management and leadership skills

as proposing and executing a first-rate research project.



Challenges of Lab-Based Teaching

Trying to incorporate laboratory work successfully in to the curriculum can present a number of challenges:

- Laboratory and practical work are expensive to run;
- Practical sessions are time-consuming to develop, organise, manage and assess;
- Space and equipment can be limited and student cohorts are often subdivided into groups;
- Students are often required to re-produce routine experiments that yield well-known results and to focus on experimental methodologies rather than on developing transferable skills.



Think About the Goals

Before you begin to develop a laboratory teaching program, it is important to think about its goals:

- Develop intuition and deepen understanding of concepts;
- Apply concepts learned in class to new situations;
- Experience basic phenomena;
- Develop critical, quantitative thinking;
- Develop experimental and data analysis skills;
- Learn to use scientific apparatus;
- Learn to estimate statistical errors and recognize systematic errors;
- Develop reporting skills (written and oral).



Plan Each Experiment

To ensure that lab exercises run smoothly and that students don't run into ambiguous directions, follow these planning steps before every experiment:

- The facilitator should rehearse the procedure before the lab sections and review the results afterwards;
- Prepare lab assignments at least a week in advance;
- Try out each experiment before giving students the assignment sheet;
- Make sure that the requirements are feasible and clearly stated and that the specific numbers chosen produce the desired results.



Reviewing Each Experiment

After each experiment, your lab scheduling should include time for the facilitators to review the results of the exercise with the class. This step is essential to help the students check their individual conclusions and understand the results in relation to the theories of the course.

Class discussion will also enable the facilitators to identify any problems with the lab experimental protocols so that you can correct them for the next session.



Suggested Reading

Henige, K. (2011). Undergraduate student attitudes and perceptions toward low-and high-level inquiry exercise physiology teaching laboratory experiences. *Advances in Physiology Education*, 35(2), 197-205.

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Nikolic, S., Ritz, C., Vial, P. J., Ros, M., & Stirling, D. (2015). Decoding student satisfaction: How to manage and improve the laboratory experience. *IEEE Transactions on Education*, 58(3), 151-158.

Adams, D. J. (2009). Current trends in laboratory class teaching in university bioscience programmes. *Bioscience Education*, 13(1), 1-14.

