# ES Pedagogy – Best Practices in Course Management

## What is this Handbook About?

This handbook provides important guidelines about **Best Practices in Course Management**, which should help instructors manage and deliver courses efficiently. Adherence to these practices, will, in particular, **help students make the most of your course**.

## Things to Do Before the Course Starts…

Once you have been assigned a course, you should carefully execute the following:

- Review previous course files, course review forms, and course outlines to formulate the best course outline based on OBE system
    - **Course Outline should include** at least the following: Instructor's email address, office number, office hours, policies (attendance etc.), course and reference books, details of software to be used, diverse assessment methods (with weightage & CLO mapping) and lecture breakdown.
- **Identify and suggest effective tools and course components**, e.g., Complex Engineering Problems (CEPs) to the curriculum committee/Dean FES, as required.
- If a **Teaching Assistant** (TA) is assigned, guide him/her on all the necessary tasks, responsibilities, and ways of working, especially concerning Course Management System (CMS).
- In case of a **co-requisite Lab course**, hold a preliminary meeting with the assigned lab engineer to plan and discuss the lab contents/experiments, Open-Ended Lab (OEL) and Project List.

## Things to Do During the Course…

Adopting the following practices during the course will help students make the most of your course

- **Make a central course material repository** (CMS, MS teams, Google Drive etc.) and provide students access to it early on.
    - A **typical course repository** may include folders such as: Course Outline, Assignments, Lecture Slides/Discussed topics, Software, Quizzes, Reference Material and Exam Samples etc.
- Provide a properly prepared **OBE-based course outline** to students (via email and in course repository) and discuss it in the introductory lecture.
- **Update attendance** on CMS regularly (**at least once every two weeks**) and ask students to approach you or TA early on if they see any discrepancy.
    - Important: **in case of any technical issue with CMS**, please adopt one of the following approaches:
        - Send attendance sheet by email.
        - Upload attendance record in the course repository.
- Conduct OBE-based assessment (quizzes, assignments, projects etc.) on reasonably regular intervals (**avoid leaving all/most assessments for the final weeks**)
    - Important aspects:
        - **Familiarize yourself well with various levels of Bloom's Taxonomy** and make sure your assessments match the claimed levels.
        - Make special effort to encourage holistic learning by introducing **diverse set of assessments** including projects, presentations, and use of modern tools.
        - In particular, **avoid/minimize assessments that may encourage rote memorization**.
- Provide **assessment results** and solutions to the students regularly (at most within two weeks of the assessment). Encourage students to discuss their performance with you and their advisor.
- In the case you have been assigned a **TA**, the following practices may be employed:
    - Provide detailed assessment solution and marking scheme to the TA
    - Ask your TA to announce assessment discussion time to the students
    - Ask your TA to email you all course relevant data and file samples after every activity/assessment (to avoid loss of data).
- **Build course file gradually** throughout the semester.
- Provide timely feedback regarding any **equipment/facilities issues** to the Dean

## Things to Do After Course Completion…

- Carefully **complete the course file** and submit for review.
- Assess and **analyse shortcomings** in the course and suggest changes (via the course review form), if needed.
- Carefully **go through student evaluation** of the course (once available) to see areas of improvement for next iteration of the course.

## In Case You Have More Questions…

Faculty OBE Coordinator, Dean, or members of the ES Pedagogy & Trainings Unit may be approached for further queries.

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# ES Pedagogy – Lab Instructors' Handbook

## What is this Handbook About?

Laboratory classes provide students with first-hand experience with course concepts and with the opportunity to explore methods used by scientists in their discipline. Leading a laboratory session has particular challenges and opportunities that differ from those in a standard classroom environment.

At GIKI-FES laboratory classes are typically led by graduate student TAs. The TA needs to know and review the experiment, plan clear explanations, and create questions to stimulate student thinking. In addition, it is the responsibility of the TA to ensure that safety standards are followed. This handbook contains a variety of resources to help TAs insure that they, and the undergraduate students they teach, get the most out of the laboratory class.

## What are the Typical Goals of a Laboratory Class?

Potential **goals** of laboratory classes include:

- 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).
- Practice collaborative problem solving.
- Exercise curiosity and creativity by designing a procedure to test a hypothesis.
- Better appreciate the role of experimentation in science.
- Test important laws and rules.

- Develop an appreciation for research in the field.

## What Should I Consider When Preparing to Conduct a Lab?

As you **prepare** to conduct a lab, consider the following questions:

- Will I be able to do the lab myself before class?
- Am I familiar with the materials and equipment?
- What are the safety considerations?
- Would it help if I gave my students a handout highlighting key theoretical, procedural, and safety points?
- How can I link this lab to the professor's lecture?
- How can I clearly communicate the criteria used in grading the lab reports?
- What kind of preparation should my students do before they come to lab?
- What tips can I give my students, so they can complete the lab successfully within the time allotted?
- Would it be helpful if I demonstrated new techniques to the students?
- How will I monitor student progress in the lab?
- Where might my students run into difficulty completing the experiment?
- What kinds of questions should I ask my students to stimulate their thinking and to encourage deeper understanding of the experiment?
- How can I help the lab pairs/groups to work together well?

## What are Some of the Best Practices to Follow During the Lab?

- Establish the specific goals of the lab (write them on the board)
- Prepare an outline (on the board) of the lab activities
- Do not hesitate to explain things more than once or answer questions that you may consider simple (this will likely save you from headaches later on)
- Demonstrate new techniques to the class or small groups
- Review safety issues for the lab
- Visit with each student individually during the lab
- Ask specific questions of the students in order to monitor their progress during the lab

- Provide ample feedback to students during the lab

## What are Some of the Best Practices to Follow When Grading Lab Reports?

Grading Lab Reports (suggestions for providing constructive, formative feedback)

- Ensure that your grading scheme is consistent with course policy.
- Determine whether students understood the lab.
    - Assess whether many students missed a critical concept.
    - Evaluate whether students drew reasonable conclusions from the data they collected.
    - Reward creative and rational but unconventional thought in application of principles.
- Read, evaluate and return lab reports in a timely manner with cogent feedback.
    - Help students improve by telling them how they could have done better.
    - Focus comments in specific areas rather than on the report as a whole.

## What Makes a Good Lab TA?

In their feedback to TAs, students indicate that they appreciate lab TAs who:

- Summarize the theory and procedure briefly before the students begin the lab.
- Demonstrate new techniques.
- Relate the lab to the lecture and to real world applications.
- Are willing to help and answer questions.
- Walk around and check with students to make sure that they are making progress.
- Ask questions that make students think more deeply about what they are doing and why.

## What Safety-Related Matters Should I Consider?

Safety is always an important concern in teaching laboratories. Consult the faculty lab coordinator with questions about departmental safety policies. In particular, make sure that a brief “Lab

Guidelines and Safety Instructions" page is added to the lab manual and also posted in the lab room for easy access. Such a page must include clear instructions/info on:

**Lab Environment and Conduct**

**Handling Equipment**

**Reporting and Returning Equipment**

**Preventing Electric Shock**

**Preventing Other Bodily Harm (e.g., Soldering Precautions)**

**Fire, First Aid, and Emergency Numbers**

Also make sure that emergency equipment (fire extinguishers, first-aid kits) are easily accessible and known to students.

## Are there any Training Courses I can Take for Lab Instruction?

Apart from FES organized trainings/meetings, it may be possible to find free online courses for improving lab instruction skills. One such course is offered free by Coursera (with a certificate).

Teaching in University Science Laboratories (Developing Best Practice)

## What is an Open-Ended Lab?

A lab experiment may have different levels of "openness" in that how much it leaves to the students (see Tables below). In planning a lab course, special attention should be given to the experiments - such that they gradually become more open-ended.

**Table-1.** Level of Openness according to Schwab-Herron

| Schwab/Herron Levels of Laboratory Openness | | | |
|---|---|---|---|
| **Level** | **Problem** | **Ways & Means** | **Answers** |
| 0 | Given | Given | Given |
| 1 | Given | Given | Open |
| 2 | Given | Open | Open |
| 3 | Open | Open | Open |

**Source:** McComas (1997)

**Table-2.** Scientific Enquiry Rubric

| Establishing the level of independence and autonomy expected of students to carry out an assessment task | |
|---|---|
| **Level of Enquiry** | **Description** |
| **0** | The problem, procedure and methods for achieving solutions are provided to the student. The student performs the experiment and verifies the results with the manual |
| **1** | The problem and procedure are provided to the student. The student interprets the data in order to propose viable solutions |
| **2** | The problem is provided to the student. The student develops a procedure for investigating the problem, decides what data to gather, and interprets the data in order to propose viable solutions |
| **3** | A "raw" phenomenon is provided to the student. The student chooses the problem to explore, develops a procedure for investigating the problem, decides what data to gather, and interprets the data in order to propose viable solutions |

**Source:** Fay *et al.* (2007)

## What if I Have More Questions?

Faculty Lab Coordinators and/or members of the ES Trainings Unit can be approached for further queries.

Sources:


- Science Teaching Reconsidered, National Academy Press, 1997
- Center for Instructional Development and Research, University of Washington
- Teaching Resource Center, University of Virginia
- Center for Teaching, Vanderbilt University