

Engineering Laboratory Demonstrator Handbook



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Introduction

“Demonstrators are the most significant resource applied to the laboratory experience”

Rice, Thomas, O’Toole, 2009 p.71

Research has shown that how students experience interacting with their Laboratory Demonstrator consistently ranks highly as a contributing factor toward students’ interest in and attitudes to their courses (Osborne, Simon, and Collins 2003). As a demonstrator, you can play a vital role in students’ learning and you are a very important and valued member of staff.

This Laboratory Guide has been designed for you as a new demonstrator and aims to provide practical ideas and teaching strategies to help you confidently engage and communicate with your students and facilitate effective learning outcomes. The Laboratory Guide is designed as a general reference. Discipline-specific information and support for each timetabled laboratory activity will be given to you by other academic staff who are teaching the students in lectures and tutorials. They are referred to in this guide as the Module Leader. The Guide should be used with the online support and resources that are provided.

TOP TIPS

Communicate regularly with academic staff.

Have a copy of the Module Descriptor that you are teaching.

Conduct an engaging demonstration by being prepared.

Be knowledgeable about all emergency, health and safety procedures.

Be familiar with all equipment, materials and procedures for experiments.

Enjoy your teaching and remember you play a vital role in the students’ learning.



1. Role of a laboratory demonstrator

What do you think makes a good laboratory demonstrator? Below are some of the characteristics that have been identified as making an effective demonstrator in laboratory classes:

- Be approachable to students.
- Provide clear explanations to student questions.
- Give clear explanations of what is expected of students.
- Set a good example for students in their preparation and behaviour in the laboratory.
- Show good knowledge of the theory as well as demonstration techniques and skills.
- Be able to link the material presented in the laboratory with theory presented in lectures and tutorials.
- Provide prompt feedback and suggestions to students as they work in the laboratory.

2. The aims of laboratory work

In order to teach and assess a laboratory class successfully, it is important to understand the aims and anticipated learning outcomes of each topic. In the short term the typical aim of a session spent in the laboratory is to provide a context to explore concepts from lecture material as well as allowing the students to complete any associated assessments. The long-term goals of laboratory classes include:

- Fostering an ongoing interest in the laboratory topics and the programme.
- Providing students with specialised technical skills.
- Encouraging student interaction, exchange of views and open communication.
- Reinforcing the lecture theory by providing students hands-on practical experiences.
- Improving students' understanding of the methods of enquiry through experiments.
- Developing general skills such as measurement, observation, recording, reasoning, problem-solving, note-taking, team work, and written and oral presentation skills.



3. Preparation before a laboratory class

It is important to make time to consider what you are trying to achieve and how you will approach this. Your approach will be partly shaped by the topic being taught. Speaking with the module leader and laboratory technicians about each of the topics will help you to prepare and align your approach. Two helpful questions to ask are:

- Am I teaching concepts, facts, skills or a mix of these?
- How can I enable the students to have an active role in their learning?

Many module leaders will hold regular planning meetings with demonstrators. Preparing for and attending the planning meetings will help you identify potential problems or difficult questions you may encounter before the session starts. Before you attend these meetings, ensure that you have read all the relevant material in the module descriptor and that you understand the aims of the next laboratory demonstration. Arrive at the meeting with any specific questions you have about the concepts, methodology or equipment that will be used. Make sure you know how to use any pieces of equipment and identify the person to contact if there are problems or if equipment malfunctions. It is very important to find out from the Module Leaders where the students are in their learning and what material is currently being presented in the lectures. This will help you link the material presented in the practical class with the theory being taught. Make the most of these meetings - the better prepared you are the more you will get out of your students.

It is equally important that you give some consideration to the motivation of the students you are going to be teaching. For many new students university is an intimidating experience. Try to remember your first few weeks at university and how you may have felt when you were new and less familiar and experienced with university life. Think about these questions:

- Why are the students studying this topic?
- What can I do to help facilitate their learning?
- What do the students expect of themselves?
- What do the students actually want to learn?
- What do they expect of me to help them be successful?
- How might I encourage students to be active, self-motivated and independent learners?



4. Preparation for teaching your laboratory class

For each lab demonstration session you need to develop an outline of how you will conduct the class with time-lines for each activity. You may be given a laboratory guide by the Module Leader in which case you need to go through each step, or you may need to prepare your own lesson plan.

The key point for you to consider is how you can give clear explanations and demonstrations to students so they can successfully complete each particular laboratory task. How can the allotted time best be used to achieve the final learning outcomes? Remember you are familiar with the material but it is all *new* for the students. So to help you give clear explanations to the students remember your:

(a) Communication Skills

Speak clearly, precisely and confidently, at a steady pace, not too fast or too slow and at a good volume, not too loud or too soft.

(b) Written Instructions

If your topic already has a set of written instructions for a task before your first practical class or laboratory demonstration it is best to work through them. Do they work? If not, why not? Where do changes need to be made? If you find the instructions need amendment or are not operational, first tactfully bring this to the attention of the Module Leader before making any changes. Together you can revise the parts which are unclear and go through them again or ask another demonstrator to go through the re-written format.

(c) Presentation Plan

Organize your information in a logical manner, tell the students *how* you have organized the laboratory class and describe the purpose for each activity. Where possible make references to the theory and material covered in the lecture.

(d) Conveying Ideas

You need to alert students to the purpose of the laboratory session and the ideas to be introduced and learned. Also, you need to connect ideas throughout the laboratory demonstration class and use multiple sources of input. The best way to indicate and connect ideas is by using certain phrases such as:



'Next I will review ...'

'Now I'd like to move on to ...'

'What I'd like to do next is focus on...'

'Now that we have explained the first part of the process, let's focus on the second part...'

'Let's go back and look at...'

Another helpful strategy is to use *multiple approaches* when teaching new ideas. Students tend to remember images longer than they remember words. Vivid images or appropriate examples can assist students understanding and comprehension for example:

- Charts and graphs can easily depict differences, comparisons and contrasts.
- In describing velocity in a physics laboratory, use the example of a speeding bullet.
- Showing a photograph or a video rather than just describing a process can be clearer.

(e) Rehearsal

Once you have completed these steps it is always helpful to rehearse your class in your head or out loud. This will not only help confirm you are prepared but also build your confidence and reduce any nervousness. Make sure you give yourself enough time in case you need to go back and clarify or review a few aspects of the class. At this point it is also a good idea to try and pre-empt possible questions students may ask. It is helpful before each class to go through this set of questions and write notes for yourself.

Summary Checklist - Teaching Preparation

Questions to Consider	✓
Are you clear what the tasks of the lesson are?	
What concepts do the students need to have mastered before starting the class and what actions will you take if some students have not mastered these concepts?	
Do the students need any particular skills to be able to complete the task?	
Is there a written set of instructions with examples available for the students?	
Have you got all the necessary equipment available and set-up for the laboratory demonstration?	
Is the task to be completed and assessed during class time?	
Do you have a class list with the names of the students?	
Are there any accommodations that need to be made for a student with a disability?	
Are you familiar with all necessary H & S procedures for this class?	



5. Health and safety

As a laboratory demonstrator you are responsible for supervising your students at all times and for ensuring that the students are aware of the Health and Safety policy of the School. At all times you need to talk to students about general health and safety issues, as well as those specific to each laboratory session. If you are in **any doubt** about any health and safety issues within the laboratory, you should approach the laboratory technician or your Module Leader for advice.

6. Teaching strategies for laboratory classes

It is absolutely natural to feel nervous before any class and even very experienced teachers can still feel a little anxious before teaching. The following section aims to help you not remove but reduce some of your anxiety and manage any nervousness.

(a) Beginning the Laboratory Class

Always arrive early and if there is no class in the lab before you enter, set-up as much of the equipment and teaching resources as possible. Welcome students as they arrive, this is a good way to get to know students names and establish a friendly classroom atmosphere. Also ask students about the previous lecture, often a laboratory class is timetabled straight after a lecture and this will assist you to be in-sync with the students.

(b) Introductory Talk

In some demonstrations the lecturer will introduce the class, however, if this is your responsibility then you need to start the laboratory class with a pre-lab talk or introduction where you include:

- A demonstration of how the equipment works.
- A rough timetable of how the session will progress.
- An outline of all Health and Safety guidelines.
- Definitions of terms and jargon that may be unfamiliar to students.
- Details of any assessment tasks during the class and what is expected.
- Explanation of concepts fundamental to successfully completing the session.
- The aims of the session and how these relate to the lecture and course materials.

At the end of this section and *before* the laboratory commences provide the opportunity for students to ask questions and clarify the purpose and direction of the tasks of the laboratory demonstration.



(c) Main Practical Session

Now it is time to start the session and this will depend a lot on the type of ideas, demonstrations or experiments that are being conducted. Guide the students through each process, allowing and encouraging them to ask questions throughout the class. It is very important that students are given the opportunity to make their own discoveries and learn to reason and problem-solve. Use your own knowledge of the topic in the laboratory to facilitate them to find their own answers rather than *'just giving them a solution'*. This may mean explaining a concept or theory in a number of different ways, helping them to get started, moving them forward when they get stuck, providing anecdotal evidence or practical experience scenarios or re-directing them back to the lecture notes or text book to clarify and better understand the concepts.

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7. Student support

Providing assistance to *all* students means:

- Making sure you get around to all students and not missing anybody.
- Ensuring no one student or group of students takes up all of your time.
- Being sensitive to students who are struggling – offer guidance and encouragement.
- Remembering to be inclusive of all students, acknowledging each student will be coming from their own particular level of understanding and particular learning style.

Here are some ideas to help you manage the class while students are working on their task:

- Walk around the class rather than only standing at the front.
- Create a checklist-system to make sure you get to see each student or group.
- Always be visible so you can observe all students and they can get your attention.

(a) Managing time

Managing time when teaching can be challenging, particularly when you have a diverse group of students. Sometimes you may feel you have too much time or too little time. Being prepared will help minimise this feeling as well as help you find the balance between teaching students who understand new ideas quickly and those who need more practice. If for example you feel you don't have enough time for lots of question during the lab, you could offer to answer questions via email or answer questions on the course forum/blog. If you feel you have too much time, always have extra questions prepared or start to introduce next week's topic.



(b) Questions and learning

Reward questions as much or more than answers, and remind students there are no silly questions. Encourage students to question and reflect on their own thoughts, processes and conclusions, other student's findings, as well as the steps outlined in any given text. You can share one student's questions with the class and discuss them as a group, as they may be questions of common interest to the entire class.

In addition, consider the following techniques:

- *Pausing* - allows students time to think about a question before responding.
- *Re-phrasing* - students genuinely may not understand the original question.
- *Probing* - helps stimulate thinking skills. You can probe for clarification or examples.
- *Reacting* - always react positively to student contributions. If an answer is clearly wrong or inadequate, try re-phrasing and clarifying the question.

(c) Summarising the Laboratory Lesson

When planning your laboratory demonstration it is important to always leave enough time for *summarising* the day's lesson and *cleaning-up* the laboratory. First gather *all* the students as one group and when you have their attention briefly summarise/review the key concepts covered in the lesson. When summing-up you need to:

- Remind students of any assessments, due dates and submission format.
- Summarise the key concepts of a task or experiment and suggest further readings.
- Emphasise the links between the lectures, course materials and laboratory exercises.

8. Guide to student assessment

The assessment of laboratory tasks serves two important purposes:

- To assess students learning and grade students on set tasks.
- To provide immediate feedback to specific problems so students become aware of gaps in their understanding.

If you are unsure about any aspect of marking, always check with your Module Leader, your fellow laboratory demonstrators and ask yourself the following questions:



Questions to Consider about Assessment	✓
Am I clear about what the students are being assessed on in each task?	
Do I have a copy of and understand the marking criteria and marking scale?	
Do I take marks-off for poor grammar, spelling and English and what do I do with poor referencing methods?	
What are the guidelines for granting students extensions? Are there penalties for late submissions?	
Do I know what to do if I suspect students have submitted work other than their own?	

9. Academic integrity

The University regards academic dishonesty as a very serious matter. Plagiarism and Cheating are both forms of academic dishonesty. Remind students where they can find information about how to avoid plagiarism and the institutional assessment regulations. If you suspect students of plagiarism or cheating then you need to contact your Module Leader immediately.

You may also need to be aware of students inappropriately 'sharing' experiment results. If you notice what you think may be plagiarised work you need to consult and be guided by your Module Leader in how to respond and manage this. Some tips that may help you notice plagiarism include:

- Generally poor referencing techniques.
- Lack of quotation marks or correct referencing.
- Noticeable repetition from one student paper to another.
- Language that seems inconsistent with the student's other work.
- Inconsistencies in writing style or fonts within a piece of written work.

10. Providing student feedback

In order for students to learn and to make the most of the assessment process it is essential to provide students with feedback. Often students are unsure of what constitutes feedback and only see marks and written feedback on individual reports as feedback. It is helpful to explain that in addition to comments on individual assignments, answering questions in class, on email or in forums/blogs is also feedback. Effective feedback:



- Is timely and given as close to task completion as possible.
- Allows students to adapt and adjust their learning strategies.
- Leads students to being capable of assessing their own work.
- Gives students a clear indication of how work can be improved.
- Focus students on fulfilling the task rather than effort or time spent.
- Addresses students' misconceptions and gaps in their understanding.

If students are to learn from written comments on individual/group assignments they must read, understand and act upon what you have written and respond accordingly in their next piece of work. All students need to receive feedback, not only those who did not do so well. Students who do well need to know why they achieved a high mark and what else is needed to progress further.

Remember to:

- Try to sign off on a positive and encouraging note.
- Make *constructive* criticisms on potential improvements.
- Clearly explain why you have awarded a particular mark.
- Where applicable, encourage students to come and discuss the report with you.
- Use positive reinforcement and congratulate students on what they have done well.

As well as individual written feedback, it is also useful to provide some general feedback to the whole class. This can be done either during a class or at the start of the next week's class by drawing attention to common problems and questions asked during the week or from assignments that have been recently assessed.

11. Evaluating your laboratory class

As a laboratory demonstrator you are not formally evaluated on your teaching. However, your teaching contributes to the overall student experience in any programme and each programme is formally evaluated at the end of the semester. During the laboratory demonstration or towards the end, you may wish to get some immediate feedback on how the laboratory was perceived by the students. You could ask for a show of hands or request that students complete anonymously a simple 5 scale-checklist, which you can prepare before class and students drop into a box on their way out.

Feedback on your teaching will guide you to improve your planning and delivery and therefore gradually build your confidence. You can work on improving your teaching by yourself, with peers, as well as with more experienced staff.



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