

# Chapter Summaries from Learning Engineering Through Projects

This FDTL project, based at Nottingham University, produced a Guide to Learning Engineering through Projects.

See... <http://www.pble.ac.uk>

## ***Project Design***

Project based learning takes many forms and offers many potential benefits to students on engineering programmes. The potential advantages of project work can best be realised by careful matching of project type to topic and intended learning outcomes.

The different types of projects that can be made available to engineering students include:

- individual/group projects
- open/closed projects
- incremental/innovative projects
- multi-disciplinary projects
- industry-based projects

Each project type holds particular advantages, as well as presenting some potential pitfalls. Each demands that the tutor pays attention to a range of practical and technical issues at the planning stage to ensure successful implementation.

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## ***Learning Outcomes***

Learning outcomes describe the essential learning that students must acquire. Programme learning outcomes reflect the learning achievements that students must evidence in order to successfully complete the programme. Module learning outcomes reflect the learning required to pass the module.

Learning outcomes will usually involve a combination of:

- Knowledge and understanding
- Intellectual abilities
- Practical, subject-specific skills
- Generic or transferable skills

Learning outcomes should always inform:

- The way the curriculum is designed
- The learning and teaching methods employed
- The types of assessment used

Project based learning is well suited to developing a wide range of learning outcomes. In the engineering context, it is particularly suitable for developing many of the specific skills and more generic attributes required of the graduate engineer. These skills and attributes reflect the standards described variously by SARTOR 3, the EPC and QAA.

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## **Learners**

The characteristics of learners will impact on the learning process. Lecturers need to take account of student characteristics in planning and implementing learning through projects.

Characteristics that students bring to the learning situation will include:

- Differing expectations
- Varying levels of motivation
- A range of abilities
- A variety of preferred learning styles

An important feature of the HE learning process is the need to respond to an increasingly diverse set of learners. As a lecturer it is worth spending time finding out what learners bring with them, both in terms of the four key aspects noted above and a range of personal and social variables including educational experiences, socio-economic background, ethnicity, gender, age and disability. This will enhance your understanding of the student group and strengthen your ability to respond to their particular needs and qualities.

In planning to use project based learning, an appreciation of learner characteristics can help inform your approach to:

- Setting appropriate learning outcomes
  - Choosing learning materials
  - Timetabling
  - Designing the learning environment
  - Learning, teaching and assessment methods
  - Determining the type and extent of tutorial support
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## **Knowledge Based Skills**

To elicit theory-based learning appropriate assessment methods and assessment outputs must be structured in to project work.

Within a well-structured project, information, concepts, principles and numerical skills are learnt and integrated with one another due to the context.

The resulting benefits of learning knowledge based skills through a project are :

- improved comprehension / understanding
- improved context and student motivation
- theory is learnt and applied in a situation resembling a work based scenario
- improved communication skills for theory based content

- ability to apply theory to a real application
  - improved retention
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## ***Process Skills***

The term process skills is used to describe the range of generic, transferable skills that all students need to acquire. In engineering, project based learning is a particularly effective means of developing some of the more complex, demanding process skills needed by the graduate engineer. Three key sets of skills relevant to engineering students are:

- Planning and organisation
- Working in teams
- Formal communication skills (eg reports, presentations and demonstrations)

There are a number of different ways you as a lecturer can promote the development of these skills using projects. What matters is that you include the development and assessment of generic process skills alongside more discipline/subject specific skills when planning to use learning through projects.

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## ***Assessment***

The key principles of assessment are:

- assessment and learning are integrated
- assessment methods must be aligned to the learning outcomes
- appropriate criteria must be matched to the methods
- frequent appropriate feedback is required
- marking must be reliable and valid

The following steps are a guide to production of effective assessment:

- Review the learning outcomes
- Identify performance criteria for each outcome
- Look at alternative assessment methods
- Decide which methods will best test the essential intended learning outcomes
- Determine what tasks the students will undertake
- Determine what outputs will be produced
- Develop a method of grading the outputs
- Develop an assessment schedule
- Produce an assignment brief

## ***Supporting Individuals and Groups***

- learning through projects requires support both for the theory and content and for the process skills that are developed through a project.
- a variety of skills are often developed within a project that may be supported through a diverse range of mechanisms
- support within projects is available from peers, project tutor(s) and from the

student

- the appropriate selection and structuring of groups is essential
  - health and safety must be embedded and supported within the project
  - it is important to identify failing projects early, and to put mechanisms in place to rescue and support them
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## **Resources**

A wide range of resources are utilised by students during project work. Careful consideration needs to go into planning and budgeting of these resources, which include:

- consumables
- equipment
- library resources
- information and communication technology resources
- work rooms
- staff time

Additional issues have also been identified for:

- large groups
- off-campus learners
- multidisciplinary projects

It is important that project staff liaise with their colleagues in the use of resources, particularly in terms of planning and time commitment.

The production of good documentation, such as a staff project plan, which includes the set-up time, student spreadsheets for budgetary control and learner logs to track progress will help with the management of resources.