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## Functional skills in Diplomas

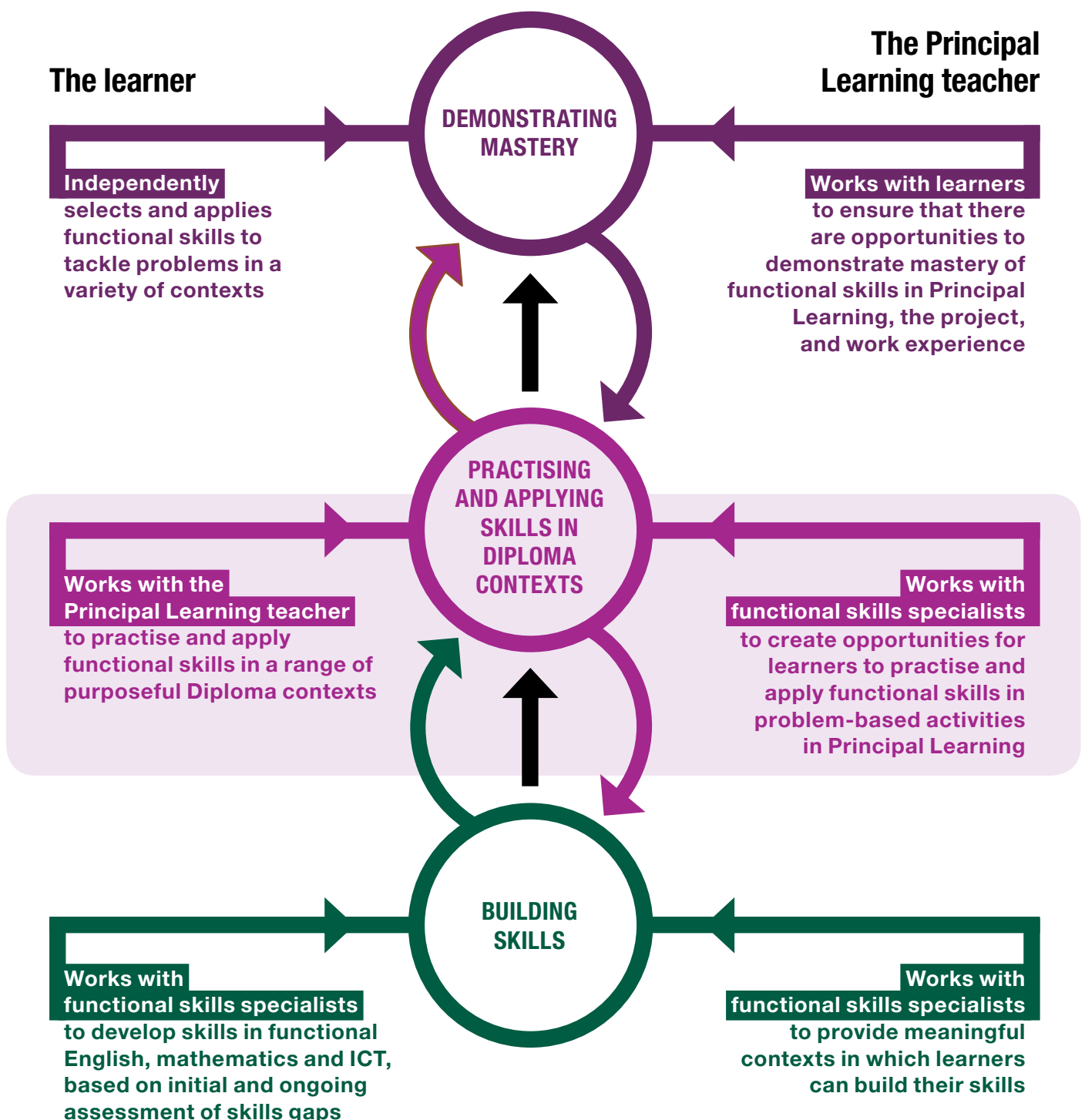
## Engineering

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This booklet has been produced for teachers of Principal Learning in the Diploma in Engineering, at any level. It assumes that, while you are not a functional skills specialist, you have a basic knowledge and understanding of functional skills and their central role in the Diploma.

# The role of the Principal Learning teacher: developing learners' functional skills in the Diploma in Engineering

The diagram below aims to show how the learner, the Principal Learning teacher, and the functional skills specialists should work as a team to enable the learner to achieve mastery in functional skills. The diagram is of course a model rather than a description of what happens in the real world of learning. In practice, each learner will start from a different level of competence in each functional skill or sub-skill and will develop and master the skills in different ways and at different speeds, often returning to an earlier stage to reinforce learning. Similarly, learners will continue to build their skills as they practise and apply them. When they have achieved mastery, learners will continue to develop and transfer their skills in other contexts.



# Approaches to the delivery of functional skills

“The Engineering Diploma is a fantastic new way of blending academic and applied learning with the functional English, mathematics and ICT skills that engineers need. It will open up the world of engineering, and the exciting development opportunities there are in the industry, to many more young people.”

Director of Engineering, integrated energy company

Research and experience have shown that the most effective approaches to teaching and learning these skills involve some degree of embedding or integration into wider programmes of learning. Learners are motivated when they find that improving their functional skills helps them to do better in the rest of their programme. They learn that these skills are transferable and relevant in many situations.

When considering the delivery of functional skills in the Diploma in Engineering, it is helpful to think in terms of four possible approaches:\*

\*To find out more about these approaches and how they might work in your context, look at *Managing delivery of functional skills* (LSIS, 2008).

## Discrete

Functional skills are taught by specialists separately from other areas of the Diploma.

## Partly embedded

Functional skills are taught by specialists and are flexibly applied in a range of Diploma contexts.

## Mostly embedded

Functional skills are taught by specialists, and are reinforced and applied in a range of purposeful contexts within and across the Diploma programme.

## Fully embedded

Functional skills are taught, developed and applied by all teachers across the Diploma programme. Learners use naturally occurring opportunities for functional skills development.

Discrete delivery of functional skills defeats the object of developing learners' ability to apply functional skills in purposeful contexts. It is therefore likely that, in the early stages of delivering the Diploma in Engineering, your approach will be in the range from 'Partly embedded' to 'Mostly embedded'. The aim is to move towards 'Fully embedded', while retaining the emphasis on learners being able to transfer their skills to a wide range of contexts in education, work, and life in general.

**Crucially, whatever approach is taken in your centre or consortium, you will need to plan how the functional skills will be integrated into Engineering Principal Learning. This will mean working in a team with other teachers, especially functional skills teachers, as shown in the diagram opposite, and will require the full support of your senior management or leadership team.**

The activities that follow demonstrate how you can provide opportunities for learners to practise and apply functional skills in the Diploma in Engineering and to help them reflect on how they can use the skills independently in other contexts. On page 10, there is a planning tool designed to help you plan your delivery of an activity that develops learners' functional skills in the context of the Diploma.

# Activity 1

## Measuring resistance

Suitable for:  
**Foundation  
Diploma;  
Unit 6.**

Level 1  
functional  
English,  
mathematics,  
ICT.

### Aims

This activity will familiarise learners with resistors, their values and colour coding. It will give them the opportunity to use electronic test equipment. As part of their work with standard electronic components, learners will measure the resistance of a number of resistors with a range of different values. The activity focuses on using functional ICT and functional mathematics and includes some functional English. You may find it helpful to work with a functional mathematics specialist.

### Learners will:

- carry out basic circuit testing and measurement
- practise and apply the use of numbers expressed in engineering and graphical formats.

The coloured text shows some of the opportunities to develop functional skills and PLTS, and draws attention to the teaching and learning approaches that are being used in this activity.

**FE**  
Functional English

**FM**  
Functional  
mathematics

**FICT**  
Functional ICT

**PLTS**  
Personal, learning  
and thinking skills

**FE L1** Take part in ...  
informal discussions

**PLTS** teamworkers

Experiential learning

**FM L1** Identify and obtain  
necessary information

**FM L1** Find mean  
and range

**FM L1** Collect and  
record discrete data

**FICT L1** Interact with  
and use ICT systems

**FICT L1** Enter, develop  
and format information

**FM L1** Use appropriate  
checking procedures

**FICT L1** Create and develop  
charts and graphs

**FE L1** Write document to  
communicate information

**FICT L1** Select and use  
ICT to communicate and  
exchange information

Using e-learning

**FE L1** Use language, format  
and structure suitable for  
purpose and audience

**PLTS** reflective learners

# 1

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- **Planning.** Discuss with learners the concept of resistance, using some everyday or familiar examples. Show them how to measure resistance using a multimeter. Introduce the concepts of colour coding and nominal value in resistors and give them opportunities to practise reading these.

If necessary, work with the functional mathematics specialist to ensure that learners understand powers and how to present numbers in engineering format (eg  $10 \times 10^3 = 10,000$ ). They should also know how to calculate mean values, and to draw graphs using standard conventions and correct labelling.

# 2

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- **Measuring.** Organise learners into teams of three. Give each team a set of colour-coded resistors with different values. Ask each learner to measure the resistance of each resistor (ie three measurements per resistor). They should then calculate the mean resistance values for each resistor and record the result alongside the colour codes.

# 3

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- **Analysing results.** Next, learners enter their results into a spreadsheet that you have provided (perhaps in consultation with your functional ICT specialist). You may wish to set up and show a completed example. Learners should enter both the nominal value of each resistor and its mean measured value. They must check that their calculations and entries are correct.

They should then use the spreadsheet file to create a graph that shows mean measured values against nominal values. They should use the spreadsheet's built-in graph drawing software to do this, but must fine-tune the graph to conform with the standard graphical conventions.

# 4

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- **Presenting findings.** Each learner writes a simple report (which could be word-processed) that incorporates the graph and a description of what it shows. The report should explain the terms 'nominal value' and 'preferred value' in resistors and comment on the relationship between mean measured values and nominal values.
- Learners should lay out the report in a way that is attractive and easy to follow, with appropriate use of headings and paragraphs.

# 5

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- Ask learners to reflect on what they have learned and how they learned it.

## Useful internet resource

**Excellence Gateway**  
<http://excellence.qia.org.uk/page.aspx?o=131338>

## Extension ideas

- Learners could check their calculations by creating a formula in the spreadsheet and entering the raw data.
- Learners could present their findings using PowerPoint.

## Activity 2

# 'Goods in' inspection

Suitable for:  
**Higher  
Diploma;  
Unit 6.**

Level 2  
functional  
English,  
mathematics,  
ICT.

### Aims

In this activity learners will act as 'goods in inspectors'; they will check delivered components against specification. The activity suggests using stepped shafts but you can adapt it to other components, depending on what you can obtain. The main emphasis of this activity is on functional mathematics in a realistic work-related engineering context, as well as some functional ICT and functional English.

### Learners will:

- use inspection techniques
- develop their measurement and recording skills
- apply mathematical skills to an engineering problem.

The coloured text shows some of the opportunities to develop functional skills and PLTS, and draws attention to the teaching and learning approaches that are being used in this activity.

**FE**  
Functional English

**FM**  
Functional  
mathematics

**FICT**  
Functional ICT

**PLTS**  
Personal, learning  
and thinking skills

**PLTS** Teamworkers

Cooperative learning

**FE L2** Make a range of contributions to discussions

**FM L2** Identify the problem and the mathematical methods needed to tackle it

**FM L2** Understand routine and non-routine problems

Experiential learning

**FM L2** Select and apply a range of mathematics to find solutions

**FICT L2** Select and use software applications to meet needs

Using e-learning

**FM L2** Use appropriate checking procedures and evaluate their effectiveness

**FE L2** Write documents

**FM L2** Draw conclusions and provide mathematical justifications

**PLTS** reflective learners

**FICT L2** Select and use software applications to meet needs

# 1

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- **Introduction.** Ask learners to work in teams of three. Give each team an engineering drawing that specifies the dimensions and tolerances of a stepped shaft (or other engineered component that you have chosen to use). Explain that their task will be to inspect three stepped shafts to determine if they meet the specification. Encourage teams to discuss how they might read, interpret and use the technical data from the drawing. Ask for comments from each team to check that they have clearly understood what is involved in the task.

— Explain that they will need to calculate the tolerances/limits specified in the drawing (eg  $55\text{mm} + 0.005 - 0.000$ ), and to create a document (on paper or using a computer) in which they can enter the values that have to be measured, the maximum and minimum sizes permitted, and spaces to insert the measurements they make.

# 2

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- **Inspection.** Give each team three stepped shafts; explain that these might have been taken from the quarantined supply received from a subcontractor. Ask them to use inspection techniques to measure the specified dimensions of the shafts, using tools such as micrometers or digital callipers. They should record their measurements appropriately.

— Each member of a team should make and record their own measurements. This will help them to check, in the next step, whether the readings are accurate.

# 3

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- **Pass or fail?** Learners then tabulate their data, either on paper or in a spreadsheet, and compare their measurements with the limits specified in the drawing. They should decide if each component 'passes inspection' or 'fails inspection'.

— They should also compare the measurements that they have each made separately, to look out for 'false' readings. They need to discuss and resolve any discrepancies in order to ensure that their conclusions are based on accurate and reliable measurements.

# 4

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- **Report to QA manager.** Learners then prepare a report for the QA manager on whether the batch of shafts can be 'released for use in production'. The report should include the table from the spreadsheet (if used).

— Ensure that all members of each group are involved in preparing the report and that the workload has been shared.

# 5

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- You could ask each group member to develop a reflective log on their individual input to the activity. This could be developed through a VLE such as Moodle.

## Extension ideas

- Learners could decide on tolerances and determine their own values for acceptance.
- If the drawing and components could be supplied by a local company, this would be real evidence of engagement with local industry/employers as well as contributing to the work-related learning aspect of the Diploma.

## Activity 3

# Engineering and climate change

Suitable for:  
**Advanced Diploma;  
Unit 1.**

Level 2  
functional  
English,  
mathematics,  
ICT.

### Aims

In this activity, learners research the ways in which engineering can contribute to controlling carbon emissions and climate change. Functional English – discussion, research, report, and presentation – forms the basis of this activity. You may wish to involve the functional English specialist.

### Learners will:

- investigate the environmental and social impact of engineering activities
- give a talk to a group of teachers and the head of Engineering at the school or college.

The coloured text shows some of the opportunities to develop functional skills and PLTS, and draws attention to the teaching and learning approaches that are being used in this activity.

**FE**  
Functional English

**FM**  
Functional mathematics

**FICT**  
Functional ICT

**PLTS**  
Personal, learning and thinking skills

**FE L2** Make a range of contributions to discussions

**PLTS** Self-managers

**PLTS** Independent enquirers

Using e-learning

**FICT L2** Access, search for, select and use ICT-based information and evaluate its fitness for purpose

**FE L2** Compare, select, read and understand texts

Cooperative learning

**PLTS** Teamworkers

**FM L2** Understand and use positive and negative numbers of any size in practical contexts

**FE L2** Write documents

**FE L2** Read and summarise succinctly information/ideas from different sources

**FICT L2** Present information in ways that are fit for purpose and audience

**FE L2** Make effective presentations in a wide range of contexts

**PLTS** Reflective learners

# 1

**Planning.** Explain the activity to learners. Discuss some examples of the kinds of engineering activities they might investigate, eg:

- alternative propulsion systems for cars (electric, hybrid, hydrogen etc)
- air travel
- carbon capture
- renewable energy generation
- nuclear energy generation.

Explain the importance of action planning and the techniques and styles for effective report writing (you may wish to involve the functional English specialist). Learners should then develop individual action plans with identified targets and discuss these with you.

# 2

**Research.** Each learner should use the internet and other sources to research the ways in which engineering can contribute to controlling carbon emissions and climate change, and the complex issues that this raises. Small groups should then try to organise a visit to at least two engineering companies to investigate at first hand how the engineering sector is tackling these issues. They will need to investigate the scientific aspects and evaluate the quantitative impact of the topics they investigate. They will need to plan very carefully the questions they would like answered as this is an opportunity to conduct some primary research interviews.

# 3

**Report.** Each learner should produce a draft structure for their report and presentation and discuss this with you and/or the functional English specialist. They should revise the structure if necessary, and write their report.

# 4

**Presentation.** Each learner prepares a five-minute talk for a panel of teachers and/or peers that summarises their findings on the impact of engineering on the environment, highlighting ways of minimising the carbon footprint of the engineering industry. Learners should be encouraged to be innovative (using video, graphs, animation etc) in their approach to the presentation, and not simply produce a set of bullet-pointed slides. As learners complete the activity and deliver their reports, coach them in the type of questions which may be asked by the panel, so they will be able to support their conclusions using reasoned evidence.

Learners deliver their talk to the panel and answer any questions.

# 5

Learners review what they have learned and how they might improve their learning and performance in the future.

## Useful internet resources

**Institution of Engineering and Technology**  
[www.theiet.org](http://www.theiet.org)

**Intute – Environment**  
[www.intute.ac.uk/sciences/environment](http://www.intute.ac.uk/sciences/environment)

**Newspaper article**  
[www.independent.co.uk/environment/up-and-running-innovative-mechanical-engineering-839838.html](http://www.independent.co.uk/environment/up-and-running-innovative-mechanical-engineering-839838.html)

**Institution of Mechanical Engineers**  
[www.imeche.org](http://www.imeche.org)

**Centre for Alternative Technology**  
[www.cat.org.uk](http://www.cat.org.uk)

## Extension ideas

- You could extend the activity to develop ICT and mathematics further through individual research and the presentation of findings – for example, by presenting and comparing numerical and statistical data on a local, national and international basis.
- Learners might make a group presentation.
- Instead of writing a report, learners could use ICT to produce a promotional leaflet in which the company demonstrates its green credentials.

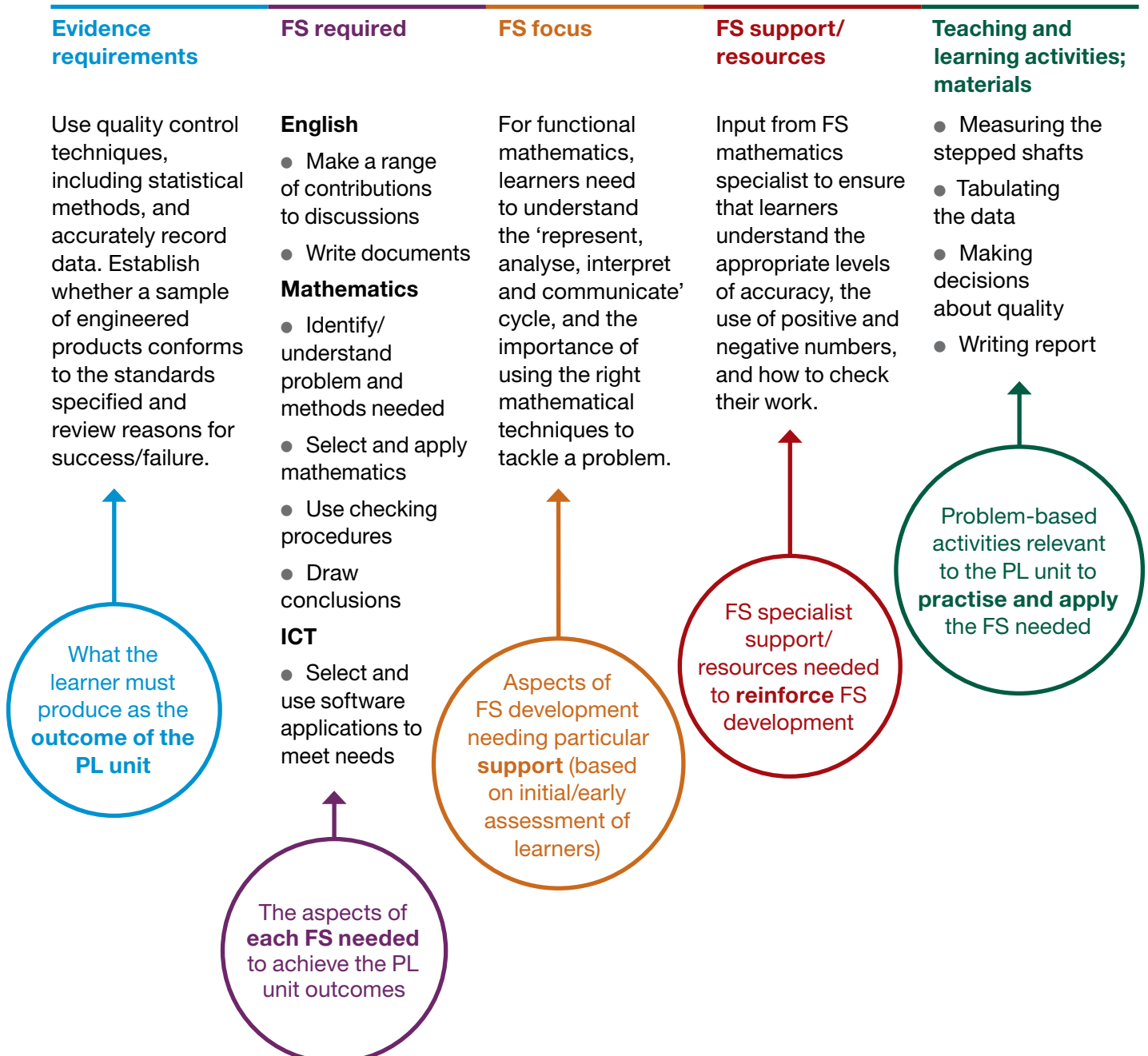
# Functional skills in the Diploma in Engineering sample planning tool

The planning tool below provides a structure for planning a Diploma activity that integrates functional skills (FS). Note that it starts from the Diploma activity and that the functional skills are naturally required to complete the activity. It is a mistake to distort a Diploma activity simply to ensure that it includes functional skills. As shown in the example completed below, the tool enables you to:

- specify the Diploma activity and evidence requirements
- identify the functional skills needed to carry out the activity
- decide which aspects of functional skills you will focus on
- identify the resources, including support from colleagues, that you will need
- identify the teaching and learning activities and any materials that you will need.

**Activity:**  
'Goods in' inspection

**Diploma:** Engineering  
**Level:** Higher **PL unit:** 6  
**Functional skill level:** 2



## Resources to support functional skills

**Managing delivery of functional skills** (LSIS, 2008)

<http://excellence.qia.org.uk/169938>

**Teaching and learning functional mathematics** (LSIS, 2008)

<http://excellence.qia.org.uk/169932>

**Teaching and learning functional English** (LSIS, 2008)

<http://excellence.qia.org.uk/169929>

**Teaching and learning functional ICT** (LSIS, 2008)

<http://excellence.qia.org.uk/169935>

**Good practice guide: Leading from the middle** (LSN, 2007)

[www.lseducation.org.uk/user/order.aspx?code=072785](http://www.lseducation.org.uk/user/order.aspx?code=072785)

## Resources to support the Diploma in Engineering

**Teaching and Learning Programme resources for Engineering**

<http://teachingandlearning.qia.org.uk/tlp/eng/index.html>

<http://teachingandlearning.qia.org.uk/tlp/cpd/cpdbuilder/engineering/index.html>

**Engineering Diploma Development Partnership**

This site has links to a wide variety of related sites, including for resources.

[www.engineeringdiploma.com](http://www.engineeringdiploma.com)

## Links

**Diploma Support Programme**

[www.diploma-support.org](http://www.diploma-support.org)

**Functional Skills Support Programme**

<http://excellence.qia.org.uk/159670>

Helpline: 0870 872 8081 or [helpline@lseducation.org.uk](mailto:helpline@lseducation.org.uk)

**QCA functional skills**

[www.qca.org.uk/qca\\_6062.aspx](http://www.qca.org.uk/qca_6062.aspx)

## FAQs

**Does every activity have to cover all three functional skills?**

No. Learners should be given as many opportunities to practise their functional skills as possible in realistic engineering contexts. These may include one, two or all three of the functional skills.

**Do learners have to produce a functional skills portfolio?**

Assessment of functional skills will be the responsibility of the awarding bodies, within parameters set by QCA. At Levels 1 and 2 assessment will usually be through timed tasks. There will be no portfolio. However, centres/consortia must contact their awarding bodies in all matters relating to assessment.

**How can employers support learners in functional skills?**

It is very helpful to obtain statements or quotes from local employers that confirm the importance of functional skills. Employers may be willing to supply data, or to take part in discussions.

**If Advanced Diploma learners have GCSE Grade C or above in English, mathematics and ICT, do they have to do functional skills?**

Until 2012, all learners on a Diploma programme will have to do functional skills, unless they have already achieved the functional skills qualifications. From 2012, learners with a GCSE grade C or above will have achieved the corresponding functional skill as part of their GCSE.

See also [www.qca.org.uk/qca\\_19077.aspx](http://www.qca.org.uk/qca_19077.aspx)



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The Learning and Skills Improvement  
Service (LSIS) and the National  
Strategies (Secondary) are jointly  
managing the Functional Skills Support  
Programme (FSSP), on behalf of the  
Department for Children, Schools and  
Families. The Programme provides  
materials, training and advice for staff  
in centres involved in the functional  
skills pilot. For further information,  
please contact the functional skills  
helpline on 0870 872 8081 or  
[helpline@lsneducation.org.uk](mailto:helpline@lsneducation.org.uk)