National Centre for Excellence in the Teaching of Mathematics

The Education & Training Foundation

Unlocking Maths

Teaching Maths in the Secure Estate

Resources created as part of the Maths Pipeline programme.

NIACE The National Voice for Lifelong Learning

www.et-foundation.co.uk

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External references
This guide offers links to external websites and resources. At the time of publication all urls provided were correct; however, website addresses may be updated and changed. For each reference, the full name of the publication / resource has been provided to help you deal with any broken links.

Unlocking Maths

Contents:

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About this guide

This guide is for you as a maths teacher working with learners, up to and including Level 2, within the Secure Estate in England.

The guide is not intended as a comprehensive handbook on teaching maths but aims to provide information and ideas to stimulate the approaches you use with your learners.

The first section looks at the context of teaching in the Secure Estate. The second section identifies key principles for the effective teaching of maths. The following sections look at practical teaching strategies. We include a range of examples to demonstrate how you can make learning more active.

Throughout the guide you will find sections encouraging you to 'Take a look at' other websites or educational research documents which provide further ideas, resources and evidence to help in your teaching and personal mathematical skills development. These sections are identified using icons as shown below.

Take a look at documents
e.g. research papers, publications and government documents.

Take a look at resources
e.g. provides ideas, activities and links to other maths resources.

Take a look at a film.

The guide is one of five in a series from the Education and Training Foundation (ETF) Maths Pipeline Programme, all aimed at supporting maths in post-16 provision. The other guides are aimed at vocational teachers who support the mathematical development of learners in the following sectors:

1. *Construction and the Built Environment*
2. *Hairdressing and Beauty Therapy*
3. *Health and Social Care*
4. *Hospitality and Catering*

With the emphasis on the development of vocational and employability skills within the Secure Estate, the development of maths skills to achieve vocational goals is a key factor. In this guide you will find a section on Embedding maths (p17). The four vocational guides provide many additional ideas which can assist you in contextualising maths activities within the classroom to specific vocational areas. These ideas and activities can epage 17asily be replicated and adapted to fit most contexts.

The guides are also supported by a collection of films; begin with the clip that introduces the series and then explore the library of films.

To keep up to date with news, resources and events, please sign up to the Foundation's free offender learning newsletter at http://offender-learning.excellencegateway.org.uk.

Working in the Secure Estate: rewards and challenges

Rewards

Working in a secure regime brings specific challenges. For some learners, attending a class can be the most positive element of their prison day. Teachers can find great satisfaction from supporting learners to build their skills and being part of the rehabilitation process. Helping learners achieve and progress can be particularly satisfying where learners have had poor experiences of initial education. Teachers can find that the way learning is structured in some prisons, with smaller classes and more regular sessions, means they can get to know the learners and so support them better. Some teachers assume that security will limit their approaches but have been pleasantly surprised when creative solutions are found.

What challenges do I face?

Of course there are challenges, working within a secure regime. The prison regime requirements, such as lockdown, roll-on roll-off courses and interruptions caused by population movements, can impact on learning. Other challenges occur because of the background, health and often poor initial learning experiences of many people in prison. The length of stay within prison inevitably has an effect on the learners' motivation and how they perceive the relevance of attending maths groups.

If learners have transferred from another prison or internally, communication of background information can be problematic. Initial assessment for maths and English are carried out at most prisons as part the induction programme, with outcomes assessments, aspirations and careers goals recorded on Individual Learning Plans (ILPs). All this information is important for teachers if they are going to meet learners' needs effectively. Formative assessment also helps teachers gain insights into learners' needs.

Take a look at: *Using individual learning plans are used to improve personal and vocational skills development* at HMP and YOI Low Newton and *It's not Personal*; these show ways in which Offender Learning Individual Learning Plans (ILPs) are recorded and shared within the Secure Estate. More generic information on ILPs *Individual Learning Plans: Planning and recording achievement* can be found on the Excellence Gateway.

HMP North Sea Camp undertook an action research project to look at how assessment for functional skills could be contextualised. This has included differentiating the assessment tasks. At Entry Level, maths and English assessment is combined. The prison canteen sheet is an example of the source material used for assessing functional maths and English abilities; it has the additional outcome of also supporting the learners in managing their life in prison. At Level 1 and 2, maths activities include problem solving tasks as well as maths skills tasks.

Take a look at: *Initial and diagnostic assessment for functional skills* at HMP North Sea Camp. This initiative was also highlighted in the *Offender Teaching and Learning Toolkit* film which provides useful information about assessment for learning. The document *Approaches to formative and summative assessment of functional skills* provides further useful information.

The main challenges identified by those who teach maths within the secure environment, along with links to teaching ideas and resources, have been outlined below.

Roll-on roll-off courses

Roll-on roll-off has been identified during the NCETM Maths Vitaliser Programme events as one of the principal challenges for teachers within the Secure Estate. When a new learner can join the course at any time, and have varying lengths of sentence, it can make planning difficult. It can also be more difficult to foster the supportive collaborative environment which is particularly important for learners who are less confident. Some solutions include using a variety of active learning and topic-based approaches, developing flexible schemes of work, splitting teaching sessions into small discrete activities and structuring courses into short units. Other solutions involve working with the prison to alter the structure of activities and the regime timetable; for example some prisons have moved to offer modular-based courses with fixed start dates. However, it is also important not to demotivate potential learners by delaying their course start date for too long.

There are plenty of ideas for collaborative group work in How do I make learning more active? (p6). See also the section on Using Topics (p13) and the activities in Using technology (p19).

Three-hour sessions

Regime timings mean that many prisons classes last three hours. Keeping learners motivated and engaged for this period of time can be a challenge for teachers. Practitioners have suggested a number of approaches to keep learners engaged, including splitting up the time into smaller chunks of learning and using active learning approaches. Active learning approaches can be used with the whole group, with small groups and with individuals.

Take a look at the practical activities in the section How do I make learning more active? (p6) and Using technology (p19). You will also get further ideas in the sections Using Topics (p13) and Mini whiteboards (p15).

Take a look at: The *Offender Teaching and Learning Toolkit* which highlights how HMP Onley used a diamond teaching model for running three-hour maths classes.

Using technology

There are restrictions on the type of technology that can be used within the Secure Estate and the proper permissions need to be undertaken before any are introduced.

Take a look at: The documents *Enabling Offender Learning and Skills: E Learning in the Secure Estate* and *E-Enabling Offender Learning and Skills: What a difference e makes*, both provide useful information on how technology has been used within the Secure Estate.

Some ideas about using technology - with links to case studies - have been provided in the Using technology section (p19). The examples and ideas for active learning given throughout this guide will enhance teaching and learning especially when access to technology is restricted.

Meeting the needs of learners with learning difficulties and/or disabilities

A high proportion of prisoners in the Secure Estate (approximately 30%) have mental health or learning disabilities. These issues are compounded by many prisoners having had a negative experience of school education.

Take a look at: The ETF online learning environment area for courses around *Equality and Diversity* and at the Excellence Gateway exhibition area on *Special Educational Needs and Disability - Meeting the needs of learners with learning difficulties and / or disabilities* which contains case studies, reports and examples of effective practice.

Take a look at: Access for All. It was written for teachers supporting learners with learning difficulties or disabilities in their classes, and provides background information and key principles. You may also find A Framework for Understanding Dyslexia by the Department for Education and Skills (DfES) and Developing Access to Skills for Life for Offender Learners with Learning Difficulties or Disabilities helpful.

You can use all the group activities suggested in this guide to support learners with learning difficulties and/or disabilities; but also take a look at the Maths mentors (p16) section as another way to support learners.

Mixed-level groups

Many of the classes within the Secure Estate include students with a wide range of needs. This can pose a planning and delivery challenge to teachers.

By using collaborative approaches and differentiation you can effectively teach across the ability range within a class. Mathematical topics such as Measurement, Money, Time and Number are areas that all learners can explore at their own level.

Topic based learning is another approach you can use to support mixed groups. By using a topic agreed by the group, such as 'Becoming Self Employed', you will be building connections across mathematical topics and making the subject real. You will also be providing valuable ideas for preparing learners for life outside the Secure Estate.

Mixed-group teaching also provides valuable opportunities for peer support within the group, resulting in an opportunity for 'high level' learners to reinforce and develop their own understanding.

Take a look at: The activities in the sections How do I make learning more active? (p6) and Using technology (p19) for ideas on mixed-level groups. You will find other ideas to support mixed level groups in the sections on Using topics (p13) Using mini whiteboards (p15), Maths mentors (p16) and Embedding maths (p17).

Developing teaching approaches and ideas

The Professional Standards for Teachers and Trainers in Education and Training (2014) define the professional requirements along with the skills, knowledge, values and attributes that you should have as a teacher of post-16 learners. When looking for ideas to use with your groups, there are many resources available online that can help you. Here are some good starting points.

Take a look at: The *Offender Exhibition* area which provides many resources, case studies and articles. The Resources (p25) section of this guide provides more links to online resources.

Take a look at: A film introducing the resources available as part of the Maths Pipeline to support maths provision.

Take a look at: *Thinking through Mathematics* by the National Centre for Excellence in the Teaching of Mathematics (NCETM). It was written for teachers working with learners at Entry 1 – Level 2. The resources emphasise active learning approaches and the interconnected nature of maths. (You will need to register free on the NCETM website to access the resources.)

Take a look at: Improving Learning in Mathematics produced by the DfES Standards Unit in 2005 and written for teachers working with learners at Level 1 – Level 3. It contains teaching strategies as well as many resources which encourage active learning approaches.

Malcolm Swan (Nottingham University) identified eight principles for effective teaching of maths and these underpin the approaches in *Improving Learning in Mathematics.* Teaching is more effective when it …

- builds on existing knowledge
- exposes and discusses misconceptions
- uses higher-order questions
- uses cooperative small group work
- encourages reasoning not 'answer getting'
- uses rich, collaborative tasks
- creates connections between topics
- uses technology in appropriate ways

A number of **types** of activities are suggested in *Improving Learning in Mathematics* that would encourage deep, connected mathematical thinking. These are:

- Classifying mathematical objects
- Interpreting multiple representations
- Evaluating mathematical statements
- Creating problems
- Analysing reasoning and solutions

Each type of activity is designed to challenge students to reason in a different way. They show how you can make learning active, thus giving learners the opportunity to explore, discuss and develop critical thinking skills and so become independent learners. Like most of the activities in this Guide, these resources also adopt formative assessment approaches to help learners and teachers become aware of and address the learners' needs.

> *"Active learning involves providing opportunities for students to meaningfully talk and listen, write, read, and reflect on the content, ideas, issues, and concerns of an academic subject."*
> Meyers & Jones, 1993

How do I make learning more active?

Active learning uses strategies such as group work, discussion and open questioning to encourage learners to become reflective, become aware of and address any misconceptions they may have, think mathematically and make links between topics instead of using memorised techniques or processes. You can use active learning approaches with your whole group, small groups and individuals.

Active learning can be in sharp contrast with many classes where learners have been relatively passive members. If you have not used active learning before, using short, active learning strategies at various points within the session is a low risk strategy, supporting you and your learners to explore the new approach.

Producing active learning materials can be time consuming (some activities need sets of cut-out cards for example). It can be made easier by maths teachers working together to produce and share resources. Some prisons have print rooms that could perhaps produce the materials, and prisoners on other courses may help prepare the materials which could replicate maths developed within vocational courses e.g. examples of different lengths of wood and shapes produced whilst learning carpentry skills.

Group dynamics are important and can affect learning in the Secure Estate; this is particularly important within the interplay of complex relationships. In particular, it is important that you leave space for communications and allow group support to develop. When using group work and collaborative activities, consider the make-up of your groups as initially collaborative activities may be difficult for learners who find communicating difficult for a range of reasons, such as a lack of literacy or language skills, or a hesitancy to communicate within the secure environment.

An explanation of the **ground rules** is important for all learners before starting group tasks. Start off with a small short activity, making sure that the group know exactly what you want them to do. The more often you use discussion based activities, the more familiar they will become with their own group and what they are expected to do.

Your role during the activities is not to immediately confirm or give answers but is to listen to discussions and ask questions, develop discussions, and identify and help resolve any misconceptions. You are using formative assessment approaches here to help you and your learner become aware of and address any difficulties they may have. You will need to be able to react to situations where discussions go 'off task' or where a group cannot agree.

Try using checking strategies where learners mark or compare their work with other groups. This is a powerful way of encouraging learners to think beyond their initial answer to a problem and to become reflective and self-critical. Make sure at the conclusion of the group activities you follow-up with a whole group session to discuss the activity, any issues and misconceptions.

Take a look at: These documents, *The Benefits of Active Learning* and *Active Learning* by Geoff Petty.

Take a look at: A film from ETF which explore active learning in the Secure Estate.

Activity example 1: Whole group work - target boards

Try this idea - target boards

This activity would make a good starter to engage learners at the beginning of the session, as a way of breaking up a three-hour lesson or as a means of assessing learning or prior learning formative assessment.

Target boards can be used with a number of different mathematical topic areas. They are most commonly used when looking at numbers and their connections. This is an area where many learners are weak.

50	27	13	15
39	44	2	83
7	5	18	9
63	21	74	43

Using the activity

Draw a grid containing numbers on a flip chart or whiteboard. The numbers should be chosen to help develop and practise a particular mathematical concept, or to help learners see the relationships between numbers. You can now ask a range of questions such as:

- How many multiples of 5 are there?
- How many factors of 30 are there? Which ones are missing?
- Which number is the lowest common multiple of 27?

Learners can write their responses on mini-whiteboards.

You can then follow-up with more probing questions, such as 'Which numbers have…?' and 'Why …….?'

Ask your learners to make up their own questions for the group. They can also create their own target boards.

You can adapt the activity for vocational areas e.g. use the measurements used within construction, catering, hair and beauty.

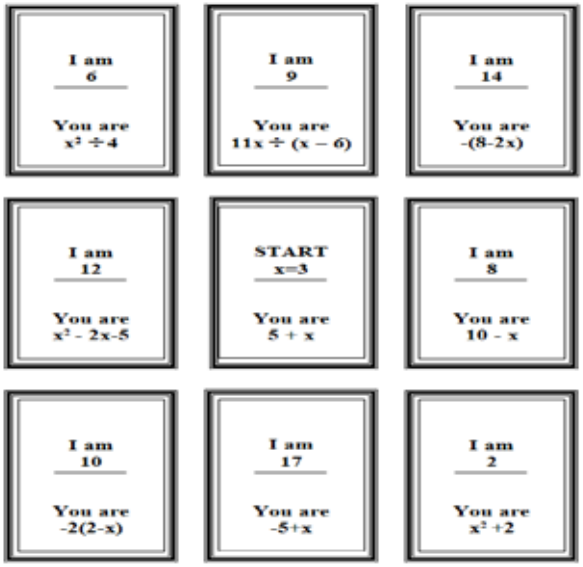
Take a look at: This resource on the Times Educational Supplement website which contains a range of different target boards. It is free but you will need to register.

Activity example 2: Whole group work - follow me cards

Try this idea – follow-me cards

The activity works well as a whole group activity as well as within small groups where it will provide opportunities for discussion, collaborative group work and peer support.

Follow-me cards (also known as loop cards) can be used at any level within maths as well as being used for a range of topics. The two examples below (not complete sets) illustrate two different topics. The activity can be contextualised to a vocational area, e.g. temperature and time within health care.



I have an area of $150cm^2$ You are a rectangle with length 12cm and width 10cm	I have an area of $520cm^2$ You are a triangle with base 30cm and perpendicular height 10cm	I have an area of $150cm^2$ You are a square with side length 10cm
I have a perimeter of 60cm You are a rectangle with width 12cm and length 20cm	I have a perimeter of 144cm You are a rectangle with width 12cm and length 5cm	I have a perimeter of 40cm You are an equilateral triangle with side length 15cm

In the first of the examples above, learners have to be able to verbalise the algebraic expression as well as carrying out a calculation. In the second, perimeters and areas are calculated for a range of different shapes, requiring learners to use a range of vocabulary and carry out the calculations.

In both instances the activity provides you and your learners with formative assessment opportunities; you can identify any misconceptions or weakness and decide how to address them.

How to use

Give each learner a card; the learner with the starting card reads out the number at the top of the card, along with the statement. The learner who holds the follow-me card then provides the answer along with their statement. This continues until the activity has completed a loop.

Encourage learners to use mini whiteboards to carry out their calculations.

The activity is easy to differentiate, by giving easy or difficult cards to specific learners.

Adapting the activity

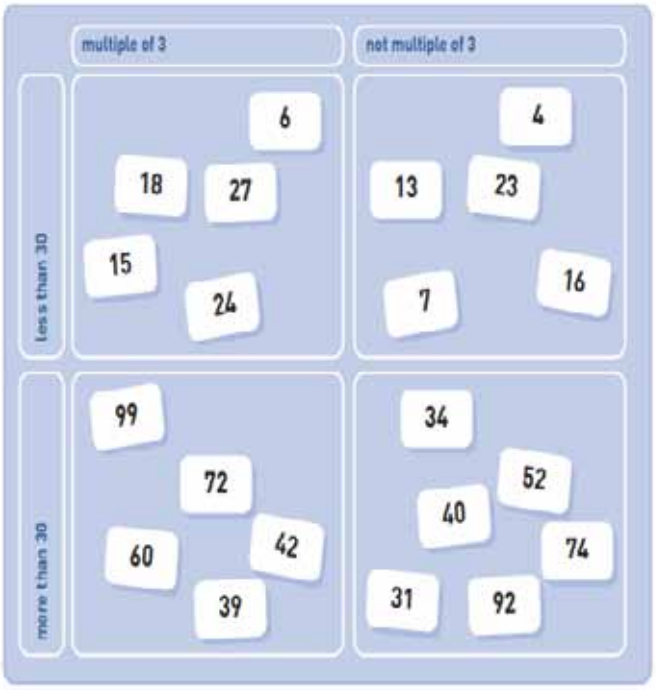
Use the activity with individuals or small groups by providing them with all the cards for them to sort and sequence. Ask a group of learners to create their own loop card activity and then try it out on the class.

Take a look at: The *Skills Workshop website* and the *National STEM Centre* for more card activities.

Activity example 3: Small group work - classifying numbers

Try this idea – classifying numbers

Classifying mathematical objects promotes the development of mathematical language as well as helping learners to understand mathematical terms and symbols.



This activity encourages learners to discuss their ideas, classify numbers according to a criterion and decide whether the classifications are mutually exclusive. The activity is from the *Maths4Life - Number* booklet. (You will need to register free on the NCETM website to access the resource.)

How to use

Provide your learners with number cards placed face down on the table. Each learner takes a card in turn and places it in the appropriate part of the grid, saying why they think it is the correct place. This will encourage the use of mathematical language as learners discuss whether the classification is correct. You can differentiate the activity by allocating learners specific numbers to place on the grid. The activity can also be extended by asking learners to construct a Venn diagram showing the connections.

Adapting the activity

You can adapt the activity by giving different groups different criteria and numbers. You can use odd/even numbers or prime/not prime etc. The activity can be contextualised to a vocational area, e.g. by using shapes, area and perimeter within construction.

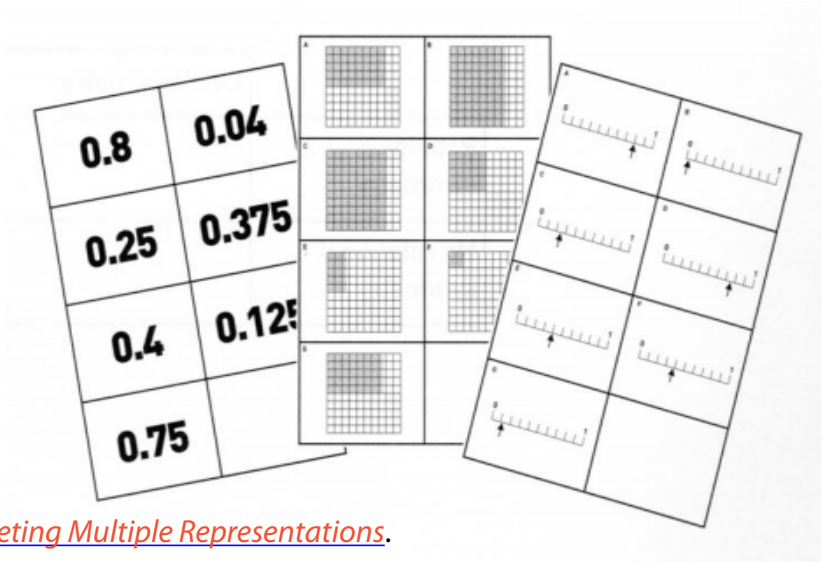
Take a look at: *Classifying shapes SS1* from the Standards Unit and the Maths4Life Fractions booklet which has an activity on *Classifying Fractions*.

Take a look at: The NCETM online course around *Classifying Mathematical Objects and Interpreting Multiple Representations*.

Activity example 4: Small group work - making connections

Try this idea – connections between decimals, fractions and number-line.

This activity encourages learners to discuss their ideas and make connections between different ways of representing numbers; as decimals, fractions and on a number line.



From NCETM *Interpreting Multiple Representations*.

Provide the learners with sets of cards containing the different representations to interpret and match. It is important that this is not just a quick matching activity but the learners discuss the representations and make reasoned statements about why their cards match.

How to use

Give the decimal card set to the learners and ask them to put them in order of size, discussing their thinking with another learner. Then give them the fraction cards to match, followed by the number-line cards. Some cards are not provided with a 'match' and learners then have to create additional cards to complete the set.

Adapting the activity

Ask the learners to identify other topic areas that could be included in order to match and create their own matching cards. The obvious ones are percentages and areas but by adapting the values slightly you could include time. The activity can be adapted and contextualised to a vocational area, e.g. measurement and angles within hair and beauty.

Misconceptions

Some common misconceptions arise in the notation learners use; for example some may ignore the decimal point and think that numbers with more digits are always bigger.

Some other examples of multiple representations are: different types of graphs illustrating the same data; words and algebraic expressions; and time in different formats.

Take a look at: These resources, Interpreting bar charts, Pie Charts, Box and Whisker Plot from the Standards Unit, and Increasing and Decreasing Quantities by a Percent from the Shell Centre University of Nottingham.

Take a look at: This research-based paper from Malcolm Swan: *The Design of Multiple Representation Tasks to Foster Conceptual Development*.

Activity example 5: Small group work - evaluating statements

Try this idea – evaluating algebraic statements.

Evaluating mathematical statement activities are powerful because they highlight any fundamental misconceptions learners may have. The statements are written to include common misconceptions and can relate to a range of mathematical topics.

$a \times b = b \times a$ It doesn't matter which way round you multiply, you get the same answer.	$a \div b = b \div a$ It doesn't matter which way round you divide, you get the same answer.
$12 + a > 12$ If you add a number to 12, you get a number greater than 12.	$12 \div a < 12$ If you divide 12 by a number, the answer will be less than 12.
$\sqrt{a} < a$ The square root of a number is less than the number.	$a2 > a$ The square of a number is greater than the number.

How to use

Provide learners with a series of algebraic statements on cards, along with header titles of *always, sometimes* or *never true*. In turn, learners select a statement, say whether it is *always, sometimes* or *never true*, and justify their answer by using mathematical reasoning. Learners should be encouraged to show examples of their reasoning by writing them alongside the statement while using mathematical arguments to justify their decisions. This is a useful way of clarifying their own thoughts. The activity lends itself to being displayed as a poster when completed. You can also use *Often, Sometimes, Never*, or *Agree, Don't know* and *Disagree* as titles.

Adapting the activity

Ask the learners to write "True" and "False" on the front and back of a mini-whiteboard, and to respond to mathematical statements you provide, by holding up the appropriate side of the board.

Misconceptions

This activity provides an opportunity for you to support learners to identify and deal with misconceptions. The activity can be adapted and contextualised to a vocational area, e.g. area and volume within construction.

Take a look at: The article on the NCETM website about mathematical misconceptions and misunderstandings and how they can be explored with learners.

Take a look at: The film from the Standards Unit on Using Misconceptions.

Activity example 6: Small group work - compare and contrast

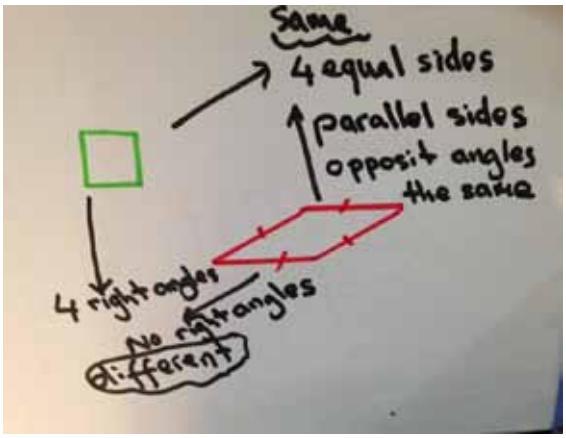
Try this idea - compare and contrast two quadrilaterals

You can use this approach to clarify concepts which learners may find difficult. It can be used in any maths area where you can make comparisons.

How to use

Set up small groups of twos or threes. Give each group two quadrilaterals. Ask them to draw the shapes, discuss the properties and then write down the similarities and differences between the two. They could write these on a flip chart to make a poster.

This activity encourages the development of mathematical language as well as understanding of the properties of the shapes.

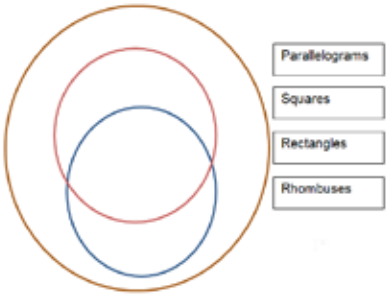


Once completed the group can exchange posters and agree, disagree or add to the findings.

You can differentiate the activity by choosing which quadrilaterals to offer different learners. You can also extend the activity by asking the question: "How else can quadrilaterals be classified?"

Adapting the activity

Venn diagrams can be used to show the relationship between objects, with learners discussing and placing the names in the appropriate section. The example shown uses the same idea as shown above but also includes parallelograms.



Mathematical language

The development of mathematical language is important, particularly for learners who do not have English as their first language, or for those who have weak literacy skills. Being aware of the literacy / language needs of your learners is vital. Some learners may find it helpful to create a glossary of numerical and mathematical words and terms, and to add new terms as they encounter them.

Take a look at: This *case study* from Leicester College on how they increased achievement by creating a glossary for ESOL learners.

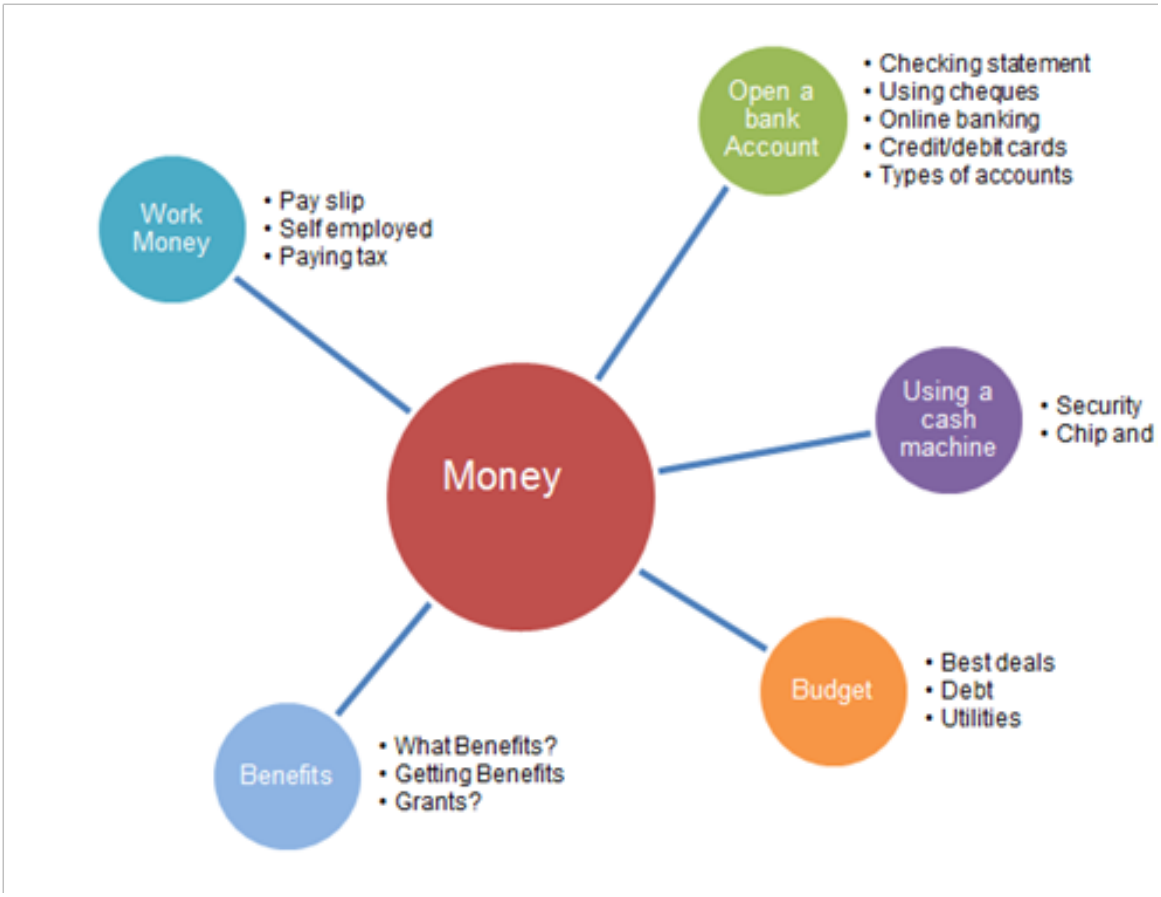
Take a look at: The NRICH activity *Property Chart* activity which investigates the properties of quadrilaterals.

Using topics

Topic-based teaching provides you with an opportunity to make connections across mathematical areas. You will need to ensure topic-based activities are relevant to your learners and the situation they are in.

Try involving your learners in identifying the topic:

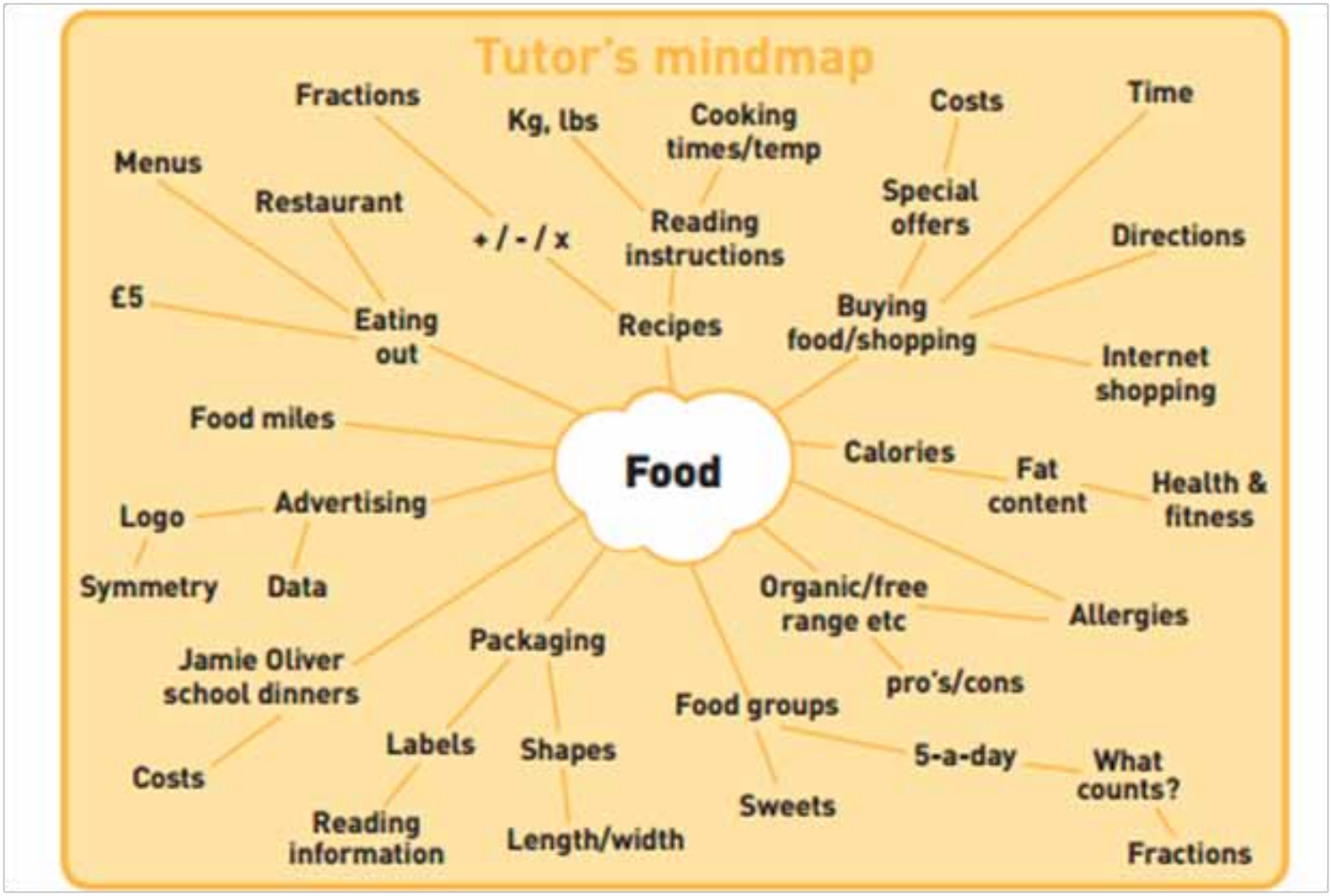
- You could use a brainstorm approach in small groups or as a whole group.
- Once you have identified a topic such as money, starting a business, or food, involve the whole group in creating a mind-map of the areas they associate with the topic.
- Split learners into smaller groups and give each group a section of the topic to investigate further. In the money example, this could be looking at how to open a bank account for payment of benefits when leaving prison, budgeting or using the canteen sheet. Then ask them to discuss everything they think they would need to know about the topic and to add these details to their own diagram.
- Once each group has agreed all the areas, you can mix the groups up so that learners share all the ideas.



From these mind maps you can then develop your scheme of work.

Take a look at: The *Maths4Life topic booklet* which provides advice about delivering topic based maths teaching. There are some sample sessions on the topic 'food', which includes activities on calorie counting, the restaurant, and special offers. A number of prisons are now setting up restaurants, such as *The Clink*, so this topic could work well.

The example below from the Maths4Life topic booklet illustrates how number, decimals, measure, percentages, ratio, shape and data handling can be included within the topic of 'food'.



Using mini-whiteboards

Mini-whiteboards are great for brainstorming and quickly expressing ideas. They can be plain, lined and squared. You can use them for most areas within maths, allowing for numerical, graphs, and algebraic and word-based answers.

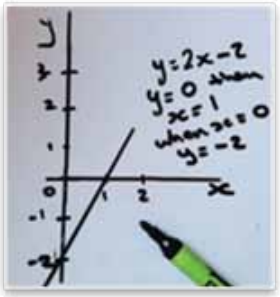
If you don't have any mini-whiteboards try using plastic document wallets with card/paper inside. Or try laminating white paper or card.

Mini-whiteboards can be used in a range of different ways:

Whole group

Ask learners to respond to a question by writing an answer on the whiteboard and holding it up after a set time. You should allow time for leaners to respond as it can be intimidating to try to calculate an answer after everyone else has already displayed their answers. Here are some useful questions:

Show me a fraction that is bigger than a half?
Draw me a shape that is a kite?
Draw and show me a sector?
Show me the graph? $y = 2x - 2$
Show me a quadrilateral with two lines of symmetry?



The approach provides you with immediate feedback to enable you to ask follow-up questions like 'How did you work it out?', or 'What makes you think that?' etc. You could collect the whiteboards and, where you have identified misconceptions, discuss the key issues.

At the start of a session you can ask key probing questions to quickly assess the learners' prior levels of understanding. You can use the same approach in a plenary to identify what learning has taken place during the session.

Take a look at: Mathematical Moments - Graphical Representations of Quadratic Equations (Exposing and Discussing Common Misconceptions). It provides ideas on how to use mini-whiteboards when reviewing quadratic equations.

You can also use True/False statements and ask learners to respond and then justify their answer.

Whiteboards can also be used to demonstrate number lines, fractions, decimals, expressions, probability and statistics etc. Ask the learners to write down a decimal between 0 and 10 and then get them to arrange themselves in size order.

Small groups

Ask learners, working in groups of three, to create a question and then pass it on to their neighbour to solve. They in turn pass it to the next person who checks the answer and marks it. The group then discusses what they have done.

A similar activity can take place using shapes and symmetry, with each learner drawing a shape and then passing it for the next person to rotate, reflect and translate the shape.

Take a look at: Some more ideas for use with mini-whiteboards:
Mathematical Moments - Linear and Quadratic Equations
Mathematical Moments - Topic: Stem-and-Leaf Diagrams

Maths mentors

Maths mentors engage new learners and support learners within the classroom, especially those who may need additional support. The National Institute of Adult Continuing Education (NIACE), funded by the Department of Business, Innovation & Skills (BIS), has developed a maths mentoring project. During the pilot in 2012-2014, over 90 prisoner mentors were trained in 10 prisons. This scheme has now expanded with *Train the mentor* events and *Train the teacher to train the mentor* events; 41 prisons have engaged with the project and 84 prison staff have been trained to deliver the mentoring training to prisoners.

Mentors are trained and provided with maths resources, basic equipment and Maths4us t-shirts so they can provide one-to-one support to prisoners on the wing, in classes and within vocational workshops.

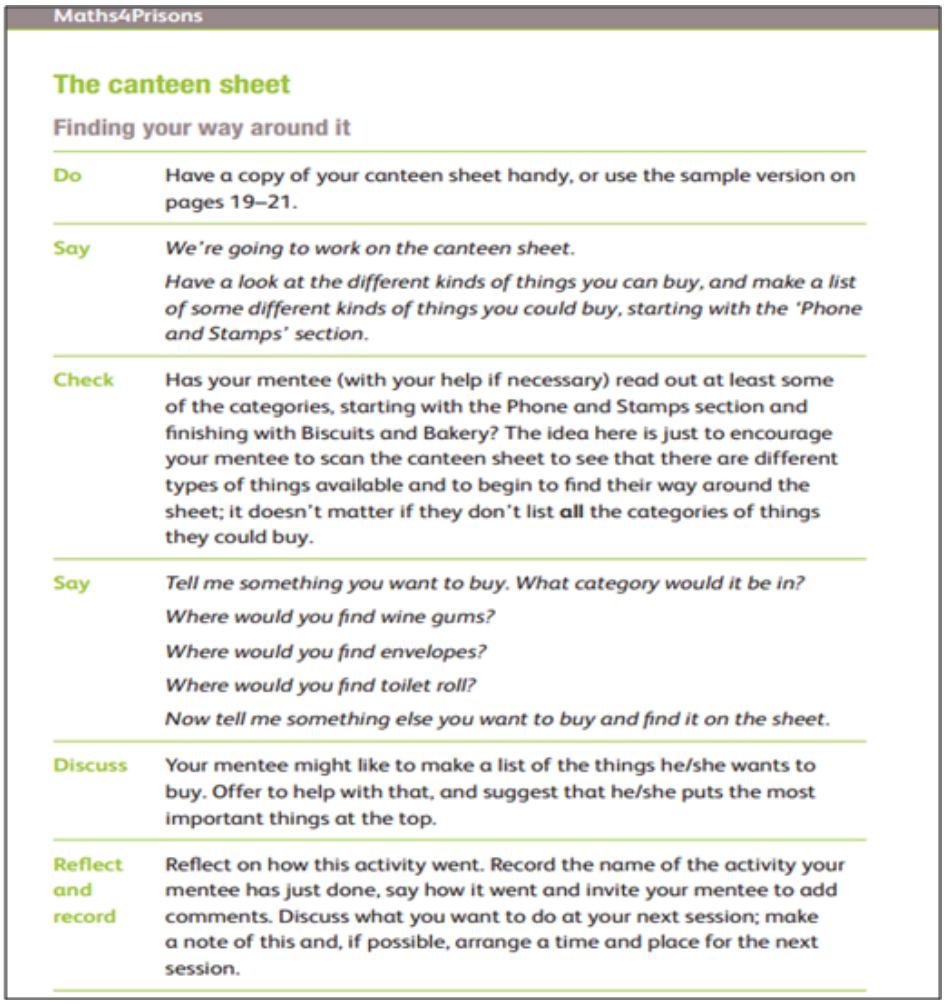
> *"I feel as though I am good at maths and would like to pass on any help that I can. The guys know who I am and come and see me on the wing."* HMP Littlehey Mentor

Take a look at: The Maths4Prisons Maths Mentor Handbook (free download) which describes the mentor project and includes resources which prison staff can use in mentor training.

Take a look at: The four associated learning activities booklets (free downloads) provided for the mentors: *Money*, *Time and Distance*, *Whole Numbers*, and *Mathematical Magic*.

Take a look at: A film where practitioners discus developing peer-mentoring schemes in the Secure Estate in England.

The following is an example of an activity in the *Money* booklet.



Maths4Prisons

The canteen sheet

Finding your way around it

Do	Have a copy of your canteen sheet handy, or use the sample version on pages 19–21.
Say	*We're going to work on the canteen sheet.* *Have a look at the different kinds of things you can buy, and make a list of some different kinds of things you could buy, starting with the 'Phone and Stamps' section.*
Check	Has your mentee (with your help if necessary) read out at least some of the categories, starting with the Phone and Stamps section and finishing with Biscuits and Bakery? The idea here is just to encourage your mentee to scan the canteen sheet to see that there are different types of things available and to begin to find their way around the sheet; it doesn't matter if they don't list **all** the categories of things they could buy.
Say	*Tell me something you want to buy. What category would it be in?* *Where would you find wine gums?* *Where would you find envelopes?* *Where would you find toilet roll?* *Now tell me something else you want to buy and find it on the sheet.*
Discuss	Your mentee might like to make a list of the things he/she wants to buy. Offer to help with that, and suggest that he/she puts the most important things at the top.
Reflect and record	Reflect on how this activity went. Record the name of the activity your mentee has just done, say how it went and invite your mentee to add comments. Discuss what you want to do at your next session; make a note of this and, if possible, arrange a time and place for the next session.

Embedding maths

Embedding learning provides a valuable opportunity to develop a learner's mathematical knowledge, skills and understanding. Interest and occupational relevance are powerful motivators for learners, and embedding maths enables learners to develop both sets of skills in an integrated and meaningful way.

At a number of prisons, sport has been used as a hook to engage prisoners who would otherwise be reluctant learners, e.g. HMP Swaleside has been embedding maths and English within practical sports courses.

Take a look at: The report *Fit for Release* about how sports-based learning can help prisoners engage in education and further information about *Teaching in the gym at HMP Swaleside* along with the associated film.

The research that taken place around the embedding of maths within vocational areas has identified the following as effective approaches to embedding:

- Vocational and maths teachers planning and working together to enable embedded learning activities to be developed holistically.
- Making activities authentic, linked to real work context and practical tasks.

Take a look at: The model HMP Oakwood developed for embedding functional skills within the secure environment.

HMP Wakefield

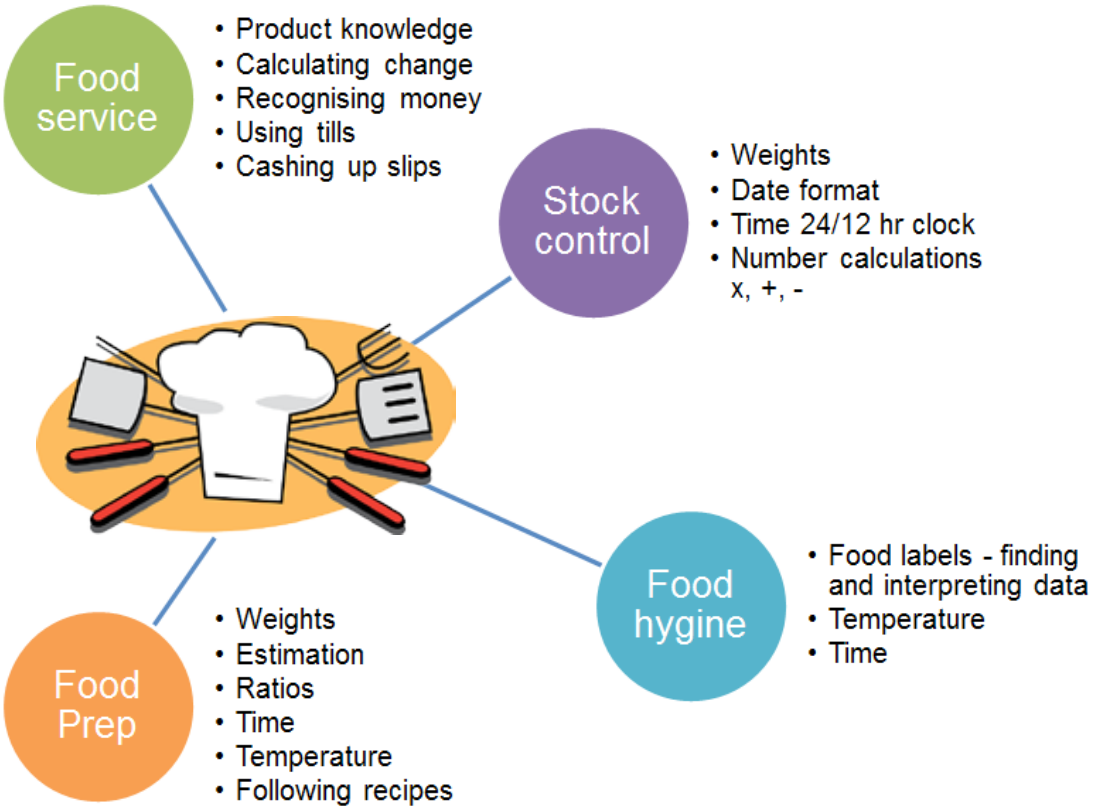
Wakefield is a Category A (high security) prison with vocational and employability training available in specific areas (primarily catering and business administration), or through the work available in the prison industries. Functional skills are embedded throughout the provision and courses are available up to Level 3.

Teachers provide contextualised learning within prison industries on a one-to-one basis to help learners who are in the separation unit and/or those who struggle with functional skills or have additional learning needs. This type of support is proven to be less disruptive to the prison day, and more effective at engaging those furthest away from learning and skills.
NIACE 2013

Take a look at the following research:
You wouldn't expect a maths teacher to teach plastering - NRDC and associated case studies.
Effective Practices in Post-16 Vocational Maths

Take a look at: The *Embedded Learning Portal* which hosts the national embedded learning materials, which were developed for a range of vocational areas including trowel trades, cleaning and warehousing.

When planning maths activities within a vocational setting, start by using the vocational scheme of work and breaking it down to find common themes or activities. You can then identify the mathematical elements that naturally occur. You will also be able to identify the links across the different areas of the curriculum. The example we have developed below shows some of the many mathematical skills that occur naturally from within catering.



You can also use the same approach with your learners, giving them a picture related to the vocational area you are working in and ask them to think about the maths that is taking place. This helps them to recognise the maths they may already be using and the skills they will need in order to gain employment.

Another idea would be to select a photo of a practical task the learners will be doing in the forthcoming lesson. This could then be used to highlight the maths in the task and expose any mathematical misunderstanding the learners may have, giving you the opportunity to deal with these just at a time when the learner can clearly see a need for them.

Take a look at: The films from the NCETM *workplace mathematics* series, where a builder reflects on how maths is a part of his everyday work and also from the *Offender teacher and training Toolkit* (Vocational).

Take a look at: Some resources at the National Stem Centre: *Starter for Ten* has been created by and with vocational teachers; *Picturing the Maths* and *Maths Matters at Work* support teachers and learners to identify and develop the mathematical skills and knowledge that underpin their vocational area.

Take a look at: A NIACE report *Vocational Training and Employability Skills in Prisons and YOI*.

"The most effective provision was where prisoners had access to vocational training. These prisoners generally developed good vocational and employability skills." Ofsted

Using technology

The use of technology within the Secure Estate is important as it provides offenders with the opportunity to develop their ability to use the ICT and digital technologies which are essential in the twenty-first century. It is also an important medium for you to use to enhance teaching and learning.

Access to technology is a challenge within the Secure Estate, and portable items, such as film and digital cameras to record ideas or progress, are not usually available. Laptops and computers are also not always available within the room where maths is being taught. As a result most of the technology you use will be via your computer and through interactive whiteboards.

In this guide we will look at just a few ideas to stimulate your thoughts and see how activities can be delivered through interactive whiteboards. If learners have access to computers or laptops then the activities can be adapted for them to use individually or in pairs.

Take a look at: The research *Through the Gateway: How Computers can Transform Rehabilitation* and *What research says about ICT and Maths*.

Take a look at: The film *Offender teaching and Learning (Technology) Toolkit*.

Take a look at: *Geogebra*, an online application which can be used to create dynamic geometric objects which may otherwise be difficult to visualise.

Interactive whiteboards (IWB)

When linked to a computer and projector, an IWB enables teachers and learners to control images and data. It enables learners to become actively engaged with the lesson, allowing them to move images and data physically rather than watch passively. This supports kinaesthetic learning. However, IWBs are frequently not used to their full potential.

The NCETM IWB project identified the following manipulations which can be used with your IWB:

- Drag and Drop
  To match a response to a stimulant and for classification, matching, processing of data, the creation of questions arising from the dragging and the organisation of material, such as matching equivalent fractions.

- Hide and Reveal
  To open a hidden response and enable material to be revealed as conceptual development takes place, for example stepping the development of hypotheses, and changing sequencing.

- Colour, Shading and Highlighting
  Used for the collection of 'like' terms, enhanced explanation, analysis through annotation and reinforcement through greater emphasis, such as matching equivalent terms.

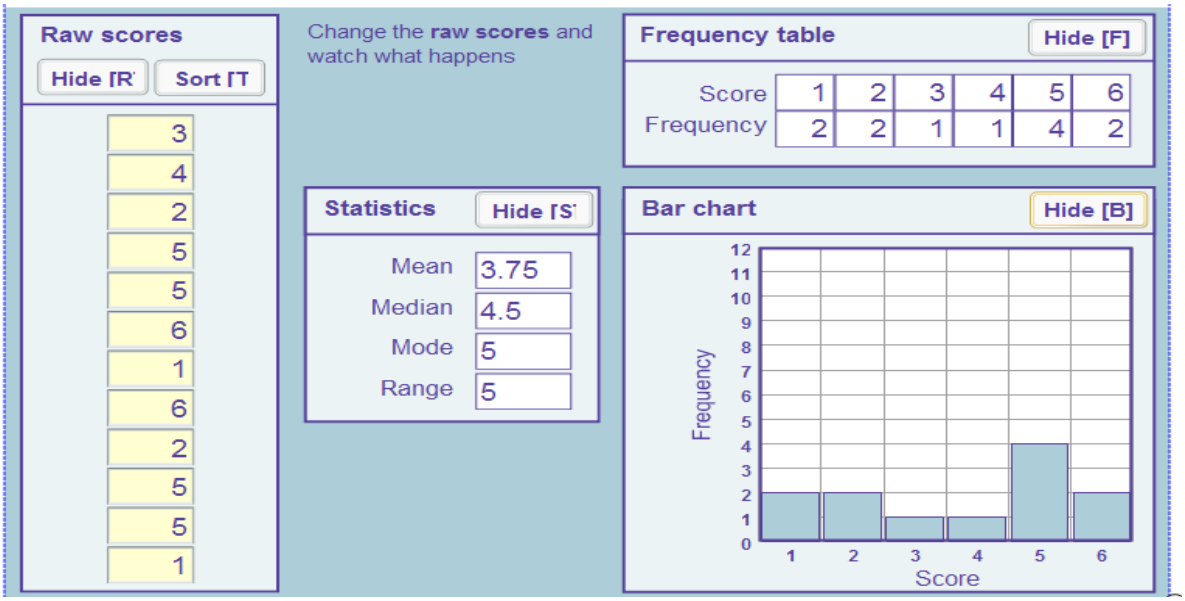
- Movement or Animation
  To demonstrate principles and to illustrate explanations, such as in the manipulation of numerators and denominators in addition processes.

Activity example 7: Using technology - statistics

Try this idea - statistics

The following activity is from the National STEM Centre *S4 Understanding Mean, Median, Mode and Range* and is an interactive activity which displays statistics in different formats. You will need to save the flash file on your computer before opening it on your IWB.

The flash interactive object can be used as part of an activity to support learners in building on and applying existing knowledge about the terms: Mean, Median, Mode, Range, and to explore their relationships and distribution.



How to use

Open the flash file on your IWB and hide each of the different elements of the interactive programme with the exception of the raw scores.

- Ask learners to suggest some raw scores that may be the result of an experiment (between 1- 6). Add to the list.
- Ask, 'If these scores were shown as a frequency table how would the results be written?' Learners add their answers to their mini-whiteboards.
- Ask, 'What will the bar chart look like?' Learners add their answers to their mini-whiteboards.
- Ask, 'What will be the Mean/ Mode/Median?'

You have the opportunity to discuss different methods of displaying data, identifying and misconceptions as well as asking further questions such as 'What if I changed the data set to …?'

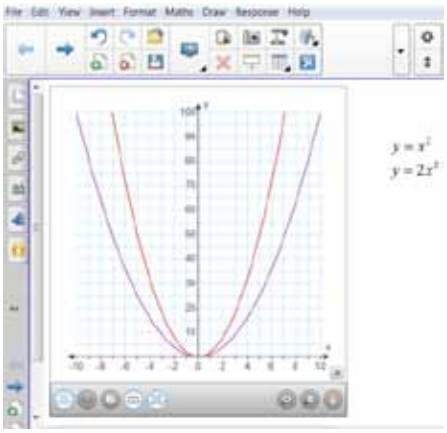
You can change the raw scores and just show the bar chart. Can your learners calculate the mean/mode/median from the chart?

Take a look at: *S4 Understanding Mean, Median, Mode and Range* resources which also contain Bar Charts and Statistics cards. These can be cut out and learners work in pairs or groups trying to match pairs of cards after which you can discuss some of the strategies that learners used to sort the cards.

If individual computers/laptops are available learners can open the interactive object, add their own raw data and experiment with "What if. . .?" questions.

Activity example 8: Using technology - exploring quadratics

Try this idea – exploring quadratics



This activity is taken from Day 3 (Algebra) of the NCETM enhancing mathematics programme.

Depending on the software on your IWB, you may find that graphs for mathematical functions are installed. For SMART IWB, take a look in Gallery Essentials>Maths>Interactive & Multimedia. Alternatively you can plot it yourself using the maths tools.

How to use

Use as a whole group activity

Plot $y = x^2$ **.** Ask the questions:

- What can you tell me about the shape?
- Possible answers you are looking for are: it's a parabola, meets zero on the x axis; symmetrical around y axis etc.
- Make sure the correct language is used and use the answers to identify any misconceptions.
- Ask the group to make a note of their answers on mini-whiteboards first before taking answers.

Plot $y = 2x^2$ **.** Ask the questions:

- Describe what has happened to the shape of the graph?
- What do you think the equation may now be?

Draw out the language of maths; e.g. "2" as a co-efficient or as an exponent.

- What do you think would happen if you graphed $y = 3x^2$, $y = 4x^2$?
- Show what these look like or ask a learner to input the information.

Use the same approach with negative or fractional co-efficients.

Show the equation $y = x^2 + 2$**.** Ask the learners to:

- Sketch the graph of this equation.
- Check to see if they are using when $x = 0$ etc.
- What about when $y = x^2 - 3$, when $y = x^2 - 5$?
- Use the IWB to check the equations and the resultant parabola.

Use the **drag and drop option** on the IWB along with a selection of different graphs and equations for learners to match. Alternatively provide them with cards containing the graphs and equations and ask them to discuss in pairs and match. Check understanding, being careful that you are giving learners the opportunity to develop their ideas and you are not just providing answers. Mathematical language should also be developed with the word 'constant' being used.

What next: The next part of the activity is to introduce $y = ax^2 + bx + c$.

Take a look at: C1 Linking the properties and forms of quadratic functions from the Standards Unit.

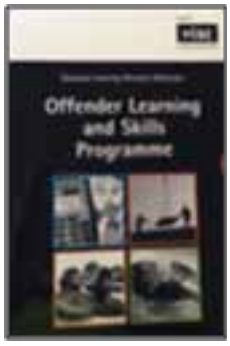
Virtual Campus

Virtual Campus has been in place within the Secure Estate for several years and provides a range of resources, from PDF files to interactive learning activities, that can be accessed by prisoners. These can be used in several ways: for independent learning; and for whole-class teaching.

Virtual Campus for Learning – *CPD in a Box* provides materials and ideas for staff on how to use the Virtual Campus for learning.

Activity example 9: Using technology - Virtual Campus

Try this idea – NLN materials on Virtual Campus



The NLN Materials are small 'bite-sized' learning objects. They are not whole courses but are designed to support a wide range of subject and topic areas. A whole range of NLN materials is on the Virtual Campus and is also hosted on http://xtlearn.net/NLN where you can download individual learning objects. You may also find you have a box set which was collated specifically for the Secure Estate.

The materials were designed for learners to work through independently, but there are useful individual activities within each learning object which you can use to engage learners and enhance your teaching. For example, there are interesting activities in a learning object about *Fractions* and *Arithmetic with Fractions*. Both are flash files.

The activities would be used after work has been completed around equivalent fractions.

A. Ordering fractions

How to use

Open the quiz on your IWB.
Learners are asked to **Drag and Drop** the fractions into ascending order with the smallest on the bottom.
Ask learners to justify their decisions.

B. True or False

How to use

Provide learners with cards containing the True/False statements. In turn, learners select a statement and justify their answer by using Mathematical reasoning and giving it a True/False.

With the quiz shown on the IWB, the True/False statements are discussed, displaying one at a time using the hide/reveal function. A consensus is reached by the group and True/False is selected. In the discussions misconceptions can be debated and addressed.

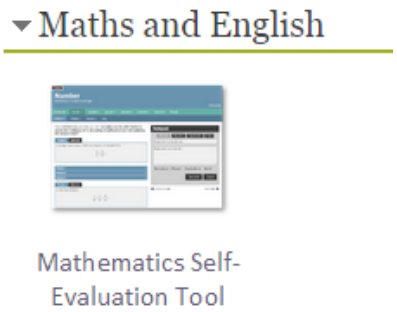
Take a look at: Virtual Campus for maths mentor resources and interactive activities such as the *Self Employed Gardener* – with examples for costing up work, scale drawings and plans.

How do I develop my personal maths skills?

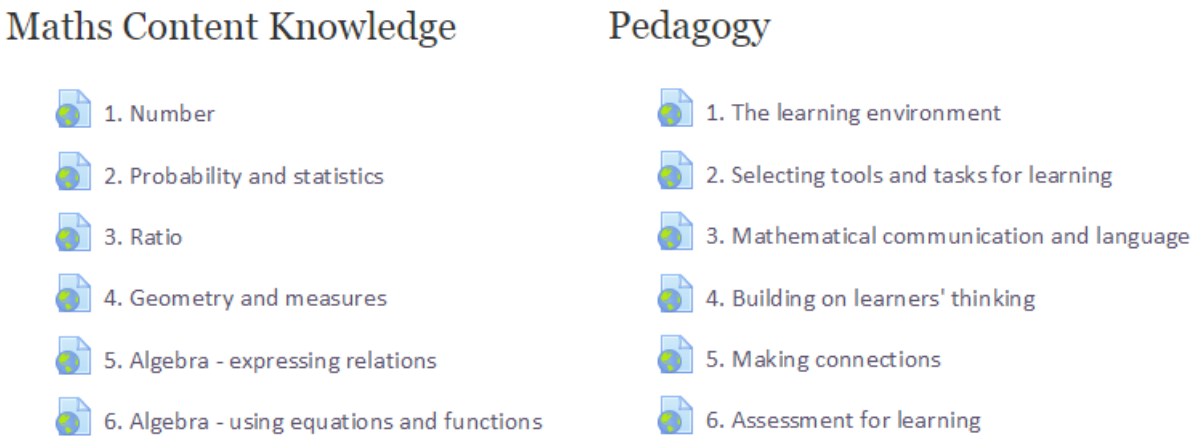
The Education and Training Foundation's online learning environment

The Education and Training Foundation's *online learning environment* provides professional development opportunities for the education and training sector and contains a maths self-evaluation tool.

To create and access the maths self-evaluation tool:

Select 'Create a new account' and follow the instructions.	Once logged in, scroll down the page and select the heading 'Maths and English'	Click on the Mathematics Self-Evaluation Tool icon
		

The self-evaluation tool contains two areas which will be useful for you:



The area on maths content knowledge provides problems for you to self-assess your mathematical knowledge. The problems rise in difficulty up to Level 3; if you are teaching maths at Level 2, being personally confident beyond that is important. The area on pedagogy contains problems, solutions and film clips on teaching strategies. There are links to resources that will help you to improve your confidence and competence.

Take a look at: The *Professional Standards for Teachers in England* on the ETF website. They provide clear guidance regarding the three interlinked sections of professional values and attributes, professional knowledge and understanding, and professional skills.

Take a look at: Materials contained in the series *Developing the personal Maths Skills of teachers and assessors* including algebra, handling data etc.

Resources

BBC Skillswise includes short films showing how maths and English are used in various workplaces, together with games and quizzes. http://www.bbc.co.uk/skillswise/job-skills

Cre8ateMaths includes a wide range of learning materials and professional development resources. Sections include: childcare and early years, building for the future, food and drink, and health and social care. http://www.cre8atemaths.org.uk/resources.

Support for offender learning provides resources (events, reports, newsletters) to support the offender learning workforce. http://offender-learning.excellencegateway.org.uk/

The Excellence Gateway is a searchable repository of over 7,000 resources including learning materials. http://www.excellencegateway.org.uk

Improving learning in mathematics materials for use with learners, and includes CPD materials for teachers. The maths level is roughly GCSE. https://www.ncetm.org.uk/resources/1442

Listening to learners' thinking was produced by LSIS. These resources encourage practitioners to actively listen to students' discussions. By doing so, you can gain an insight into the students' understanding and misconceptions.
http://www.nationalstemcentre.org.uk/elibrary/resource/2430/listening-to-learners-thinking

Mathematical moments contains short professional development activities for teachers. Many can also be used with learners. https://www.ncetm.org.uk/Default.aspx?page=13&module=search&mode=102

Maths in work includes films showing how maths is used in a wide range of jobs.
https://www.ncetm.org.uk/resources/11329

NRICH promotes the learning of mathematics through problem solving. http://nrich.maths.org/frontpage

The Nuffield Foundation has produced learning materials, some of which are vocationally relevant.
http://www.nuffieldfoundation.org/teachers

Thinking through mathematics includes materials for use with learners, and professional development materials for teachers. The mathematics level is roughly E3 / L1.
https://www.ncetm.org.uk/online-cpd-modules/ttm

Training to Teach Adults Mathematics looks at the practice of teaching adult mathematics and numeracy, including a focus on different approaches to teaching; the teaching and learning cycle; subject knowledge; and curriculum. http://shop.niace.org.uk

References

External references

This guide offers links to external websites and resources. At the time of publication all urls provided were correct; however, website addresses may be updated and changed. For each reference, the full name of the publication / resource has been provided to help you deal with any broken links.

The references below are split by chapter and section heading.

About this guide

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https://youtu.be/EiLhhqE1Rn4
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Roll-on roll-off courses

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http://shop.niace.org.uk/elearningsecureestate.html
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13. Excellence Gateway – SEND Exhibition site
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15. A Framework for Understanding Dyslexia
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16. Developing access to Skills for Life offender learners with learning difficulties or disabilities
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How do I make learning more active?

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23. Geoff Petty – Active Learning
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Activity example 1: Whole group work - target boards

25. TES - Target Boards resource
https://www.tes.co.uk/teaching-resource/target-boards-6159636

Activity example 2: Whole group work - follow-me cards

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http://www.skillsworkshop.org/resources/follow-me-cards-measuring
27. National STEM Centre - Follow-me cards
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Activity example 3: Small group work - classifying numbers

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29. National STEM Centre - Classifying Shapes SS1 (You will need to register free on the website.)
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Activity example 4: Small group work - making connections

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34. Maths Assessment Project – Increasing decreasing quantities by a percent
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35. Malcolm Swan - The design of multiple representation tasks to foster conceptual development
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Activity example 5: Small group work - evaluating statements

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https://www.ncetm.org.uk/public/files/573389/evaluating_mathematical_statements.pdf

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Activity example 6: Small group work - compare and contrast

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Using topics

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https://www.ncetm.org.uk/resources/8855
42. The Clink Charity
http://theclinkcharity.org/

Using mini-whiteboards

Whole group

43. National STEM Centre – Graphs
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Small groups

44. National STEM Centre - Graphs
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http://learning.wales.gov.uk/docs/learningwales/publications/150123-post-16-vocational-maths-en.pdf
59. Embedded Learning Portal
http://rwp.excellencegateway.org.uk/Embedded%20Learning/
60. NCETM - Workplace mathematics
https://www.ncetm.org.uk/resources/13932
61. Offender Teaching and Learning Toolkit (Vocational)
https://www.youtube.com/watch?v=2kNpx506-vU
62. National STEM Centre – Starter for 10 activity
http://www.nationalstemcentre.org.uk/elibrary/maths/collection/2004/starter-for-ten-learning-activities
63. National STEM Centre – Picturing Maths
http://www.nationalstemcentre.org.uk/elibrary/maths/resource/11642/picturing-the-maths
64. National STEM Centre – Maths matters at work
http://www.nationalstemcentre.org.uk/elibrary/maths/resource/11641/maths-matters-at-work
65. NIACE – Vocational Training and Employability Skills in Prisons and Young Offenders 2013
http://www.niace.org.uk/sites/default/files/resources/Vocational%20Training%20and%20Employability%20Skills%20in%20Prisons%20and%20Young%20Offenders%20Institutions.pdf
66. Ofsted – Annual Report 2013-2014
https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/384709/Ofsted_Annual_Report_201314_FE_and_Skills.pdf
67. Prison Reform Trust – Through the Gateway: How Computers can transform Rehabilitation 2013
http://www.prisonreformtrust.org.uk/portals/0/documents/through%20the%20gateway.pdf

Using technology

68. National Archives – What the research say about using ICT in maths
http://webarchive.nationalarchives.gov.uk/20130401151715/
http://www.education.gov.uk/publications/eOrderingDownload/15014MIG2799.pdf
69. YouTube – Offender teaching and Learning toolkit (Technology)
https://www.youtube.com/watch?v=2a--SARgWt8
70. Geogebra
https://www.geogebra.org/

Interactive whiteboards (IWB)

71. NCETM IWB resources
https://www.ncetm.org.uk/mathemapedia/BoardDeskHead

Activity example 7: Using technology - statistics

72. National STEM Centre – Understanding Mean Median Mode and Range S4
http://www.nationalstemcentre.org.uk/elibrary/resource/2041/understanding-mean-median-mode-and-range-s4
73. See above

Activity example 8: Using technology - exploring quadratics

74. NCETM Maths Enhancement Programme
https://www.ncetm.org.uk/resources/126
75. National STEM Centre - Linking the Properties and Forms of Quadratic Equations
http://stem.org.uk/rx42d

Virtual Campus

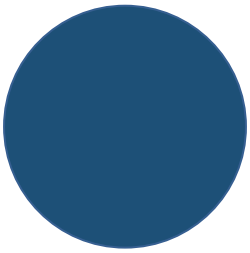
76. NIACE – CPD in a Box
http://old.niace.org.uk/sites/default/files/documents/projects/virtual-campus/CPD-In-a-box-Final-web.pdf

Activity example 9: Using technology - Virtual Campus

77. XTLEARN – Fractions
http://xtlearn.net/S/2271
78. XTLEAR – Arithmetic and fractions
http://xtlearn.net/S/2267

How do I develop my personal maths skills?

79. Foundation Online Learning
http://www.foundationonline.org.uk/
80. Professional Standards
http://www.et-foundation.co.uk/wp-content/uploads/2014/05/4991-Prof-standards-A4_4-2.pdf
81. Excellence Gateway Personal Maths Skills
http://www.excellencegateway.org.uk/search?content=Developing+the+personal+maths+skills+of+teachers+and+assessors&sort_bef_combine=score+DESC&sort_bef_combine=score+DESC



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