



# What really counts: Case studies of adult numeracy practice in Ireland



**NALA**

National Adult Literacy Agency  
Áisíneacht Náisiúnta Litearthachta do Aosaigh

## **What really counts:**

Case studies of adult numeracy practice in Ireland

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### **The National Adult Literacy Agency**

The National Adult Literacy Agency (NALA) is an independent member-based organisation, working on improving adult literacy in Ireland since 1980. We are:

- the voice of adults wishing to improve their literacy skills, and
- committed to raising adult literacy levels.

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## Introduction

This report, carried out by the National Adult Literacy Agency (NALA), presents five case studies on practice in adult numeracy in Ireland. Adult literacy and numeracy provision is mainly provided by Education and Training Boards (ETBs) through local adult literacy and numeracy services (ALS). The ALS offers a range of programmes that include Adult Basic Education, Numeracy, Family Learning, English to Speakers of Other Languages (ESOL) and Workplace Basic Education. The majority of adult learners receive about two to four hours tuition a week during the academic year.

The case studies in this report focus on different aspects of practice including general teaching practices, teaching mathematical concepts and the use of technology to teach numeracy in the classroom.

The data was collected at five selected sites throughout the country. The sites were:

1. Alpha Learning Service, Louth and Meath ETB
2. Bray Adult Learning Centre, Kildare and Wicklow ETB
3. Newbridge Youth Training and Development Centre, Kildare and Wicklow ETB
4. South Tipperary Adult Learning Scheme, Tipperary ETB
5. Tallaght Probation Project Service Provision

The research is a follow up phase to an initial piece of work that was carried out in 2012 by numeracy consultant Daniel Sellers. This initial piece of work researched and described a range of adult numeracy programmes across Ireland, focusing on various aspects of practice. This work did not focus on teaching practice, which is what this second phase of the research aimed to do.

## Background

There is a lack of research into adult numeracy practice in Ireland and to date we currently know relatively little about the teaching methodologies and pedagogical approaches of numeracy tutors. In order to address this knowledge gap, the National Adult Literacy Agency (NALA), has embarked upon a programme of research in the area of adult numeracy. This research will capture teaching and learning in numeracy practice and identify the training needs of tutors delivering numeracy tuition to adults.

In 1997 the publication of the results of the OECD International Adult Literacy Survey (IALS), provided Ireland with its first profile of literacy skills of Irish adults aged 16-64 years. The IALS findings showed that 25% of the population performed at the lowest end of literacy and numeracy skills (Level 1 of a five-point scale).

In 2013, over a decade after the publication of IALS, the OECD published the findings from its first survey of adult skills. The survey, Programme for the International Assessment of Adult Competencies (PIAAC) was designed to provide an insight into the availability of key competencies and to measure proficiency in skills such as literacy, numeracy and problem solving in technology rich environments (OECD, 2013).

The numeracy results for Ireland show that just over 25% of Irish adults score at or below Level 1 for numeracy compared to a 20% average across participating countries. This score ranks Ireland 19th out of the 24 participating countries. Males score higher than females by 12 points. Adults aged 25 – 34 have the highest score for numeracy while adults aged 55 – 65 have the lowest score. This mirrors a trend across participating countries which shows a decline in numeracy proficiency for older age groups. 30% of those aged 16 – 24 are at Level 1 compared to 18% for those aged 25 – 34 and 36% of those aged 55 – 65 (CSO, 2013).

Data from the Department of Education and Skills (DES) shows that in 2012 the total number of learners in the ETBs adult literacy service was 54,870. Over half of the learners presented with less than a Leaving Certificate or NFQ Level 4 qualification. The DES operational guidelines 2013 state that numeracy should be an integral part of the range of learning options offered throughout the ETB Adult Literacy programme and learners should be offered an opportunity to gain accreditation at NFQ Levels 1-3. The Adult Literacy Review also recommends that ETBs should strongly promote numeracy as an option for adult participants and seek to increase participation in both standalone and integrated numeracy options. This report intends to add to the discussion around quality numeracy provision for adult learners.

## Methodology

The aim of the research was to:

- capture and document effective approaches in using specific numeracy teaching strategies with adults,
- provide detailed information on numeracy practice that will be a resource for adult literacy practitioners, and
- disseminate examples of practice to stakeholders within adult literacy and numeracy, adult basic education, community education, further education and to the international adult numeracy research and practice communities.

The study sought to explore these issues with numeracy tutors to gather their experience of, and views on, delivering numeracy tuition to adults. We collected the data using a qualitative case study approach. The choice of data collection techniques was semi-structured in-depth interviews. This method allowed the researchers to explore identified themes in detail with numeracy tutors. It also allowed us to elicit data on the teaching as it happens in the classroom and to provide an opportunity for the individual tutors to reflect on their own existing practice.

## Data analysis

The data analysis was guided by grounded theory methodology as described by Strauss and Corbin (1990). Verbatim transcripts of individual interviews were prepared. Analysis was ongoing throughout the fieldwork stage of the research process. It was standard practice for the researchers to meet and discuss issues arising from the interviews, including the 'unique' aspects of practice in each of the case studies. The formal analysis involved managing and coding the interview data. Open coding was used in all of the transcripts to categorise the concepts such as teaching style and teaching methods.

## Finally

The focus of this research was to examine numeracy strategies used by tutors when working with adults engaged in numeracy learning. Each of the five case studies illustrates numeracy practice as it happens and details the practice of the tutor in the classroom. The data provides an in-depth insight into specific practices that support numeracy development. This includes teaching strategies that improve learners' understanding and use of maths in different contexts and their ability to transfer numeracy knowledge to everyday situations. Tutors amass substantial skills and knowledge through learning by doing and often by trial and error. NALA has carried out this research in order to gain access to the experience and ability of numeracy tutors in relation to practice.

The adult learners in these case studies are not a homogenous group and it is not useful to think of them as such. They attend numeracy classes for general learning or as part of an:

- apprenticeship programme,
- job activation programme,
- work based return to education course, or
- referral to study through the criminal justice system.

They may attend numeracy class for various reasons, for example, developing skills and or to gain a qualification. Tutors consider the reasons and motivations for attendance when planning, preparing and teaching sessions. This in turn engages more learners and more effectively addresses their particular needs.

Oftentimes there can be a tension for numeracy teachers between teaching to a specific course or programme curriculum and making the learning meaningful to adults by relating it to specific real life situations. Research suggests that learners learn best when they can take 'ownership' of learning and apply what they have learnt into 'real life' contexts that have specific meaning for them (Kaye, 2013; Boaler, 1993).

Benn (1996) argues that all education, including adult education, needs to be learnt and applied to contexts that are 'relevant and meaningful' to the learner's life. The research also shows that literacy levels and language play a vital role in learners' understanding of numeracy, and there can be a 'gap' between mathematical linguistics and the use of numeracy and numerical concepts in everyday life (Woolley, 2013). We discovered that these were among some of the problematic issues when teaching and learning numeracy in the classroom.



NALA is keenly interested in improving the quality of adult numeracy teaching and learning. We believe that this research's documenting and recording of numeracy practice as it happens, will be a useful resource to practitioners working in the area of adult numeracy in Ireland.

The following chapters present each of the five numeracy case studies in turn. We consider each under eight headings:

1. Background
2. The tutor
3. The tutor's understanding of numeracy
4. Preparation and planning
5. Working with groups
6. Approaches to teaching
7. Teaching strategies for specific topics
8. Evaluation

The report concludes with an overall discussion and analysis.



# Case Study 1: Alpha Learning Service, Louth and Meath Education and Training Board

## Background

Louth and Meath ETB's Alpha Learning Service has introduced iPads into its literacy and numeracy programmes. The staff believe that students are more motivated and are learning more effectively as a result of the introduction of this new technology. This case study describes one tutor's teaching of mathematics, and how he has introduced touchscreen technology into his classes to further engage students and to deliver particular topics.

## The tutor

The tutor, Philip Madden, works for Louth Meath ETB in County Meath. He is a qualified Network Engineer but started tutoring in IT over 15 years ago. Philip has taught in County Meath VEC (now the Louth and Meath Education and Training Board) since 2010. He teaches mathematics and computer subjects and has a Microsoft Office Master Qualification.

## The tutor's understanding of numeracy

The tutor recognises the complexity of the debate about the conceptual terms 'numeracy' and 'mathematics' and how they interact. He understands numeracy as the ability to see and use numbers in everyday life. For him, the teaching of numeracy is always situated in a context that the individual is familiar with. He believes that numeracy is an application of mathematics in that context but because of this everyday application, learners might not always recognise that they are using maths skills.

When learners hear the word 'maths', they say, 'I don't want anything to do with maths'. But every single minute of every single day they are using numeracy, but don't always associate it with maths.

The tutor sees part of his job as being to show learners that maths is not remote and difficult but is useful everywhere and part of our lives.

## Preparation and planning

### Identifying learners' goals and levels

The ETB's Alpha Learning Service implements a Pre-Course Placement (PCP) to assess each new learner. This follows an initial interview and can be carried out one-to-one with more nervous learners by either the co-ordinator or by any of the trained tutors. The process establishes information about the learner's background, what age they left school and why they left school early, if that was the case. The PCP asks the learner what they know about numeracy using simple questions. The learner answers by saying whether they think they could complete a particular question, if they think they would need to use a calculator, and if they understand the symbols. The learner's responses help identify which level (1, 2 or 3) is best to start at, while always acknowledging that learners can have 'spiky' or complex profiles.

Tutors have access to the PCP results and any notes from the initial interview, even if they did not carry out the interview and PCP themselves. The learners have a group learning plan but information from individual learners' PCPs enable the tutor to meet the needs of individuals within the group as well.

### Meeting the needs of diverse groups of learners

The Adult Learning Service is working with increasing numbers of migrant workers. Many of these learners have adequate numeracy capabilities but struggle to apply their skills in an English-speaking environment. The language of numbers and the use of numbers in an English-speaking society are covered in ESOL (English for Speakers of Other Languages) classes.

The Service is also working with more men, who are improving their skills to regain work after the collapse of the construction industry. The tutor has worked with a number of these learners. He finds that they often have strong, though informal, numeracy skills in the context of their former work (for example, carpenters would be comfortable measuring and working with ratios in terms of cutting timber), but that they struggle to transfer their skills and knowledge to new areas. Much of the tutor's work with these learners is about formalising their skills and knowledge and filling in gaps they might have, for example, around the metric system of measurement.

The tutor has noticed that more learners are asking for sewing classes in order to make clothes and save money. He has run maths classes for learners on these courses in metric measurement, conversion tables and angles. He recognises that these classes are attended mostly (between 80% and 90%) by women but that the maths topics they are need are often the same as those required by the unemployed men.

## **Preparing resources**

The tutor sources most of his teaching materials from the internet. He uses iPads in his teaching, so several of his resources are downloadable applications, or 'apps'. Several of these apps are free but some have a charge. These are bought using iTunes vouchers which are purchased centrally by the ETB. He has sourced apps to teach geometry, measurements, ratio, percentages and place value. Because of the ease of using the technology, rather than finding apps himself he often encourages his learners to search for an app and download it themselves.

The tutor often has learners using apps in combination, though he says that it is currently quite tricky to 'multitask' on the iPad, as it means you have to change to another screen to use a different app. He has created worksheets that guide learners through tasks using an app, or multiple apps and even referring them to YouTube videos and other online activities.

As well as using apps for materials, the tutor regularly sources materials from the internet, and from existing resource packs, including those published by NALA and the Maths Eyes project. He explains that he often adapts these resources depending on the topic he is teaching as well as the learners.

## **Working with groups**

The tutor usually teaches groups whose members share the same concrete goal (for example, a qualification). Within these groups, though, he will have learners who have strengths and weaknesses and differing gaps in their knowledge and understanding. He often splits a large group into smaller groups to enable learners to work on areas that they need to focus on. For example, one small group might be using iPads to develop their skills at division, while another will be reinforcing times tables. He will then mix up the groups so that peer learning can take place with, for example, a learner who has been working on division for the first time showing a learner who was previously working on times tables how they solve division problems.

He recognises that it is important that learners are engaged, even if they are ahead of their peers in a particular topic. He ensures he has back-up activities to extend a particular learner's work if they finish before others. He finds that this is a useful way of keeping moving learners on in their learning and assessing what else they might be capable for when they move up to the next level.

## **Supporting learners to overcome barriers to learning**

The tutor ensures that he uses a range of methods, while minimising lecturing or verbal

instructions without visuals or hands-on equipment. He uses PowerPoint presentations and videos, especially from YouTube. He finds iPads excellent for enabling learners to 'handle' maths: he uses many applications, or apps that allow learners to manipulate shapes, including three-dimensional shapes.

Where learners have identified specific learning difficulties, such as dyslexia and dyspraxia, at their PCP, one-to-one tutoring is available, especially at the start of the learner's course. At times the PCP might not identify a specific learning disability and this might emerge during the course. The tutor and his colleagues are trained to recognise if someone has difficulties. They assume that any learner could have a difficulty. Learners who are dyslexic, or who show signs of dyslexia, appear comfortable using touchscreen technology, where they can see shapes and lines and manipulate them to gain better understanding.

The tutor finds that learners who have emotional barriers (for example, fear), to learning mathematics will often tell him early in the programme. He uses discussion to identify where someone's fears lie and quickly establishes all the numbers that they use in their everyday lives. He gives an example of talking to a learner who gambled. He was able to show the learner that he used ratios every time he visited the betting shop. This realisation helped the learner to be more open to maths from then on.

## **Approaches to teaching**

### **Style of teaching**

The tutor says that his teaching style uses a multitude of different approaches. He draws on a range of methods and strategies that are practical, physical, technological and visual. He encourages discussion and collaboration among learners. As far as possible he avoids lecturing, though he will provide inputs and demonstrate activities when he needs to. He believes that he needs to get learners involved in an activity as soon as possible. He uses the classroom and the environment outside the classroom. He encourages learners to move about and experience their learning as much as possible, as he believes this helps make the learning come to life.

### **New teaching ideas and approaches**

The tutor regularly attends workshops at national conferences. He gives two examples of how he has been inspired recently by practice workshops: one was a workshop about 'Geogebra'<sup>1</sup>. He was inspired by this new and visual way of assisting people to understand calculations involving speed, distance and time. Another workshop he attended showed him how he might use snooker to teach algebra. When he and his colleagues attend

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<sup>1</sup><http://www.geogebra.org/cms/en/>

conferences they share out which workshops they attend and share their learning afterwards, in person and by uploading their notes onto a shared drive used by the ETB. Rather than bringing new ideas and methods straight into the classroom, the tutor often keeps them in reserve. He tends to recall new ideas and methods when learners are looking at particular topics. He gives an example of a time when a learner was working on speed, distance and time, and he was able to show the learner the examples on the Geogebra website. The tutor believes that because he uses technology in his teaching, including the use of iPad touch screen technology, he is more open to try a range of new teaching ideas and strategies, whether they use technology or not.

### **Taking advantage of teachable moments**

The tutor recognises that it is important to answer learners' questions. He points out that if doing this would distract from the main topic, he might say, for example, 'Ten minutes from now I'm going to show you example of that.' He says it is then imperative that you remember to go back and that this might mean writing the question down. He says that you might forget but that the learner will not. 'The student never forgets.' He believes that by respecting learners' questions he shows learners that they are contributing to the class, and encourages them to ask more questions and to feel free to discuss aspects they don't understand.

### **The use of questioning**

The tutor often uses questioning to encourage learners to relate answers to tasks or problems to real life. He asks questions such as: 'where in real life would you find this problem?' and, 'How would you solve this problem in [another situation]?' His questions tend to be open, encouraging learners to think through problems and to explore ideas. He believes that learners asking questions is a sign that they are comfortable in a class. He encourages them to ask him questions and to ask each other questions as well. While learners are working in small groups he listens and intervenes by asking questions. These questions encourage the learners to work towards a solution. Ultimately, he believes that learners' ability to ask questions of themselves and of each other is a sign that they are developing towards not 'just taking things at face value'.

### **Encouraging discussion and collaboration**

The tutor uses projects in his teaching and encourages discussion about ways of approaching particular tasks and problems within these projects. He gives the example of a project about the Titanic. The learners discussed who would take on which tasks and then met to discuss their findings and collaborated to solve problems that arose within the project. The tutor took part in these discussions, stepping in if the learners were having difficulties. He says that, 'They are solving their own problems and coming up with their own questions. They are questioning themselves.'

**Using problem-based learning**

For the tutor, questioning skills are best developed during a problem solving activity; especially problems that involve exploration and activity. He has created projects with the learners involving problems of different scale. For example, from planning and measuring a flower-bed (which involves learners measuring plant pots and calculating the volume of soil needed) to planning a theoretical trip to Edinburgh and working out the cheapest and quickest routes.

The tutor believes that problem solving is about both developing skills and about the application of skills. He says, 'Problems make it real, relevant ... this is motivational.'

**Using context effectively**

The initial context for the learning is the individual's life, their interests and their original goals in coming back to learning; however, as individuals' learning develops the learning content becomes more general, though still relevant. The focus of the learning becomes more collaborative and based on shared problems, such as those in the projects.

The tutor leads the learners through a process of developing skills within a particular context, which are then applied and practised within that context. He then enables the learners, through the use of questioning and discussion, to examine how they can apply skills learned in class to real life situations that they face. The tutor strongly believes that contexts in which skills are learned and applied have to relate and be relevant to learners' lives. 'There's no point in saying to them, you are going to go away and build a table,' he says. 'Most of the class aren't going to go home and build a table.'

**Using technology in the classroom**

In 2012 the Alpha Learning Service invested in 10 iPads for literacy and numeracy students to use. Students have been using the iPads to access educational applications (or apps), to get onto the internet, to make and check calculations, and to take photographs and record video clips. The use of iPads is integrated into teaching and learning as a whole, so that students use and experience a range of materials and teaching methods.

The Alpha Learning Service has used mainly free-to-download apps on its iPads. Free apps often have a pay-for version, costing a few euro. Pay-for apps tend to have more features than free versions. Free apps will often have advertisements embedded within them. If tutors need to buy an app, they simply order an iTunes voucher through the ETB's IT department orders system or if multiple apps are required the iPad management support service company buys them directly. This service company is contracted by the ETB.



Some of the apps that have been used by the Louth and Meath ETB are detailed below. They are suitable for adult learners and support various learning outcomes of the FETAC qualifications.

- *Number Line* provides an empty number line on the screen. Students have to use spatial awareness to identify where on the line a whole number should be marked.
- *TapTap Blocks* depicts a three-dimensional cube. Learners can rotate and manipulate the cube to get a feel for the shape, to count its faces, edges and corners.
- *Think 3D Free* presents several different three-dimensional shapes for learners to build onto, paint different colours and generally to manipulate and become familiar with.
- *Protractor 1st* allows students to identify and change angles. They can type in a number of degrees and see the angle against the protractor scale.
- *Volume of Solids Lite* presents numerous three-dimensional shapes and shows the student how to calculate their volumes.
- *Geometric Cabinet* is a pay-for app which allows learners to explore and work with a range of shapes.

The tutor has noticed that learners are more motivated to practise outside classes, with or without technology of their own. In addition, the iPads appear to help learners to pick up new concepts much more quickly. For example, an animation showing the balancing of equations helped learners to visualise and understand why numbers change their sign when they move to the other side of the equals sign.

## Teaching strategies for specific topics

The tutor is keen when teaching any topic to reassure learners, to draw their attention to when they are using maths already and to 'call it what it is', in other words, not trying to hide maths within everyday practices.

### Percentages and fractions

The tutor often uses money and discounts to introduce the learning of percentages, with practical questions such as, 'If you buy an item with a 25% discount are you getting a bargain? If so, why?' A learner explained why it was a good deal by volunteering that 25% is the same as 'a quarter off.' He finds that learners can often relate to percentages - and fractions - in terms of shopping deals. He also uses a pizza to reinforce understanding of fractions. 'You get a pizza and cut it into four. There are four people. How many slices does each person get?' He then writes down the sign for  $\frac{1}{4}$  so that learners can relate the concept and the reality to the sign.

**Time**

The tutor uses iPads to teach the time. He describes a number of free apps that are available that show clock faces that can be manipulated. The apps will pose a problem, such as: 'Show ten-past-twelve on the clock face,' and the learner will need then move the hands on the iPad screen and press a button marked 'Yes' when they believe they have done it. The clock faces can be changed to show digital time, and learners can convert between the two formats. He has found that learners learn time more quickly using the apps than using paper-based methods.

**Handling data**

The tutor often asks learners to carry out surveys during project work. He gives the example of a project that investigated people's mobile phone use. Questions sought answers about mobile phone providers, networks, by how much individuals 'topped up' each month, and how many text messages they sent. These questions were supplemented with information about respondents' age and gender. Learners had to fill in a spreadsheet with their findings and then represent the information in different charts. The learners spend time looking critically at different options for visual representations of their data and the tutor finds that they gain a deeper understanding of the functions of different charts and graphs (for example, the different functions of a pie chart as opposed to a bar graph).

**Calculators**

The tutor uses two types of calculator with the learners: physical calculators and those on iPads and smartphones. He finds that some learners are nervous about using calculators in case it is 'cheating'. He tells them that using a calculator is a sensible way of checking money when they are shopping. He finds that learners often do not understand how to use the calculator's memory button and that even if they are not going to use it, knowing what it is helps them to feel more comfortable about using the calculator in general: the buttons are no longer mysterious and they feel less likely to 'break' it.

**Spaced learning**

The tutor has been trying out an innovative teaching approach called 'spaced learning'<sup>2</sup>, with a number of topics. This approach aims to break up sessions into short chunks by breaking up thinking time with physical activity. This means that learning takes place in short, intense bursts. One application of spaced learning is that the tutor has used pi ( $\pi$ ) to calculate the circumference of circles. He showed learners the theory by using videos, and demonstrated the calculation with them. He then asked the learners to go outside and spend 10-15 minutes measuring the radius and diameter of car wheels in the car park. The learners brought these measurements back and calculated the circumferences on paper.

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<sup>2</sup><http://www.susangreenfield.com/assets/Uploads/Spaced-Learning-Guide.pdf>

They then had to go back out to the car park and check the circumferences against their calculations.

He has found this mixing of activity and thinking, in line with the findings of the originators of spaced learning, helped learners to pick up concepts quickly and in more depth.

### **Accreditation**

The tutor ensures that learners meet specific learning outcomes for qualifications, and these are explicit in their learning. However, learners understand that these outcomes are being met in the context of broader learning, and that the learning isn't solely focused on the accreditation.

## **Evaluation**

The tutor believes that his programme succeeds in opening learners' minds to new ideas, and that technology is key to this. He incorporates videos, iPad apps, real-life objects and large projects into the learning, while keeping a practical focus. He says that a crucial success factor is that learners are able to relate their maths learning to their everyday lives. As a tutor, he has found it challenging to integrate algebra, which can be abstract, into practically-focused learning activities. He has found that the solution is to introduce algebraic concepts (such as variables) and some of the language and symbols early into the programme.

Learners keep a log at the end of each class, recording what they did, what they learned and what else they would like go over again. He says that the records help the learners and him as tutor to remember what has been covered and any issues there have been for individuals.

The tutor researches methods and resources online and attends conferences and workshops when he gets the opportunity. He also discusses and picks up ideas and information from colleagues in the ETB, and shares ideas and resources of his own with them.



## Case study 2: Bray Adult Learning Centre, Kildare and Wicklow Education and Training Board

### Background

Bray Adult Learning Centre is one of six designated adult learning centres in Kildare and Wicklow Education and Training Board (ETB). Bray is a large, densely populated town and is the largest urban area in Wicklow. The town has areas of disadvantage, with six designated 'disadvantaged' schools and two RAPID designations. Most of the Centre's students are aged 35 to 55. Younger people are coming along, but under-25s are in the minority. Older men are attending lately, largely due to unemployment in the construction industry. Learning is delivered in the Centre and in outreach, including in the designated schools and several community development projects. Many students find the centre through word-of-mouth, but the Centre also takes referrals from local education networks and other agencies. Most students have a full curriculum; around 60% attending a minimum of twice per week. Very few study numeracy only. The Centre has 12 part-time group tutors, as well as the Organiser and a resource worker. The Centre has a small number of volunteer tutors to support students.

This case study describes the numeracy teaching practice of one of the Centre's tutors. It explores the general teaching strategies she employs and specific strategies she uses to teach particular topics, in particular 'number.' It recognises the tutor's use of peer support in a programme, where she encourages and makes space for learners to boost one another's morale and to support each other's learning.

### The tutor

Kathie Orr is a part-time adult literacy and numeracy tutor at Bray Adult Learning Centre. Her background is in law and taxation. She started in adult education in 2007 as a volunteer and became a group tutor three years ago. She has an ACELS qualification and has completed a number of modules towards the Waterford Institute of Technology Higher Certificate in Literacy Development together with other NALA literacy and numeracy courses.

## The tutor's understanding of numeracy

The tutor understands numeracy as being one strand of 'functional literacy', which also includes reading, writing, communication and information technology, in that it equips people with the skills and knowledge they need in order to engage with society. She recognises the importance of learners feeling confident to use numbers and to apply critical understanding. 'It's not just being able to complete a computation,' she says, 'but also an ability to decide what computation to use, where, and in what situation.'

She believes that the relationship between maths and numeracy is in the application: mathematics is the academic subject but when you apply maths processes to real and practical situations, the maths becomes numeracy. She suggests that numeracy is 'common sense with numbers, or number sense', and that it could be described as 'the practical end of a theoretical subject'. She points out that this distinction does have relevance for learners. She gives the example of a learner who could complete pages of sums but struggled to solve problems in real life contexts; she also talks about learners who can successfully solve problems involving numbers, such as estimating money, but who cannot relate to maths on the page, with its symbols, named concepts and algorithms. She says that many of her learners are 'using maths every day – but they don't call it that. They would say they were 'bad at maths.'

## Preparation and planning

Programme planning in the Centre is ongoing, with end-of-term and end-of-year reviews identifying learning successes and setting future learning goals. Once a Course is planned a Course Outline is prepared, which is shared with learners. If the course is accredited then an assessment schedule will be built into the course outline. Individual lesson plans are flexible enough to be able to accommodate learners' needs that arise during the session, and the tutor makes notes during and following each lesson to inform planning for next time.

### Identifying learners' goals and levels

Learners are initially assessed by either the Adult Literacy Organiser (ALO) or the Resources Worker, but this assessment tends to provide an indication of a general level. The assessment of each learner's capabilities and the review of goals is ongoing during learning programmes.

## Working with groups

### Meeting the needs of diverse groups of learners

The tutor suggests that diversity is almost always a feature of adult learning, because of the variety of backgrounds learners come from, the range of experiences they have had of life and of education, their different purposes in returning to learning, and the range of starting points they have. In addition individuals will have different learning needs. The teaching approach used in the Centre emphasises the need to recognise people's strengths and aims to utilise these in a group setting. Diversity in ability and experience can create opportunities for learners to support one another. The Centre aims to foster a group dynamic where the learners look out for such opportunities.

When one person is very down on themselves, saying 'well I'm hopeless at this,' they're very good at saying, 'yes but you're really good at something else.'

She suggests that technology is particularly good as a 'leveller', in offering opportunities for learners to learn together and to help each other without any fear of feeling inadequate: technology changes so quickly that new skills must constantly be acquired.

### Supporting learners to overcome barriers to learning

The tutor states that most if not all of the learners in the numeracy class have some degree of anxiety about numeracy or maths, even if they appear competent in their everyday maths practices. She believes that in most cases this is due to negative experiences in school and attached to a sense of inadequacy there. However, she makes the point that she cannot say whether this anxiety is more exaggerated than the anxiety learners of reading and writing exhibit.

She believes the Centre's incorporation of induction themes enables new groups to have a settling-in time which helps learners to feel comfortable and safe in the learning environment. It also stresses the importance of acknowledging common anxieties within the group. At the start of the course the group discusses their hopes and fears surrounding the course and a record of these are made. At the end of the course the group revisits these to see what hopes have been met and if their fears have dissipated.

### Preparing resources

When planning her lessons, the tutor ensures she uses a variety of resources, so that learners can benefit from repetition but through different media. She will develop or reinforce a concept or skills by employing a mix of resources, including paper-based materials, computer programmes, the internet and touch screen technology. The tutor makes sure to plan a variety of materials and activities for the different levels within the group.

## Approaches to teaching

### Style of teaching

The tutor feels that she identifies most closely with the facilitative approach to teaching. In other words, the tutor's role is to provide a positive learning environment with materials and resources, and then to support learners to take responsibility for their own learning. In situations where learners have returned to learning of their own volition, they are often very motivated and can be supported quite effectively to become independent learners. She describes this as 'putting learning in the learners' hands.'

### New teaching ideas and approaches

The tutor finds materials and ideas by meeting with and talking to colleagues, and by exploring resources that the Centre already has. The Centre's Resource Worker is an excellent support for tutors looking for materials and ideas. The tutor also spends time researching online, and gathering useful everyday materials. The tutor has found in-service FETAC training provided by KWETB very useful. She also finds [www.writeon.ie](http://www.writeon.ie) useful for providing examples of ways to cover learning outcomes required of FETAC qualifications. She finds workshops at NALA and other conferences valuable. The in-service training held in the Centre this year on the use of iPads in literacy and numeracy teaching was very valuable.

The tutor feels comfortable trying new methods with her learners, so long as she believes they are justified by the needs of the individuals. She recognises, for example, that some of her learners are stimulated by using technology and so facilitates this wherever possible, to introduce or consolidate concepts. She gives an example of how a student used technology to record her progress. The learner was reluctant to write in a learning journal. The group discussed what they wished to record in the learning journal and notes of this were made on the board. The learner then took a photograph of the notes on her mobile phone. The tutor was more than happy to adapt to this preferred method of recording.

Another example she provides involves a learner who was more familiar with the Arabic alphabet and numerals than those used commonly in Ireland. She had difficulty writing the numbers. The tutor used a Nintendo DS Brain Training maths game with her. The learner had to do a mental calculation and then write the number answer on the screen with a stylus. The number had to be written accurately for the game to recognise it as the correct answer. The learner enjoyed practising her accuracy in forming numbers using this method.



### **The use of questioning**

The tutor tries to use questioning selectively where appropriate. It would obviously be counter-productive to put a student on the spot with direct questioning. She tends to ask open questions of the group so that anyone who feels able to could suggest an answer. Quite often she leaves a pause in an explanation in the hope that learners might fill it for her. She believes that this approach keeps the atmosphere in the class easy-going and non-threatening.

She believes that the atmosphere of the group, and the bond that develops between the learners, encourages them to feel comfortable asking questions when they do not understand something. The tutor is aware that learners often ask questions of one another, especially when she is busy with another person. This is to be encouraged provided learners do not become 'too helpful' with each other, offering answers before another learner has had an opportunity to find their own solution.

### **Using problem-based learning**

The tutor appreciates the value of problem-based learning for checking learners' ability to apply skills and concepts. She tends to teach the general topic or concept first and provide skills exercises for practice and to ensure the security of the skills, then introduces problems for the learners to solve by applying the skills and concepts. She uses a mixture of problem types: those with an answer that can be selected from a list, such as a multiple choice question; and those without any answers to choose from. She would tend to use problems with a choice of answers with learners at lower levels. She also uses problems with open answers (those with a number of possible correct answers) with some concepts such as estimation.

### **Using context effectively**

The tutor understands that the contexts for the numeracy she teaches are the learners' lives and the situations they want to be able to use numeracy in, whether it is to be able to help their children with homework, or another area of their life they are having difficulty in. Fundamentally for the tutor, the scenario needs to be familiar. If she provides a context she aims to use a relevant one, such as budgeting a shopping trip or holiday, where numeracy will arise. She has used photographs from the Maths Eyes website to generate discussions about situations where maths arises in day to day life.

I begin with the scenario, and draw from this the numeracy which I encourage learners to practice in isolation (for example, decimal points). When the learners have practised the skills I have them put it back into the original context but change it slightly: if I have started with paying for a meal in a restaurant, I might change it to a budgeting for a wedding.

If a learner can use a concept in a number of different contexts then the tutor knows that the learner has learned successfully.

### **Using technology in the classroom**

The tutor uses technology to complement, extend and blend her teaching of numeracy. She feels that technology can also be a tool for engaging learners' interest, especially younger learners. The technology she uses includes computers, iPads and the learners' own smartphones if they have them. She also uses calculators. She has used PowerPoint presentations to help learners to visualise concepts. She finds the iPads help learners to get to grips with concepts in a multisensory way. They can use their hands and manipulate numbers and shapes.

The course includes an introduction to using the calculator and specific skills work around using the calculator. However, often in problem based exercises it is left up to the learner whether they wish to use it or not. Some learners prefer to perform calculations in their heads or on paper. Learners should be able to use the technology that would be available to them in an everyday situation, such as the calculator on a smartphone that many of them have but do not make full use of. The tutor feels that it can be a problem to find suitable online numeracy materials and websites specifically designed for adults.

## **Teaching strategies for specific topics**

### **Place value and sequencing numbers**

To introduce the concepts of sequencing numbers and place value the tutor found the suggestions in the indicative content of the FETAC Level 2 Co. Wicklow VEC Module Descriptor for the Working with Numbers component particularly useful, it involves asking learners to suggest numbers between 1 and 100, and writing these on the board. The learners are then asked to order the numbers they have chosen from lowest to highest or vice versa. When focusing on place value, three digits are written on the board, and the learners are asked to identify the largest number they could make from this set of numbers, then the smallest.

### **Odd and even numbers**

To introduce the idea of even numbers being numbers where each digit had 'a pair', the tutor used a PowerPoint presentation showing pairs of items, and exploring the situations where items come in pairs.

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<sup>3</sup><http://www.haveyougotmathseyes.com/resources/>

She used the Street View feature of Google Maps to show learners how odd and even house numbers are found on opposite sides of the street.

### **Time**

The tutor used the Maths Eyes photograph collection<sup>3</sup> to introduce the concept of time, using the image of the airport arrivals and departure board. A variety of real life materials were then used to enable learners to identify the different formats for showing time, such as calendars, timetables, TV listings.

### **Accreditation**

The tutor supports learners towards assessment by preparing them in plenty of time and ensuring that they feel comfortable with the form of assessment. She gives an example of the FETAC Level 2 Quantity and Number assessment requirements that needed a minimum of five tasks (to cover the necessary learning objectives). The learners understood the format of the assessment and were able to practise similar formats of tests beforehand. Her general opinion is that accreditation is positive for learners: it is evidence of their progress, which they can use to reassure themselves that they are indeed learning.

## **Evaluation**

The tutor has only taught one year of the numeracy programme but still feels able to identify some important successes and challenges. She feels that the technology available at the Centre lends itself well to use in numeracy classes. The learners appeared to take to the iPads particularly well, possibly because they felt they were learning to use a piece of equipment that is widely used nowadays. She feels that numeracy websites, including [www.writeon.ie](http://www.writeon.ie), are useful as a way of practising and consolidating concepts.

Each learner has her or his own learning journal for each course that they are undertaking in the Centre. The journal is a record of what the learner has learned, how they learned it, how effectively, and what they would like to learn next. For variety the tutor sometimes encourages learners to use the iPads to complete a learning journal entry, then email what they have typed. The Centre also undertakes end-of-term reviews, in order to identify how learners are getting on and what they are finding difficult. These reviews enable the tutor to make changes to the programme or to plan to support learners in different ways.

The tutor is hoping to undertake some more NALA/WIT and other professional development and to attend any events or workshops that are available on the topic of numeracy. She finds the in-service training provided by KWETB to be very valuable. She would like to make contact with other tutors who have been using iPads to teach numeracy to exchange ideas.



# Case study 3: Newbridge Youth Training and Development Centre, Kildare and Wicklow Education and Training Board

## Background

Newbridge Youth Training and Development Centre opened in 1989 to provide training and development opportunities for young people to help them access employment or further training. All of the young people left school at Junior Secondary Level and most without a Junior Certificate qualification.

The Centre follows the Youthreach Programme, which provides a person-centred learning experience to address each trainee's needs. It includes support for trainees to develop their numeracy and literacy capabilities. During the programme all trainees work towards national certification in a range of vocational and personal development subjects. The Centre is an accredited FETAC centre, with trainees working mostly towards NFQ Levels 3 and 4.

### Integrating numeracy across other subjects

The following are some examples of how numeracy has been integrated into curriculum areas, and made practical and visual:

- The engineering instructor noticed that trainees often talked about inches and yards but were uncertain about centimetres and metres, so he now asks new trainees to make a metal metre rule in the engineering workshop, and to mark off millimetres and centimetres.
- Again in engineering, the trainees have to make a bench. They plan the construction and also measure materials and cost them. The introduction of money into the activity makes it very real for the trainees.
- In the past trainees have made solar and wind energy machines, learning about energy costs and possible savings.
- In ceramics, trainees make a colour wheel, dividing a circle into fractions (for example, thirds for the three primary colours).
- Again in ceramics, the trainees make 10cm by 10cm clay squares. They measure the squares again after firing to identify the amount of shrinkage in the clay. They write about their findings and calculate the percentage reduction.

This case study highlights how the Centre supports trainees' maths development (alongside their literacy and personal development). The tutor has access to resources that developed by FÁS for teaching numeracy to trainees. It also illustrates how the tutor integrates the use of 'real world maths' and adopts a culture of 'openness' to support maths learning among trainees. The aim of the Newbridge Centre is to support trainees' numeracy development, alongside their literacy and personal development.

## **The tutor**

The numeracy tutor, Annemarie O'Neill, is an experienced tutor who teaches pottery and numeracy at the Centre. She thinks that the two subjects compliment each other as the different perspective and contexts in which she teaches help show the trainees that numeracy is relevant and applicable in all areas of their learning. Before coming to Newbridge, she worked as a mathematics teacher for the Irish Wheelchair Association teaching mathematics to people with disabilities, some of whom had missed out on quite a lot of their education in the formal education system. She has also taught English as a foreign language up to first level certificate to children and adults in Portugal and Italy. Annemarie participates in continuing professional development including numeracy events and workshops organised by NALA.

## **The tutor's understanding of numeracy**

The tutor defines numeracy as 'using mathematics in everyday contexts'. For her mathematics is a very broad concept and is in everything we do with numbers in daily life. She believes that mathematics is a rational subject, saying 'there are always reasons for using maths.' However, she often struggles to convince her learners of this. Almost every trainee she has taught has had some form of 'maths anxiety' and they have questioned the relevance of mathematics to their everyday lives. This can be problematic as mathematics is one of the compulsory subjects at NFQ Levels 3 and 4 at the Centre. As much as she can she shows trainees the use of mathematics in everyday contexts.

## **Preparation and planning**

### **Identifying learners goals and levels**

Many of the trainees come to the Centre with Junior Certificate Foundation Level mathematics. However, the tutor has found that she often has to return to teaching the basics of Level 3 with them before introducing them to NFQ Level 4 mathematics. It is her opinion that many of the trainees would struggle with NFQ Level 4 due to the 'huge gaps' in their grasp and understanding of Level 3 mathematics. So, she starts with a

comprehensive 'grounding' of Level 3 before moving them on. This can be a delicate process and is often met with resistance on behalf of the trainees. So she has devised what she refers to as a 'sneaky test' to assess where they are at. It contains very basic questions on addition, subtraction multiplication and division, decimals and percentages. She sells it by calling it revision to 're-familiarise' themselves with what they covered at school. It requires a lot of 'wheeling and dealing' and it works better on an individual basis or in small groups. Once they are engaged in the process and after some delicate negotiation the majority of the trainees tend to agree that they will benefit from 're-taking' Level 3 again.

### **Working with groups**

The tutor describes how different trainees are at different levels - some are flying through the work while others struggle with basic concepts. As a result and whenever is practicable, she works with each learner individually to assess where they are at and identify any difficulties they have. It's like 'operating a one to one system in a group of eight or ten trainees.'

### **Breaking down barriers to learning maths**

The tutor explains that the trainees she teaches tend to 'close down' when they hear the word 'maths.' They appear to think of mathematics as being text-based, done in 'the classroom,' and not at all practical. Most of all, trainees appear to consider mathematics as being irrelevant to their lives and to their learning. In spite of these attitudes, the tutor is determined to demonstrate to trainees that they do use mathematics in their everyday lives. They simply do not perceive it as such, and oftentimes this is due to a lack confidence in their abilities. It is the tutor's belief that at some stage in their educational background someone has conveyed the message that they are not very good at mathematics and that this label has stuck.

The tutor believes that providing 'real world' examples of using mathematics helps reinforce the use of numeracy in everyday situations. She recalls how students will say things like 'maths is stupid, I don't see the need for it and I'll never use it again once I leave here'. She believes this attitude relates back to how the trainees were taught mathematics in the past, especially in relation to topics such as fractions and algebra.

Language and terminology can also be problematic for the trainees, unless they can be applied to real life situations. The tutor ensures that she uses mathematical language to teach different mathematical concepts and then takes the time to point out to the trainees when they are putting a concept into practice, in other words when they are using mathematics. She believes it is vitally important that the trainees understand when they are using mathematics and what mathematics they are using.

## Preparing resources

Numeracy courses at the Newbridge Centre are planned using especially designed FÁS materials. The starting point of the learning is using standard FÁS workbooks which are worked on in the classroom. However, there are occasions when she deviates from these and incorporates other teaching methods, including using mathematics in real life situations. She usually does this to reinforce a point or to introduce a new concept to the trainees. She has also developed her own workbook that records new learning that takes place in the classroom. She uses this workbook to refer to for inspiration.

Resources and new ideas for teaching are discussed at the monthly staff meetings. This provides staff with an opportunity to share ideas, comment on and access each other's resources. Management encourage this culture of openness and sharing.

However, it is the tutor's belief that there is a need for numeracy tutors working in the ETBs to find ways to share ideas, particularly around the introduction and use of new technologies in the classroom. She feels that the annual NALA numeracy conference is a great way to network with other practitioners and to find out what they are doing. The tutor presented a workshop on the Centre's Maths Strategy at the 2012 Numeracy Conference. This experience allowed her to demonstrate her work to other practitioners. It also allowed her the chance to reflect on where she can make improvements to her own teaching approach. For example, following the conference the Newbridge Centre 'revamped' one of its numeracy workbooks to include more visuals and colour to make it easier for the learners to work with and understand. This was a valuable learning opportunity that might otherwise not have happened.

## Approach to teaching

### Teaching style

A typical day in the classroom begins with the trainees working from their workbooks. They begin by learning 'place value' and move on to the number line, natural numbers and integers. This is where terminology can be problematic for some of the trainees: 'what knocks them is the words, language can be a big barrier.' When this happens the tutor does the computation, explains what she is doing and why, and then introduces them to the words. She says, 'I do things the other way round' so as not to 'lose' the trainee. As the work increases in difficulty, if the trainees encounter a problem they usually ask a question. The tutor helps them work through the mathematical problem their way and address any other difficulties, if and as they arise.



The tutor describes her style of teaching as practical and responsive – responding to what happens on the day. While she follows the set curriculum, she takes the opportunity to relate everyday experience to learning and endeavours never to miss a teachable moment when it arises. This is not the case in every class but she tries to exploit an opportunity when it comes along.

### **Taking advantage of teachable moments**

The tutor gives an example of how one of the trainees had a very minor car accident on his way to the Centre. ‘I knew immediately that the whole class would be taken up with the telling of the accident’, so she devised a way to put the accident ‘to good use.’

I started by asking the trainee what speed he was driving at? What is the speed limit on that stretch of road? Was he over the speed limit? By how much? Is the car insured? Will he be making an insurance claim? Will this increase his insurance payment? By how much? Could he get a better deal?

She involved the rest of the class in the calculations and soon they were engrossed in the calculations. The tutor describes this as ‘a golden moment and they were working on their maths without even realising it.’

She acknowledged that she would not run every class this way, but she feels that this was a suitable response to a particular situation and that the end justified the means. Otherwise the class would have been lost discussing ‘the accident’ but by employing ‘this tactic’ a lot of work was done with ‘a huge amount of maths work involved.’ She feels that this approach of blending real life situations with more traditional learning methods motivates the learners to improve their maths skills, helps them identify how they learn best and helps her identify the effectiveness of different teaching methods.

## **Teaching strategies for specific topics**

### **Money**

The tutor will refer to the FÁS materials when teaching the trainees about money.

However, if necessary she will use real world examples to ensure the lesson is understood. One exercise is to ‘give’ trainees €1,000 to invest over three years. They go online to look up interest rates and investment deals in different financial institutions and find out where they can get the best return on their investment over the time period. Sometimes they play Monopoly in class and this is a ‘big hit’ with trainees: ‘they’d play every day if I’d let them’.

The tutor also provided an example of using a real life learning situations that worked against her and the learner. She describes how a trainee wanted to leave class early and she felt it was important that he stay and continue learning. She had him calculate how much money he would lose by doing so. The trainee calculated how much he earns a week, then how much he earns a day and finally how much he earns an hour. Upon realising how little money he would lose by leaving an hour early he decided he'd leave two hours earlier instead.

**Time**

The tutor uses the FÁS materials to teach time in the classroom. However, she will also use real world example to illustrate to trainees how mathematics is used in this context.

For example I'll say to them what time did you get up at this morning, they'll say 8 o'clock and I'll say to them why did you get up at 8 – because I have to be here by 9. I have to have breakfast get washed and dressed and travel here. I then have them calculate how much travel time they have to get to the Centre, how much time is spent on each of the other activities and then I say to them 'ok now you see how you mathematics work in your everyday life' and the argument is over.

**Ratio**

The tutor describes how along with using the required materials to teach mathematical concepts, she incorporates real world examples into the lesson plan. This ensures that trainees fully understand the mathematical concepts they are working on. For example, she uses playing the Lotto as one way to teach ratio and algebra. The trainees have to calculate the winnings for a syndicate of eight people. This task requires simple division but it also requires the trainees to calculate how much each gets if two of the members put in twice as much as the others and if three of the syndicate only puts in half the amount of the other members. She finds this works really well as it is relatable to a real world experience and 'ratio' becomes a real thing and not just a word used in maths class.

She also integrates numeracy into the pottery class by having trainees calculate the ratio of water to powder for each stage of the glazing process.

**Measurement and shape**

The tutor explains how she is constantly shocked and surprised by the number of trainees who do not know how to use a measuring tape. The problem lies in their inability to 'use' the tape, to hold it properly or to know that the measurement starts at 0 and not at 1. The trainees learn and apply their knowledge of measurement and scale in practical ways in the class. For example, they will do a scale drawing of a living room and furnish the room

with a couch, a circular table, a square rug and so on. To bring paper based learning to life, the tutor will instruct the trainees to go online and get precise measurements and sizes for the different pieces of furniture.

She teaches Geometry by having the trainees 'dismantle' a large table that is in the classroom. The table is then separated into different parts and the trainees are able to identify that when the table is extended it becomes a rectangular shape as opposed to its original square shape and that when two of the smaller pieces were put together they make a circle. For the tutor this brings the learning off the page and into life. She also gets them to measure the length and breadth of a desk. As a once off practical exercise she took them outside and using a 'surveyor's wheel' measured the distance from the Newbridge Centre to the town centre and back again. Along the way they also measured the distance between manholes and lampposts. The tutor recalls how it was a 'great learning adventure' for those involved.

### **Using technology in the classroom**

The tutor encourages trainees to use the web as part of their learning experience.

However, they only have one laptop to use in the numeracy class and this is problematic as demand far exceeds supply. She does however have access to an interactive white board and finds this an effective way to motivate trainees to learn. Trainees usually respond positively to the introduction of technology in the classroom and the interactive whiteboard is very effective in this regard. She encourages trainees to 'play' maths games for example, finding their way out of a maze. The interactiveness of the game allows the whole class to participate at the same time and guide the individual trainee out of the maze using an online map.

### **Using calculators**

The tutor is reluctant to allow the use of calculators at the start of the course. It is her experience that the trainees can become too reliant on calculators. This means they can lose the ability to calculate simple sums and will rely on the answer the calculator gives them whether or not it's the right answer. She believes that the use of calculators 'weakens' their ability to estimate, calculate and work sums 'out in their head'.

### **Accreditation**

The minimum requirement for the trainees is that they achieve accreditation at NFQ Level 3. The trainees in her class are working towards accreditation in major awards at Level 3. The majority are working towards accreditation in Employability Skills while a smaller number are working toward an Engineering qualification. Once Level 3 is achieved she actively encourages her learners to move towards accreditation at Level 4.

## Evaluation

Each week, the class tutors evaluates how trainees are doing. There is case conferencing at monthly staff meetings. Here staff discuss the strengths, weaknesses and progression of each trainee. Trainees' case workers discuss with trainees any areas of weakness and what help they need to address this. For example if an individual is 'falling behind' in maths the other tutors, for example the IT tutor, will reinforce the application of maths in their classroom. The trainees' progression is monitored through their work folders and workbook and anyone falling behind is identified early on and offered additional help.

# Case study 4: South Tipperary Adult Learning Scheme, Tipperary Education and Training Board

## Background

The Tipperary ETB Adult Learning Scheme has a central base in Clonmel and five other permanent centres across South Tipperary. The five centres are in Tipperary Town, Cashel, Cahir, Killenaule and Carrick-on-Suir. This case study was researched before VECs were amalgamated, which is why in places it refers to South Tipperary. The Adult Learning Scheme works with adults who want to learn new basic skills or brush up on old ones. The workplace education programme tries to bridge gaps in education and encourages individuals to operate successfully both at a societal and economic level. It also helps Government to meet its learning targets and employers to meet European standards of productivity and competitiveness.

The Adult Literacy Organiser and the Resource worker with responsibility for workplace learning work with local employers, set up work-based learning provision which usually comprises information technology (IT), maths and communications. This case study focuses on the numeracy teaching of one of the ETB's tutors, making particular reference to a programme he delivered for general operatives at South Tipperary Local Authority. The case study examines the tutor's reflective approach to teaching numeracy and describes some of the general and topic-specific strategies he employed in supporting learners to learn. Among other strategies, he describes how he taught the general operatives to hold, manipulate and apply measuring tools, in the way that a literacy tutor might teach a literacy learner to hold a pen.

## The tutor

The tutor, Pat Hoban, works for Tipperary ETB. He is a basic education tutor working with core literacy groups, teaching numeracy, communications and IT. His tutoring is needs-based and he works with learners from FETAC levels one to three. Many of his learners want to get back into the workplace. More and more learners are asking for accreditation. He also contributes to the design of tutor training within the ETB.

## The tutor's understanding of numeracy

The tutor thinks of 'numeracy' in practical terms. He suggests that 'numeracy-based practices' are non-abstract and grounded in everyday tasks: 'off the paper rather than on the paper'. He provides an example of a person measuring out a room before decorating it, suggesting that to measure the room mathematically would be to do so very precisely, with tools, and to record the measurements accurately on paper; however, a numeracy-based approach might involve, rather than taking out measuring tapes and being 'mathematically correct', a person 'stepping-out' the length and width of the room, based on the fact that an approximation is acceptable in some circumstances.

He suggests that a numeracy approach involves an acceptance that the real world is 'messy' and requires predictions, approximations, judgments and a range of ways of making those judgments. Furthermore, he believes that many numeracy practices exist only in the practical and cannot be theorised: they hold value only within the context for which they are being used (for example, the strategies you would use to remember a phone number).

## Preparation and planning

### Identifying learners' goals and levels

Each learner's goals and level are identified at an initial assessment, which is usually carried out by the ETB's Adult Literacy Organiser, or the Workplace Co-ordinator, if the programme is in a workplace. The assessment provides detailed information for the tutor about what each learner's needs and interests are, how they prefer to learn and possibly information about their past experiences of education. The tutor always allows for the fact that it is often hard for learners to know what their goals are when they come onto a course. He believes that learners' nerves about starting the course, and gaps in their understanding about the possible course content, mean that they might struggle to identify concrete goals early on. He stresses the importance of ongoing review of learning and reassessment of learning goals which, while never neat, is important in keeping learners motivated. The tutor is also aware that learners have 'spiky profiles', which means they are strong in some areas and have gaps in others.

## Working with groups

### Facilitating a group of learners working at different levels and on different topics

The tutor employs a range of strategies, tailored to each group he works with. He aims to identify a common interest among group members and build projects around that interest.

For example, he created projects for different groups. One of his groups was interested in decorating and designing the layout of a room; another group were interested in online shopping. He developed group projects for both of these themes. He uses negotiation during the process of creating projects. To accommodate different levels of capability within a group, he often encourages learners to work in smaller groups of similar ability working on different aspects of a problem, so that they all feel they contribute to the whole. A possible downside of this is that sometimes one learner will lead the problem solving task, and take over to the detriment of the others.

### **Supporting learners overcome barriers to learning**

The tutor supports learners to overcome initial 'maths anxiety' by leading a discussion around the cultural and social influences on maths and numeracy, including the influence that school has had on learners' perceptions of maths as a subject and on their ability to learn it.

I always tend to talk as well about my own experience. I say, by the way, I failed maths at lower secondary level, due to a number of factors – primarily poor teaching. I grew up hating and fearing the subject.

I remember when I started in adult literacy there was little or no 'numeracy' teaching. A lot of what was available was 'maths' based and there was a shortage of expertise and experience within the field. What we would call 'numeracy teaching' only began to emerge when professional development opportunities became available from the late 1990s. I only began seriously thinking about teaching numeracy after I'd completed the Level 6 Adult Numeracy Component through WIT/NALA Higher Cert in Literacy Development. I now occasionally teach that module so it's been a massive transformation for me as both learner and teacher.

He has found that being open about his own change in attitude to maths helps the learners to open up themselves; but for him that's only one part of the process. He believes that identifying the specific difficulties learners have with maths is trickier. He also sees that some of the evidence required for accreditation is very skills-based and is difficult for learners to understand in a real life context.

The tutor ensures that he uses strategies and resources that help learners to learn most effectively. If a learner appears to prefer more visual ways of learning, he will 'get stuff out in front of them', whether this means using dominoes or manipulatives such as pieces of laminated card that the learners can move about. He will show the learner pictures or ask them to draw what a problem might look like. If the learner is someone who prefers

to listen he tries to repeat what he says, and encourages the learner to work with other people and discuss the problem they are solving. If he is working with people who take more time to absorb new ideas or who have memory problems, he is careful not to go off on a tangent if a 'teachable moment' arises.

It's very easy to get side-tracked when you're teaching maths. You see something yourself on the board and you go off and tell them, 'oh, and by the way if you do it this way, it works.' You might have had the learners up to that point and then you've just lost them.

The tutor believes that his maths teaching is most effective when it is systematic. He says that this is in some ways against the grain for him, as he likes to explore topics and pick them apart creatively, but that he endeavours to follow logical steps in a planned way for the sake of his learners. He remains unsure if this is the correct approach, so relies on formative assessment to continually check learning.

### **Encouraging discussion and collaboration**

The tutor encourages discussion and collaboration from the early stages of any programme. He encourages learners to discuss their own experiences of learning mathematics in the past. As learners share their experiences, the tutor hopes that those who have had difficulty or negative experiences will realise they are 'not the only one'. He knows from research and his own experience that adults tend to be less reticent about saying they have difficulties with maths than they do with literacy or language.

To encourage learners to start talking about maths, the tutor uses a 'maths box' (which he believes can be most effectively used in a family learning context). This cardboard box contains various items, including a tape measure, a deck of cards, money, a watch, a timetable and a utility bill. He asks learners to take turns picking something out of the box. The learner then has to say what item they have picked. This activity effectively prompts learners to notice that numbers and maths are all around them, and that they already have knowledge and skills relating to numbers in their lives. If a learner chooses the watch and comments, for example, that they are unsure about the 24-hour clock, the tutor can note this down as a topic to cover in the future. The learners' discussions inspired by the maths box contribute to future planning. He suggest that this is similar to the way a tutor might introduce keyboard skills and knowledge by drawing on what learners can already do with mobile phone keypads.

The tutor also uses real-life items such as bus timetables, Lotto tickets and maps to start conversations about numbers in our everyday lives.



## Approaches to teaching and learning

### The tutor's teaching style

The tutor believes that he blends different teaching approaches depending on the situation, the learners, their purpose and the necessities of achieving evidenced outcomes. He is very conscious of the approaches he blends. He uses a behaviourist teaching style quite often, along with a constructivist approach<sup>4</sup>. He is interested in the nature of how we construct knowledge. He encourages his learners to explore processes and ideas, asking them, as he says, 'how do you think I got to that?' or 'why do you think I got that answer?' and 'if I did this, would I get it?'

He encourages the learners to ask questions and to discuss processes and ideas with him. He is also conscious of using a Freirean approach, especially with topics that deal with money and consumer or other rights. He encourages discussions about how to calculate a percentage interest rate, and also what it means in real terms, for example, asking whether or not the shopper is really getting a good deal. In this way he believes his teaching style builds on his learners' skills and their knowledge and understanding.

### New teaching ideas and approaches

The tutor is currently studying for a BA (Hons) in Teaching and Learning which is exposing him to a lot of new ideas and approaches. As part of his studies and in his everyday work practice he looks online, trawling various maths websites. In addition to the tutor's own online research, there is a lot of resource sharing among tutors and resource workers within the Adult Learning Scheme in Tipperary ETB. The ETB has its own web site which contains useful links<sup>5</sup>.

He uses a number of online resources, from interactive and assessment content found on sites such as [www.aaamath.com](http://www.aaamath.com) to instruction and tuition sites such as [patrickjmt.com](http://patrickjmt.com). He firmly believes in the value of using ICT to help learners access resources themselves to help them learn informally in and outside the classroom. He uses Jing to create video tutorials that he can share with learners to enable this. In addition, he uses Google docs, apps and even the drawing tools in MS Word. He says that 'Resources are everywhere - we just have to take time to think about how to use them effectively.'

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<sup>4</sup>Behaviourism emphasises the acquisition and memorising of knowledge, often through repetition. Constructivism places emphasis on learning rather than teaching, preferring hands on, collaborative, reflective learning activities. Find out more: <http://arrow.dit.ie/cgi/viewcontent.cgi?article=1003&context=engscheleart>.

<sup>5</sup><http://www.southtippals.com/>

**Opportunities for using innovative teaching ideas and approaches**

The tutor believes that taking opportunities to use innovative ideas and approaches can be problematic. He offers the example of Vedic maths<sup>6</sup>.

I thought, Wow, this is good. This could be really useful for students with difficulty with certain concepts like multiplication. But what I found difficult was to take the pile of stuff you get online and try and pick bits out of it and see where it fits.

He suggests that another example of this difficulty is the 'lattice method' of multiplication.

I thought, this is ground breaking - this is brilliant, and then I introduce it and people say, ah, I prefer the old way. It's too new or it's got complexities that they have to get around. I think with children this would work very well, but when you bring this stuff in with adults, there's a whole heap of unlearning that has to take place and I think that's where sometimes the idea is better than the actual application of it.

I think the real challenge for numeracy teachers is to embed that stuff into your practice seamlessly. And that takes a lot of work and a lot of buy-in by the learners as well.

**Taking risks with innovative or unfamiliar teaching ideas, approaches and resources**

The tutor is wary of taking risks with learners. He believes that when learners start off in basic education the tutor is making a promise to support them to overcome previous negative experiences with learning maths. He is concerned that trying innovative strategies and taking risks with new ways of teaching might alienate some learners and believes the key is to take new ideas slowly. He does, however, feel more confident taking risks when he is training numeracy tutors who are likely to be open to new ideas.

**Taking advantage of 'teachable moments'**

In the same way that the tutor is wary of using new or unfamiliar strategies or resources with learners, he is wary of going off on tangents when there are opportunities to bring in another topic. For example, if he is showing learners how to convert a percentage into a decimal, he might be tempted to reinforce the multiplication of decimals by 100. For some learners this might be a useful revision, while for others he believes this might be a distraction from the process they are trying to focus on, as if, 'you were in the groove then suddenly the record skipped.' He believes that practice of teaching and reflection leads almost to an intuition of when to keep going or when to stop and reinforce previous learning.

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<sup>6</sup><http://www.vedicmaths.org/introduction/what-is-vedic-mathematics>

## General teaching strategies

### Questions and questioning

The tutor uses questioning in a variety of ways depending on the topic, the learners and what he needs the learners to know, understand or do. Most of his questions check for understanding.

Sometimes, and especially with groups who appear less engaged, he will check for understanding while writing on the board, by asking more closed, lower level questions that demand learners to respond, for example: So, if I add two hundred, that gives me - and then he waits for the answer. He is aware that this could seem 'schooly', but he finds it a useful method of formative assessment, checking all the time that all the learners are following.

While learners are engaged in individual or small group work, and before or during a task, he will go around asking questions that encourage the learners to think through the task, and to make predictions about results. His questions include: 'what is this going to look like when you have done that?' and 'is it going to be a big number?' He also challenges learners to think through their plans for tackling a particular problem, with questions such as: 'how are going to do that?', 'what will you do first?', 'are you sure about that?' and 'have you another way of doing this?'

The answers to these questions give him an understanding of what the learners are thinking and how they are applying their learning. He also believes that by asking these types of questions he is beginning to shape how the learners should question themselves as they tackle similar problems in the future. Once learners have solved a problem or completed a calculation he will ask them to explain the process they have used, to ensure they fully understand their own thinking and processes.

### The use of problem-based learning

The tutor negotiates projects with learners. The projects tend to involve open problems which themselves contain smaller problems or tasks to be solved. An example of an open problem that he guided his learners through was the building of a wooden gate. There wasn't a design to work to. The learners designed and built it from scratch, solving problems on the way. Another problem that the tutor used with his learners was the design of a circular paving area. The proportions, the design and the look of the pavement were all down to the learners.

He believes that while closed problems can offer a sense of neatness for learners and for the tutor, open problems are more interesting for everyone and better reflect real-life. He also believes that open problems allow for 'discovery learning' and that the learners find out about themselves as learners. Therefore, the tutor rarely plans these projects in detail. He thinks that problems should be practical and should lead to a tangible product. This makes the learning more real for the learners.

**The use of contexts in the learning**

The tutor feels that the context is the starting point in his sessions. The problems are where all the learning starts from and where it is applied. He calls the context 'the vehicle or conduit for teaching and for learning.' He believes that the context provides immediate application.

He has struggled with some topics, such as algebra, to find an authentic context or application for the learning, but has often found that problems are inauthentic and 'fake'. His response to this is to deconstruct the topic as far as possible and introduce aspects of it throughout a range of topics, using the language of the topic whenever he can. Sometimes, though, where assessment evidence is required, he realises that some aspects of topics will need to be taught in the abstract which he feels in some ways is to 'pull the carpet out from under the learners'.

**Using technology in the classroom**

The tutor aims to get his learners on computers and on the internet as much as possible. He lets learners use the calculator on the computer and shows them interactive calculation games on the [www.aaamath.com](http://www.aaamath.com) site. He believes it is important that learners should know the different symbols used for calculations in computer applications - and even in the calculator on most computers. The symbol for divide is the 'slash' and for multiplication it's the star.

He uses Microsoft Word for creating graphs, squared paper (that can be printed) and for drawing shapes. He also uses it to create scaled line and shape drawings that can then be printed to scale.

## Strategies for teaching particular topics

### Numbers, including fractions, decimals and percentages

The tutor tries to enable his learners to visualise numbers and uses number lines for teaching everything from negative numbers to fractions. He uses a thin length of wood with Velcro attached to it. Learners can stick various numbers in correct sequences on the wood. This moveable resource helps learners to understand counting left to right. He attaches markings and numbers to the Velcro to create a differently marked line each time. He believes that 'manipulative' resources like this enable learners to understand processes, by moving numbers around themselves.

He supported learners through an assessment for FETAC Level 3 maths which involved the number line. He attached decimal numbers to the line but with gaps for the learners to fill in, using a similar approach to a cloze exercise in literacy. He recognises that he could use the number line for fractions and percentages as well. He believes that many of his learners have a fear of fractions, so he approaches them by covering decimals and percentages first, then moving on to fractions as another way of writing both of these. He then has learners look at all three together.

One strategy for teaching fractions that the tutor has used is the old imperial ruler, which divides inches into fractional parts. He would only use this with learners who were used to the imperial system of measurement. Then, he uses the ruler to show them that if you add a quarter-inch to another quarter you get a half, and so on.

He also used pie charts to teach fractions. The learners undertook a data-collection project using simple questionnaires. They then transferred the data onto a pie chart. If 10 out of 20 people were of one opinion then the learners could see that this was half. Six out of 10 people would be about two-thirds. The pie-chart functioned as the pizza or cake that is often used to show fractions.

### Algebra

Before teaching algebra, the tutor struggled to find 'real' contexts and applications to make the learning real for the learners. He used the language of algebra in advance of looking at equations, introducing the idea of the variable and the constant.

In the absence of a non-artificial context, he used manipulatives - cut-out numbers and symbols on pieces of card. He and the learners could move these around on the table.

I'd start putting the cards out in front of them, and ask them to put the Xs together, and the Ys together. We'd look at the symbols then as well, and how they change when they move from one place to another.

He started this with very simple equations with only one variable. Once the learners were comfortable with the language and solving simple equations using the manipulatives, he moved them on to pen and paper. He left the topic until the end of the programme, and in retrospect wishes he had introduced elements such as the concept of the missing number, X, much earlier. This would have helped him bring the concepts into a number of topics.

### **Measuring and drawing lines and angles**

As the learners were designing the gate and the crazy-paving, the tutor noticed that not all of them were correctly holding tools such as rulers and compasses. At times they weren't able to draw straight lines because the ruler would slip; at other times he would see them measuring a piece of wood not along the edge but somewhere through the middle of the piece, risking inaccuracy.

He describes how he teaches learners to use tools effectively:

I let them play with the item first of all. I might throw out a few protractors and say, 'how do we use this thing?' I let them work away in pairs or threes and I let them see if they could figure out how to make a 90-degree angle, which is an easy thing to start off with. I get them to look around the classroom, because there are squares everywhere. I then get them to think about the protractor and getting a 90-degree angle. Then I'd ask, 'what would half of 90 be?' and 'where would we get a 45-degree angle?'. Then we talk about how we use the protractor. They might have a little bit of knowledge but quite often they were never actually shown how to actually use the protractor, or what the protractor is.

With the ruler, they might not have it straight or know that you hold the ruler with the thumb down on the desk, steady.

Another important aspect of using tools is clear space. Because it won't work if you don't have room to draw your line, if you're cramped against the person beside you, or if you've a notebook on top of what you're trying to do, or you're drawing a line across one of the holes in your pad.

Using a compass is interesting. The learners hadn't held a compass in years. I had to make sure that they knew to put it down so that it wasn't going to move.

And pencils need to be topped. The finely topped pencil is just so important when drawing any kind of a geometrical shape.

The tutor is fascinated by how learners learn to draw lines and shapes. He says that, 'A lot of us do calculations, draw lines, write down amounts or enter data as a means in itself and might not hang success on what the result actually looks like in an aesthetic or formal sense.' Through studying art history and aesthetics he has come to value the importance of the aesthetic experience.

When we draw a line we are not just engaging in a geometric exercise regarding shape, distance, or direction; we are making our mark on a page, we are creating something, we are 'drawing'. Ultimately this is a creative endeavour and reflects something about what we see as having value. The efforts we put into drawing a shape for example speaks volumes not only about our understanding of the geometric patterns we recreate but more fundamentally the result can be a reflection of the awareness of our own creativity and identity. This is the affective domain of learning at work in the maths classroom.

### **Understanding shapes**

The tutor taught shapes using everyday objects such as food packets and cardboard toilet rolls. He listened to the language that the learners were using and corrected mistakes or misconceptions. For example, many learners were referring to cuboids as 'cubes'. He noticed that learners seemed to learn more if they could handle shapes, rather than looking at them in pictures. Another strategy was to use nets, asking learners to cut them out and make a shape. Sometimes he would give them a cube shape and ask them to draw the net that would recreate the shape as a problem-solving task.

### **Accreditation**

The tutor often uses photographs to record evidence for learners' assessments. A typical photographed assessment might involve the number line and a learner having to place a decimal number in the right place on the number line. The photographs will show the line before and after. If he is involved in the assessment tasks, he asks a learner in the group to take the photographs. He favours photographs over learners' written work because his learners often have literacy difficulties or mental health difficulties. He finds a photograph is often less intrusive.



## Evaluation

A successful aspect of the programme is the high level of learner engagement. The tutor puts this down to the programme's practical and contextualised project work: designing and building a gate; designing paving; and creating a scale drawing of a football pitch. These practical elements made conceptual and potentially-more-abstract learning relevant and tangible. The tutor was inspired by the learners' creativity as well, as they put thought and imagination into their designs. He joked that he wished he had video-recorded the entire course!

At times, in small group or paired activities, certain individuals tended to dominate a little. The tutor recognises that this was probably because they were more confident in terms of the actual woodworking or their maths. The others then tended to sit back. The tutor tried to address this by negotiating specific tasks and objectives for individuals in the small groups.

The tutor formally records learners' progress at the end of a course. During the course he regularly asks questions of individuals while they're involved in tasks, to ensure they are learning. He sometimes records what they say. Following the project to design and build a gate he video-recorded himself interviewing two learners about their learning which provided a useful evaluative record, as well as being a useful process for the learners to reflect on their own learning. One of the learners said that he had learnt about the metric system, while the other said he had learnt a lot from the other learners. All the learners' comments were positive but the tutor is not sure how he could quantify these outcomes in terms of concrete 'numeracy' learning.

The tutor believes that he is learning all the time and that the key to developing his professional knowledge and skills is reflection. This has been reinforced during his study for his BA (Hons) in Teaching and Learning. He also states the importance of conversations with other tutors, as means of exchanging ideas and finding new resources. Ultimately, for him, real learning comes from doing: from experience that he can then reflect on.

You've got to have a debate with yourself after every class and you've got to talk to yourself about how important what you've done is, and how does it fit in with your philosophy of teaching. You've got to have that philosophy of teaching. You constantly need to question the validity of what you're doing.



# Case study 5: Tallaght Probation Project Service Provision

## Background

The Tallaght Probation Project (TPP) is a five day week NFQ Level 3 educational programme for 18-35 year olds leading to further training, education or employment. Participants receive an ETB (formerly FÁS) allowance. There are group based intervention programmes designed to meet the presenting need of the individual. These include:

- Crime awareness
- Drug misuse
- Anger awareness
- Alcohol awareness
- Dual diagnosis

The service offers a high level of 1:1 support to engage people, promote continued participation and facilitate progression to appropriate options. Educational provision is provided on a flexible basis five days a week. Programmes start at an accessible level and offer core skills in literacy, numeracy, computers and a broad range of NFQ accredited elective modules. The project offers a variety of services to meet the needs of the young people and to support their progression to mainstream education, training and employment. This case study examines how [www.writeon.ie](http://www.writeon.ie) is used as part of a blended learning approach in the classroom.

## The tutor

Kieran McGuire is an Educational Resource Person with the Young Person's Project at the Tallaght Probation Project. This is a part time position providing fifteen contact hours. He has a degree in Modern English Literature and Ancient Greek, an MA in Linguistics. Before coming to the TPP he worked in the Kylemore Community Training Centre in Ballyfermot Dublin where he set up a literacy programme for young adults and was involved in teaching Junior and Leaving Certificate subjects. He has also taught in a VTOS programme in Sallynoggin and has worked as an Education Officer in the Barge Project Clondalkin where he coordinated the Leaving Cert Applied for young people under 25 who had been in contact with the criminal justice system. He is currently engaged in research in Cognitive Linguistics and Literature.

**The tutor's understanding of numeracy**

The tutor defines numeracy as using maths in everyday life. He believes that daily numeracy involves using addition, subtraction, multiplication, division and other mathematical concepts in everyday situations. He encourages the learners to examine and explore what numbers are, how and when they use numbers in everyday life and in different contexts; for example, at home, in social situations and so on. When the student begins to extract the numeracy knowledge and applies it in different contexts, the tutor sees this as the successful application of what they have learned. He considers an awareness of proportionality as the beginning of mathematical thought. For students this begins with fractions and percentages where one value is in a proportional relationship with another. He believes that when the student encounters a mathematical problem, and recognises that they have the numeracy skills to solve that problem and can put the two together, then for him this is the student 'thinking mathematically.'

**Preparation and planning****Identifying learners' goals and levels.**

Young people meet their key worker first. They are given an overall assessment and from that an individual programme is developed. This is followed by a literacy and numeracy initial assessment with the tutor. The assessment helps the tutor establish the learning level of the student. It is learner focused as assessment is based on meeting the learner's learning needs.

The tutor says that many of the young people had a negative experience of formal education and that they 'arrive' at the programme with what he and the key worker have assessed as immense learning problems, personality issues and, what can be best be described as, chaotic lifestyles. The tutor goes through their experience of formal schooling in 'deep, deep detail'. Over the years a high number of their learners have been diagnosed as having dyslexia.

It has been his experience that the majority of the young people tend to overestimate their level of literacy and numeracy skills. For example, some of them have reported that they completed school to Junior Certificate Level. However, when they are assessed they have literacy and numeracy skills at NFQ Level 1.

## Working in groups

The young people use a 'pen and paper' approach when doing group work in the classroom. However, they work mainly independently on the [www.writeon.ie](http://www.writeon.ie) programme with some input from the tutor. One of the key benefits of using [www.writeon.ie](http://www.writeon.ie) is the ability to identify individual learning needs and develop individualised plans. Some of the learners at the same level choose to work in pairs. However, due to the volatile behaviour of some of the young people this is kept to a minimum.

## Approaches to teaching

### Teaching style

The tutor describes his style of teaching as 'a negotiator.' The profile of the learner is particularly important in understanding the teaching style of the tutor in the classroom. All of the young people have been through the criminal justice system and have been referred by the courts to the programme.

Because of the way the young people come to the programme, many resent being there. This means their participation in classes is an ongoing negotiation. Initially, he works on building trust and developing a relationship with the young people. However, it can be difficult to motivate them as they may have underdeveloped cognitive skills and or learning strategies.

The tutor starts off using the learning sessions by reintroducing the learners to the basics in mathematics such as addition and subtraction. He then adds in the use of multiplication and division. Once these fundamentals are established he introduces concepts such as percentages and fractions. This work is carried out at a slow pace so as to 'drill' the numbers into the learners' heads. Mathematical concepts such as algebra are the last thing he teaches, if at all, because they are a lot 'more tricky' and difficult for this group of young people to grasp.

## General teaching strategy

The tutor found that adopting a traditional approach to teaching was not the best way to engage the young people in learning numeracy. According to the tutor, he rarely gets a motivated learner and often the young people simply 'don't know how to learn.' Therefore, he has 'shopped around' to find a more blended approach that will engage the learner's interest. This is where technology has proved extremely useful. According to the tutor technology is an area that young people are familiar with and using it in the classroom

allows him to introduce learning in a non-threatening way. In this respect he says that the [www.writeon.ie](http://www.writeon.ie) programme has become a daily staple in his teaching method. Ultimately, using the [www.writeon.ie](http://www.writeon.ie) programme works better than a more traditional approach with this group of learners and is of more benefit to them and is at the core of his approach to teaching numeracy.

## Strategies for teaching particular topics

### Fractions and algebra

It is the tutor's experience that the problem with learning fractions and algebra began back in school. It is something he has tried to unravel and has had discussions with national school teachers on this issue. Part of the problem may lie in the area of linguistics and the language that is used when teaching concepts such as fractions and algebra. The jargon can be unfamiliar and 'alien' to the young people so he tries to use as many 'real life' situations as he can to explain the concepts. For example, the first step in teaching fractions is to order a pizza and divide it up to show how fractions can be used in real life situations. If there are six people eating the pizza, then the young people can see that three pieces equals half of the pizza.

Learning algebra is the area where learners require most help and according to the tutor just saying the word 'can clear a room.' The learners have a resistance to algebra and the tutor acknowledges that it can be a struggle to teach depending on the individual learner. Wherever possible he relates the concept to everyday contexts and activities. For example he explains how he uses money to explain algebra, especially the function of X and Y to the class.

When I'm teaching the concept of the missing number or X I put 'two fivers' on the table, then take one away - therefore I explain to them X is equal to the missing five euro note. I also use snooker as another example of using algebra<sup>7</sup>.

### Measurement and scale

The numeracy the young people learn is integrated into other courses in the Programme. For example, they can use what they learn in their numeracy class in their woodwork and horticultural classes. The measurement and scale concepts that are taught as part of the numeracy class are then applied in the horticultural class. The tutor makes the lesson as practical as possible using measuring tapes and cables to get the young people used to the idea of using millimetres and centimetres. The first step usually involves teaching

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<sup>7</sup>For a description of one way of teaching algebra using snooker, see the Appendix.

the young people how to properly use a measuring tape. This he describes as extremely frustrating for all involved. Some of the young people have never used a measuring tape and according to the tutor.

If there are five people measuring out a specific area, there are usually five different answers. So I designed what I describe as a life-size measuring tape to scale and literally 'walked' them through the process of 'how to measure'.

He explains that it is 'going back' to basics as the learners have to be taught how to hold a measuring tape and it can take time for them to realise that the measuring starts at 0 and not 1 on the tape.

## Using [www.writeon.ie](http://www.writeon.ie)

The NALA [www.writeon.ie](http://www.writeon.ie) site is a web-based learning resource for learners and learning content on the site is mapped to the National Framework of Qualifications of Ireland. Accreditation is available at NFQ Levels 2 and 3. [www.writeon.ie](http://www.writeon.ie) is often used by literacy and numeracy practitioners and providers as a blended learning resource, where learners are supported by centre-based tutors

The tutor uses [www.writeon.ie](http://www.writeon.ie) as a part of a blended learning approach and describes how it has proven to be a very successful learning tool in the classroom. He explains that having started at NFQ Level 1 the majority of the young people quickly move onto NFQ Level 2. At this stage he introduces the young people to the [www.writeon.ie](http://www.writeon.ie) programme. As part of the class the young people are introduced to computers and once they are comfortable using them he slowly introduces the programme by telling them 'I'll show you a programme where you can do a bit of maths.' According to the tutor, 'after they've been using it a while and realise that it's not difficult they're flying with it.' The programme is also successful in that the young people have the option of working independently or in partnership with another learner.

The technology presents learning in a way that the young people can understand and are often familiar with even in a superficial way, for example, through using their mobile phones to send texts. They are familiar with the immediacy of technology, therefore getting them to 'sit in front of a computer' is not an issue. The young people do however, tend to resist the use of the more traditional 'pen and paper' as it 'reminds' them of their school experience. Using the [www.writeon.ie](http://www.writeon.ie) programme incorporates technology into the learning, makes the learning more real to the young people and allows them to interact with the learning in a way that paper and pen does not. He gives an example of how when using pen and paper to answer a numeracy question:

One young man insisted he could not answer the question even though I knew it was well within his level. This resulted in a 'screaming match' and with student storming out of the classroom.

According to the tutor this situation exemplifies the attitude among the young people towards more traditional approaches to teaching numeracy. According to the tutor the young people do not like to use pen and paper and often feel 'defeated' by it, so using [www.writeon.ie](http://www.writeon.ie) is a new and interesting way of learning. Using [www.writeon.ie](http://www.writeon.ie) also allows them to answer questions and get an immediate score: 'it's like instant gratification, they love it.'

One key benefit to using [www.writeon.ie](http://www.writeon.ie) is the ability to diagnose individual learning needs and to quickly develop individualised learning plans. With a traditional group situation, the tutor is often forced to teach 'to the group', trying to make a designed course fit the needs of a disparate group of learners. This can be very de-motivating to learners who feel their particular needs are not being met. Because every learner has different learning needs, [www.writeon.ie](http://www.writeon.ie) allows tutors to cater to each person's needs more specifically and thereby maintain greater levels of learner motivation.

The tutor tells of how when the young people complete an exercise and get a perfect score they're elated:

This is probably one of the few times they've felt a sense of achievement in years. They particularly like using the pull and drag facility, the fact that you can click on something and 'ding, ding' numbers are coming up and that you can get through some exercises in under thirty seconds and then you're done. They think 'it's cool.'

Using [www.writeon.ie](http://www.writeon.ie) assists the learning process as the young people can see the mathematical problem in an applied, practical and visual way therefore it is very hands on and relatable.

I've seen guys coming out of here beaming, you know, after twenty minutes they're literally beaming. They ask if they can go on and do the next exercise. It's really important here, I can't emphasise how important it has been. It has changed lives here. I really mean that.

The tutor provides an example of 'the success' of using [www.writeon.ie](http://www.writeon.ie) with one of the more vulnerable young people.

When one particular lad was assessed he had a lot of problems. So I started him on writeon.ie and supported him very heavily with at least three sessions then I put him on [www.writeon.ie](http://www.writeon.ie) and immediately it clicked and he ran away with it. He left here with a General Learning Cert.

Once they start working on Level 2 and find their confidence, they are ready to contemplate going for accreditation which would have been unthinkable when they first came to the programme. The tutor has been successful in introducing and familiarising the young people with Level 2 which is the level at which the majority of leavers are at. However, moving them beyond Level 2 to Level 3 can prove to be difficult: 'sometimes, it is too much of a leap for them'.

According to the tutor since he started using [www.writeon.ie](http://www.writeon.ie) in December of 2012, the difference has been 'like night and day - it's been amazing'. He describes how apart from its benefits as a learning tool the programme can help him address and deal with behavioural issues in the classroom. He illustrates what can happen in a more traditional learning situation where a young person will 'kick off' if they think that one of their peers is getting more attention than they are. Using [www.writeon.ie](http://www.writeon.ie) can alleviate and dispel these behavioural problems as the young people work independently with assistance from the tutor on request rather than as a necessity. He concludes by stating that [www.writeon.ie](http://www.writeon.ie) has proven to be a 'very successful' programme with the young people and it moves them on in terms of their progression.

## Evaluation

When it comes to recording and evaluating the progress of the learners the Tallaght Probation Project must be 'forensic' in its approach. They are required by the criminal justice system to keep records of the progress made by the young people and the level of success they have achieved in providing them with education and training skills. According to the tutor they measure 'success' in a number of ways, for example by progressing the young people onto programmes such as Youthreach, ensuring that they stay out of 'trouble' and adhere to the conditions of their probation.

The service aims to nurture people's creativity and promote progression to further training and education and or employment in the Arts. There are also specific activities which meet the requirements of a Community Service Order which are centred on reparative projects, which benefit the community. The Service offers pre and post supports in conjunction with Prison based and Community Probation teams. This service promotes the successful transition to other suitable options.

The tutor measures success by the progression of the learners along the NFQ Levels. 'Seeing them grow in confidence...that's my goal', he concludes.



# Discussion and analysis

## Introduction

The primary aim of the research was to capture and document effective approaches in using specific numeracy teaching strategies with adults.

The case studies presented in this research, illustrating numeracy practice in the classroom, achieve this aim. Four of the five case studies feature programmes run by the ETBs. These services offer learning opportunities to adults who want to improve their general learning and/or workplace skills. The programmes provide free, inclusive, individualised tuition to adults. The programmes are designed to be flexible, adaptable and to differentiate between the different ability levels within groups.

They all offer accreditation as an option for those learners who wish to work towards a qualification. The fifth case study, The Tallaght Probation Project, provides a range of services to people referred to the programme by the criminal courts. It offers accredited education and training to 18-35 year olds which can lead to further training, education or employment. Participants receive an ETB (formerly FÁS) allowance.

## About the tutors

Analysis of the data shows a shared understanding among the tutors of numeracy as: the application or use of mathematics in ‘everyday’ situations. They stress the importance of making numeracy relevant to ‘real world’ situations that the learners can relate to. This reflects the broad consensus among numeracy tutors in NALA’s research into the numeracy training needs of numeracy tutors in Ireland (NALA, 2013) and international research into numeracy principles and practice (Oughton, 2013).

### Numeracy and ‘real world’ application

Each of the tutors elaborate on this shared understanding by suggesting that numeracy tasks can be performed using informal methods, using methods that take account of the specific context of a problem, and in supporting learners to develop a more positive relationship with mathematics and illustrating that numeracy, like literacy, can support people to engage with society. The tutors are also in broad agreement that numeracy practices need to involve critical decisions, based on the context of a particular problem and developing learners’ confidence to use numeracy in everyday contexts and situations

In developing the concept of numeracy as ‘everyday numbers’, these tutors demonstrate an understanding of numeracy that research has described as a sophisticated, complex construct that is in line with research that views numeracy as incorporating the mathematics, communication, cultural, social, emotional and personal aspects of each individual in a particular context (Maguire and O’Donoghue, 2004).

### **Numeracy language and literacy**

According to the research adults can struggle with learning mathematics and mathematical calculations, therefore they need to learn numeracy in a different way (Newmarch, 2013; Boaler, 2009). Part of this struggle can be related to the language involved in learning mathematics. The tutors in this study were aware of this struggle and looked at ways to work around this problem. As part of their daily practice, they endeavoured to provide learners with ways to understand difficult mathematical concepts, and to make connections between how what they learn in the classroom can apply to everyday situations, such as arriving to work on time and budgeting.

The tutors recognised that their learners had an emotional relationship with numeracy and maths. Adult learners’ attitudes toward mathematics are more often than not shaped by their experiences of formal schooling. Research suggests that adult learners can experience a range of emotions when taking part in a numeracy class; these can include panic, boredom and anxiety (Holloway, 2013; Macrae, 2003; Buxton, 1981). In general the tutors were aware of this ‘maths anxiety’ and were sensitive to potential emotional barriers throughout their programmes. They made room for emotions to be discussed during sessions where appropriate. They indicate that while learners demonstrate some degree of anxiety about mathematics, it is often based on past learning experiences. However, one of the tutors pointed out that she cannot say for sure that her learners’ maths anxiety is any different from their anxiety about learning literacy.

### **Assessment and accreditation**

In each of these programmes the tutors are working with learners who have received a thorough initial assessment of their likely NFQ entry Level. Assessment, in particular initial assessment, helps identify learners’ levels, their past learning experiences, their interests and their goals. These are normally carried out at the start of a programme and the records of these assessments inform the numeracy tutors’ planning and are revisited during the programme as learners’ progress is reviewed. To date there is no standardised model of initial assessment in Ireland therefore it is standard practice for schemes to adapt or adopt existing assessment models.

In these programmes accreditation is available to all learners. However, recent research by the Department of Education and Skills suggests that a very small proportion of adult learners achieve certification in Communications and Numeracy (DES, 2013). The DES draft operational guidelines also recommend that numeracy should be an integral part of the range of learning options and learners should be offered an opportunity to gain accreditation at NFQ Levels 1-3.

Accreditation is fully supported by each of the tutors in this report. However, they are keen to stress that it is part, and not all, of what their programmes offer learners. Learners' needs remain the main driver of the planning and delivery of the programmes. Even where a course is leading to a qualification, the learning programme integrates the production of evidence into broader learning delivery.

## **Practice in the classroom**

### **The use of questioning**

The tutors are conscious of how they use questioning in the classroom, and why (to encourage the learners to link their learning to 'real life' or to check understanding of particular concepts). They are also aware of the methods they use to encourage their learners to ask questions of not only them, but each other. The Louth/Meath tutor talks of learners' confidence to ask questions of him as being a sign of their comfort in the learning environment, and the Bray tutor underlines the importance of a relaxed atmosphere in her groups to facilitate questioning (and answering). The Newbridge tutor refers to her responsive approach to teaching, and describes how she leads learners through problems to encourage them to think through the possibilities and consequences, for example when one of her learners had a car accident and was thinking about an insurance claim. The Tallaght tutor is conscious of the care he needs to take in communicating with his learners, and describes his role as that of a 'negotiator'.

The importance of questioning in the teaching of mathematics is emphasised by Swan and Swain (NRDC, 2007), who identify the range of questions that teachers should employ to teach effectively; and who describe the importance of exploring the use of questioning in professional development of teachers. Black and Wiliam revisited their earlier research into assessment, *Inside the Black Box: Raising Standards Through Classroom Assessment* (1998), in a 2004 article which made recommendations for the use of questioning in the mathematics classroom, with particular reference to the need for questioning to draw learners' attention to the application of procedures in a range of contexts, where those procedures might be more or less appropriate.

**The use of problem-based learning activities**

The tutors use problem-based learning activities with their learners as part of their teaching across most topics. The Tipperary tutor calls this problem-based approach 'discovery learning', and negotiates projects for his learners that interest and challenge them with multiple sub-problems. He favours problems that involve the learners in making critical judgements, including aesthetic choices (for example, how widely to space the pickets in a gate).

The tutors use problems as contexts for the learners to develop and apply their skills, but also to demonstrate the link between the skills and the real world. Many of these problems are open-ended, with multiple possible solutions that inform decisions. The Newbridge tutor encourages her learners to explore and use information from the real world. In one scenario she asked her learners to identify savings interest rates online and to consider options for investing money with different institutions.

The problem solving activities often involve the recognition of the importance of, and the application of, common sense: these are not simply maths problems where numbers are 'crunched' and solutions found. Colleran et al. (2002) discuss the importance of the application of common sense, along with other emotional responses, in problem solving in adult basic education.

**The use of meaningful contexts**

The tutors are clear that the immediate context for the each learner is their life. They also believe that the context is the starting point for the learning (the source of what needs to be learned) and not the end application for a set of learned skills. Ultimately, once skills and understanding have been developed, they can be applied in the context that requires them. If the tutors suggest contexts for the learners to use, in order to facilitate the development of understanding and skills in a new topic, these contexts are negotiated and familiar to the learners, in order to be as meaningful as possible.

The Newbridge tutor aims to use situations that occur with her learners as immediate and useful contexts for learning. She describes a time when a learner wanted to take an afternoon off; she used the opportunity to ask him to calculate how much of his attendance allowance he would lose. The context for the calculation was immediate, relevant and meaningful.

Learners need to be able to use their skills in more than one context, however. The tutor in Bray describes the process by which she ensures that learners are secure in using their new skills: she has them apply the skills in the original context that required them and then tweaks that context bit by bit to test the application in a number of scenarios.

There is often an assumption made when discussing contexts for maths learning that the contexts needs to be 'real', or 'realistic'. However for some topics (such as algebra) tutors struggle to find realistic scenarios in which to situate problems. They risk 'faking' the context, but this does not fool the learners, and neither does it help them. Boaler (1998) challenges the assumption that a 'veneer of reality' can motivate learners, make learning relevant, and consolidate learning. She argues that instead tutors should aim to make contexts 'meaningful', suggesting that 'learners need to be able to take ownership of meaning and direct the learning into contexts that are meaningful for them, where 'real-life' factors come into play.' In other words, tutors need not strive for 'real'-sounding contexts which are meaningless. The Newbridge tutor has used the scenario of a Lotto win with her learners in order to teach ratio. This scenario may not be realistic in terms of its likelihood, but it was meaningful because they could relate to it, and it enabled them to learn the meaning of ratio. Similarly, the Tallaght tutor has used a snooker analogy to teach algebra. It is unrealistic that learners would ever use formulas while playing or scoring a game of snooker, but it was meaningful because they enjoy and understand snooker as a game, and therefore the strategy was successful.

### **The use of technology**

To varying degrees, all of the tutors integrate technology into their teaching of numeracy. Between them they use calculators, smartphones, iPads and their applications, desktop computers, the internet, the [www.writeon.ie](http://www.writeon.ie) distance learning platform, interactive whiteboards and digital cameras.

Two important points emerge from the tutors' reflections:

- the use of calculators can be problematic, in terms of learners' fear of using them to 'cheat'; and learners' over-reliance on what is, after all, just another tool. These problems are common in adult numeracy classes and prompted the writing of the Bestimation guide (NRDC, 2007) to using calculators effectively with adult numeracy learners; and
- the issue of apps and websites catering principally for children and presenting childish graphics and situations (for example, sharing out sweets)

[www.writeon.ie](http://www.writeon.ie) was used in three of the case studies, with careful management by the tutors, blended with the learning that was taking place in the classroom. The tutor in Tallaght believes that [www.writeon.ie](http://www.writeon.ie) has had a positive impact on his learners: he blends it into his teaching and has found that his learners, whom he often struggles to engage, take to it very well. They enjoy using the technology, which they are already familiar with, and get great satisfaction from the immediate feedback and the sense of progress as they complete sections.

The ways in which the tutors employ technologies fit within the four classes of approaches identified by Ginsburg (Ohio State University, 1998) for the use of technology within adult basic education. The four classes are as follows:

- *Technology as curriculum*, where technology skills are among the planned and achieved learning outcomes, for example in Louth/Meath and Bray, where learners develop skill using iPads, or in Tipperary, where the learners have learned to use calculators effectively
- *Technology as delivery mechanism*, where learners engage with a learning system (in this case [www.writeon.ie](http://www.writeon.ie)) that meets them at an appropriate level and allows them to learn, practise and be assessed on the skills and understanding they acquire
- *Technology as complement to instruction*, where technology is used to allow learners to practise or extend their learning, and
- *Technology as instructional tool*, where the technology is used among the tutor's range of teaching methods, for example in Bray and Newbridge where the tutors use an interactive whiteboard.

### **Strategies for teaching topics**

The strategies that the tutors use to teach particular topics evidence a mix of 'tried-and-tested', or traditional methods of teaching concepts (such as cutting up a pizza to show fractions), and more creative methods of describing, demonstrating and practising topics. These include the Tipperary tutor's use of a number stick to which learners can attach velcro'd numbers; the Bray tutor's use of Google's Streetview to teach that house numbers usually use odd numbers on one side of the street and even on the other; the Newbridge tutor's dismantling of a table to demonstrate shape; and the Louth/Meath tutor's use of iPad apps to teach time.

These creative strategies have been found to be effective by the tutors who have used them, and add to our knowledge of the range of ideas for delivering particular topics, such as those described by the Maths4Life project in their range of topic-based booklets. The strategies supplement existing knowledge as well. The Tipperary case study describes how the tutor has taught learners to hold and manipulate measuring equipment, and there appears to be little existing research in this area.

The Louth/Meath, Tallaght and Tipperary tutors have experienced challenges in teaching algebra. Learners have expressed anxiety about the topic and the tutors have struggled to find non-artificial contexts for teaching it. Manly and Ginsburg (2010) suggest that an effective strategy is to integrate algebraic thinking and language into other topics throughout a learning programme (National Institute for Literacy, 2010). Interestingly, tutors in Louth/Meath and Tipperary have come to this conclusion themselves and have endeavoured to make the learning meaningful for learners through clear explanations and

steady development through their programmes; the Tallaght tutor has used a meaningful, if not so 'realistic', analogy for algebra in a game of snooker. Boaler (2009) supports striving for meaning rather than the 'veneer of reality,' and these tutors' approach would appear to chime with that aspiration.

Strategies for teaching individual topics that are described in the case studies are collated in the Appendix.

### **Reflective practice**

The data from the case studies show that the tutors are able to reflect critically and in detail about their role in the learning environment. Their descriptions of their teaching styles demonstrate a clear awareness of the importance of mixing and adapting approaches according to the needs of the learners they are working with. Their approaches to numeracy teaching are in line with the facilitative, responsive and adaptive approaches of literacy tutors.

In their descriptions of their practice, the tutors demonstrate a keen desire to reflect on their teaching, and a real interest in their learners and how they are learning. Their commitment to developing as professionals is evidenced in their efforts to record and evaluate their programmes, and to improve their own practice. The Louth/Meath, Bray and Newbridge tutors both describe the positive impact of professional development and reading of research on their practice; and the Tipperary tutor talks passionately about the all-encompassing importance of continuous critical reflection in his practice.

### **Final word**

This report illustrates numeracy practice with a focus on the delivery of learning and teaching on a day-to-day basis. It is intended to be a resource to tutors working in the area of adult numeracy in Ireland, providing ideas and inspiration about teaching ideas, learning activities and resources.

The research will inform the continuing profession development workshops and seminars that NALA offers to adult numeracy practitioners. It is also intended to be of interest to a wider audience including learners, practitioners, managers and policy makers.





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# Appendix

## Teaching strategies and learning activities

The following teaching strategies and learning activities are taken from the case studies. We present them here for the benefit of readers who are seeking inspiration on how to teach particular topics. Tutors found these strategies and activities effective in their work with learners. To understand the contexts in which the tutor uses them, we recommend that you read the relevant case study.

Topic	Teaching strategy and/or learning activity	Taken from case study
<b>Ordering whole numbers, decimals and fractions</b>	<p>The Tipperary tutor uses number lines to help his learners visualise the order of numbers, from negative numbers to fractions and decimals. He uses a thin length of wood with Velcro attached to it. Learners can attach various cut-out numbers to the stick in the correct order. This moveable resource can help learners to understand counting left to right and also up/down. The tutor attaches markings and numbers to the Velcro to create a different number line each time. He believes that 'manipulative' resources like this enable learners to understand processes, if they can move numbers around themselves.</p> <p>An assessment for FETAC level 3 maths that he supported learners through involved the number line. He attached decimal numbers to the line but with gaps for the learners to fill in, using a similar approach to a cloze exercise in literacy.</p>	Tipperary
	<p>The Bray tutor asks learners to suggest numbers between 1 and 100, and writes these on an interactive white board. She then asks the learners to order the numbers they have chosen, saying which is the smallest and which is the largest, and in what order the numbers in between should go.</p>	Bray

Topic	Teaching strategy and/or learning activity	Taken from case study
<b>Ordering whole numbers, decimals and fractions</b>	<p>When she is focusing on place value and on larger numbers, the Bray tutor writes three digits on the board and asks the learners to identify the largest number they could make from this set of numbers, and the smallest.</p> <p>She then provides sheets with numbers on and gaps for the learners to fill in. She uses these to check that individuals have understood the concept of place value and ordering.</p>	Bray
<b>Odd and even numbers</b>	The Bray tutor asks learners to suggest numbers between 1 and 100, and writes these on an interactive white board. She then asks the learners to order the numbers they have chosen, saying which is the smallest and which is the largest, and in what order the numbers in between should go.	Bray
<b>Fractions</b>	<p>The Tipperary tutor uses the imperial ruler, which divides inches into fractional parts, with learners who are used to the imperial system of measurement. He uses the ruler to show that if you add a quarter-inch to another quarter you get a half, and so on.</p> <p>The Tipperary tutor has also taught fractions using pie charts. The learners collected data using simple questionnaires. They then transferred the data onto a pie chart. If 10 out of 20 people were of one opinion then the learners could see that this was half. Six out of 10 people would be approximately two-thirds. The pie-chart functioned as the pizza or cake that is often used to show fractions.</p>	Tipperary
	The Tallaght tutor uses a pizza, and divides it up to show how fractions can be used in real life situations. If there are six people eating the pizza then the learners can see that three pieces equals half of the pizza.	Tallaght

Topic	Teaching strategy and/or learning activity	Taken from case study
<b>Fractions</b>	The Louth/Meath tutor often uses money and discounts to introduce the learning of percentages, with practical questions such as, 'If you buy an item with a 25% discount are you getting a bargain? If so, why?' A learner explained why it was a good deal by volunteering that 25% is the same as "a quarter off." He finds that learners can often relate to percentages - and fractions - in terms of shopping deals.	Louth/Meath
<b>Time and money</b>	The Louth/Meath tutor uses iPads to teach the time. He describes a number of free apps that are available that show clock faces which can be manipulated. The apps will pose a problem, such as: 'Show ten-past-twelve on the clock face,' and the learner will need then move the hands on the iPad screen and press a button marked 'Yes' when they believe they have done it. The clock faces can be changed to show digital time, and learners can convert between the two formats. He has found that learners learn time more quickly using the apps than using paper-based methods.	Louth/Meath
	The Bray tutor touches on the 24-hour clock when she teaches addition, by showing learners that to convert from the 12- to 24-hour clock you needed to add 12.	Bray
	The Newbridge tutor uses real world examples to illustrate mathematics is involved in time: 'I'll say to them what time did you get up at this morning, they'll say 8 o'clock and I'll say to them why did you get up at 8 – because I have to be here by 9. I have to have breakfast get washed and dressed and travel here.' She has them calculate how much time they have to get to the Centre, how much time is spent on each activity and then I say to them 'ok now do you see how you use mathematics in your everyday life.'	Newbridge

Topic	Teaching strategy and/or learning activity	Taken from case study
Time and money	<p>The Newbridge tutor 'gives' her trainees €1,000 to invest over three years. The trainees go online to look up interest rates in different financial institutions and find out where they can get the best investment deal over the time period.</p> <p>They also play Monopoly on a regular basis and this is a 'big hit' with trainees. The tutor says, they'd play every day if I'd let them.'</p>	Newbridge
	<p>The Newbridge tutor used a real-life situation to get her trainees to practise using time and money. A trainee wanted to leave early once day and the tutor asked him to calculate how much money he would lose by doing so. The trainee calculated how much he earned a week, then how much he earned a day, and finally how much he earned an hour.</p>	
Ratio	<p>The Newbridge tutor uses playing the Lotto as one way to teach ratio (and also algebra). The trainees have to calculate the winnings for a syndicate of eight people. It requires simple division but it also requires the trainees to calculate how much each gets if two of the members put in twice as much as the others and if three of the syndicate only puts in half the amount of the other members. She finds this works really well as it is relatable to a real world experience and 'ratio' becomes a real thing and not just a word used in maths class.</p>	Newbridge
Algebra	<p>The Tipperary tutor uses the language of algebra before looking at equations, introducing the idea of the variable and the constant.</p>	Tipperary

Topic	Teaching strategy and/or learning activity	Taken from case study
Algebra	<p>In the absence of a non-artificial context, he uses manipulatives - cut-out numbers and symbols on pieces of card. He and the learners can move these around on the table.</p> <p>I'd start putting the cards out in front of them, and ask them to put the Xs together and the Ys together. We'd look at the symbols then as well, and how they change when they move from one place to another.</p> <p>He starts this with simple equations with only one variable. Once the learners are comfortable with the language and solving simple equations using the manipulatives, he moves them on to pen and paper.</p>	Tipperary
	<p>The Tallaght tutor has used snooker to teach algebra.</p> <p>Dublin Institute of Technology presented on this strategy at NALA's Numeracy Seminar in 2012<sup>8</sup>. The strategy involves giving each ball a variable, for example:</p> <ul style="list-style-type: none"> <li>• Black ball is worth 7 points – we call it a (to represent the number of times it is potted in a game)</li> <li>• Pink ball is worth 6 points – and is potted b times in a game</li> <li>• Blue ball is worth 5 points – and is potted c times in a game</li> <li>• Brown ball is worth 4 points – and is potted d times in a game</li> <li>• Green ball is worth 3 points – and is potted e times in a game</li> <li>• Yellow ball is worth 2 points – and is potted f times in a game</li> <li>• Red ball is worth 1 point – and is potted g times in a game.</li> </ul>	Tallaght

<sup>8</sup>Thank you to Mark Prendergast for these instructions and example

Topic	Teaching strategy and/or learning activity	Taken from case study
<b>Algebra</b>	<p>The total possible score (S) a player can achieve in a game of snooker is therefore:</p> $S = 7a + 6b + 5c + 4d + 3e + 2f + 1g$ <p>Example: In an exhibition game between Ken Doherty and Jimmy White, Ken potted 9 reds, 8 blacks, 2 blues and 1 yellow. Jimmy potted 6 reds, 6 blacks, 1 blue, 1 pink, 1 brown and 1 green.</p> <p>The expressions for Ken's and Jimmy's scores are as follows:</p> <p>Ken's Score: <math>S = 7(8) + 6(0) + 5(2) + 4(0) + 3(0) + 2(1) + 1(9) = 77</math></p> <p>Jimmy's Score: <math>S = 7(6) + 6(1) + 5(1) + 4(1) + 3(1) + 2(0) + 1(6) = 66</math></p> <p>So we can see that Ken won the game by 11 points.</p>	Tallaght
<b>Measuring</b>	<p>The Tipperary tutor has noticed that his learners often have difficulty holding and using measuring equipment. At times they appear unable to draw straight lines because the ruler slips; at others he sees them measuring a piece of wood not along the edge but somewhere through the middle of the piece, risking inaccuracy.</p>	Tipperary



Topic	Teaching strategy and/or learning activity	Taken from case study
Measuring	<p>He describes how he teaches learners to use tools effectively:</p> <p>I let them play with the item first of all. I might throw out a few protractors and say, 'How do we use this thing?' I let them work away in pairs or threes and I see could they figure out how to make a 90-degree angle, which is an easy thing to start off with. I get them to look around the classroom, because there are squares everywhere. I then get them to think about the protractor and getting a 90-degree angle. Then I'd ask, 'What would half of 90 be?' and 'Where would we get a 45-degree angle?'. Then we talk about how we use the protractor. They might have a little bit of knowledge f but quite often they were never actually shown how to use the protractor, or what the protractor is.</p> <p>With the ruler, they might not have it straight or know that you hold the ruler with the thumb down on the desk, steady.</p> <p>Another important aspect of using tools is clear space. Because it won't work if you don't have room to draw your line, if you're cramped up against the person beside you, or if you've a notebook on top of what you're trying to do, or you're drawing a line across one of the holes in your pad.</p> <p>Using a compass is interesting. The learners hadn't held a compass in years. I had to make sure that they knew to put it down so that it wasn't going to move.</p> <p>And pencils need to be topped. The finely topped pencil is just so important when drawing any kind of a geometrical shape.</p>	Tipperary

Topic	Teaching strategy and/or learning activity	Taken from case study
<b>Measuring</b>	The Newbridge tutor recognises that many learners do not know how to use a measuring tape. She believes the problem lies in their inability to 'use' the tape, to hold it properly or to know that the measurement starts at 0 and not at 1. The trainees mostly learn and apply their knowledge of measurement and scale in practical ways in the class. For example, they will do a scale drawing of a living room and furnish the room with a couch, a circular table, a square rug and so on. In order to bring paper based learning to life the tutor will instruct the trainees to go online and get precise measurements and sizes for the different pieces of furniture.	Newbridge
	The Tallaght tutor recognises that many of his learners have never used a measuring tape and according to the tutor, if there are five young people measuring out a specific area, there are usually five different answers. He designed a life-size measuring tape to scale and showed them the process of measuring. He explains that it as 'going back to basics' as the learners have to be taught how to hold a measuring tape and it can take time for them to realise that the measuring starts at 0 and not 1 on the tape.	Tallaght
	The Newbridge tutor has taken her trainees outside and had them use a 'surveyor's wheel' to measure the distance from the learning centre to the town centre and back again. Along the way they also measured the distance between manholes and lampposts. The tutor recalls how it was a 'great learning adventure' for everyone involved.	Newbridge

Topic	Teaching strategy and/or learning activity	Taken from case study
<b>Understanding shapes</b>	The Tipperary tutor has taught shapes using everyday objects such as food packets and cardboard toilet rolls. He listened to the language that the learners were using and corrected mistakes or misconceptions. For example, many learners were referring to cuboids as 'cubes'. He noticed that learners seemed to learn more if they could handle shapes, rather than looking at them in pictures.	Tipperary
	The Tipperary tutor has used nets, asking learners to cut them out and make a shape. Sometimes he gives them a cube shape and asks them to draw the net that would recreate the shape as a problem-solving task.	Tipperary
	The Newbridge tutor has taught geometry by having the trainees dismantle a large table in the classroom. The table separated into different parts and the trainees were able to identify that when the table was extended it became a rectangular shape as opposed to a square and that when two smaller pieces were put together they made a circle.	Newbridge
<b>Data handling</b>	<p>The Louth/Meath tutor often asks learners to carry out surveys during project work. He gave the example of a project that investigated people's mobile phone use. Questions sought answers about mobile phone providers, networks, by how much individuals 'topped up' each month, and how many text messages they sent. These questions were supplemented with information about respondents' age and gender.</p> <p>Learners had to fill in a spreadsheet with their findings and then represent the information in different charts. The learners spend time looking critically at different options for visual representations of their data and the tutor finds that they gain a deeper understanding of the functions of different charts and graphs (for example, the different functions of a pie chart as opposed to a bar graph).</p>	Louth/Meath

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## Notes

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