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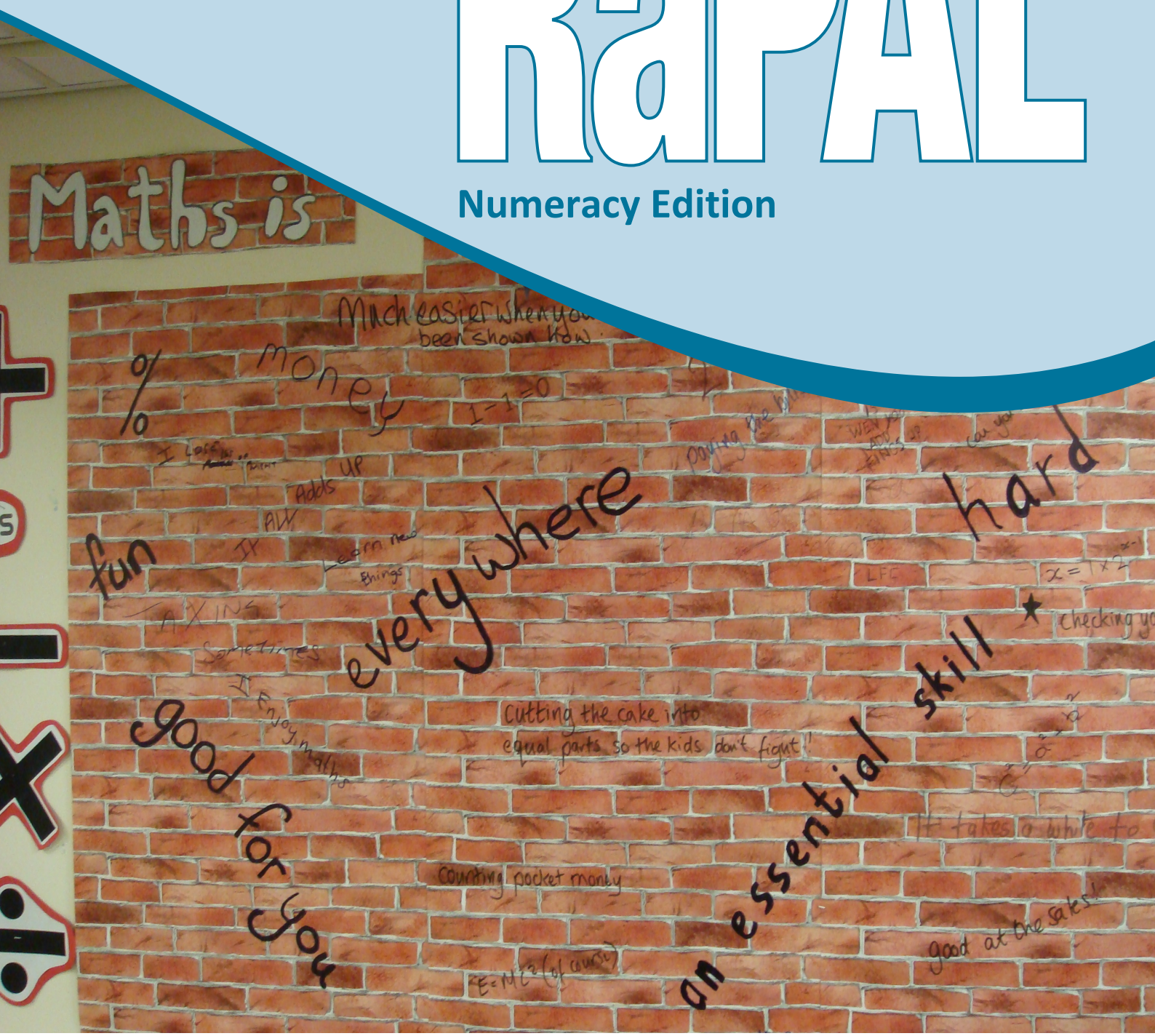
RaPAL

Numeracy Edition



Journal

The Research and Practice in Adult Literacies Network

Welcome

Research and Practice in Adult Literacies (RaPAL) is the only UK-wide organisation that focusses on the role of literacies in adult life. We promote effective and innovative practices in adult literacies teaching, learning and research; and support adult literacies practitioners and researchers. We enjoy engaging in debates that touch on English language and literacy, numeracy and digital skills across homes, communities and workplaces. Through our members, digital journals, conferences and fora, policy and advocacy work, we are active in Europe and have international links.

What we do

- Encourage collaborative and reflective research
- Publish a journal three times a year
- Create networks by organising events (including an annual conference) to contribute to national debate
- Believe in democratic practices in adult literacies
- Emphasise the importance of social context in literacies
- Critique current policy and practice where it is based on simplistic notions of literacy as skill
- Campaign for the rights of adults to have access to the full range of literacies in their lives

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Editorial Information

The editorial group for 2016-2017 includes the following researchers, practitioners and practitioner-researchers: Gwyneth Allatt, Claire Collins, Samantha Duncan, Sarah Freeman, Tara Furlong, Julie Furnivall, Sue Lownsbrough, Anne Reardon-James, Irene Schwab, Yvonne Spare, Brian Street and Rachel Stubley.

RaPAL members are involved in the compilation of the journal as editors, reviewers and referees.

We are a friendly group – open to new members and new ideas. Please contact us with any contributions (views, comments, reports and articles) and do not be put off if you are new to the field or if you have not written for a publication before. The journal is written by and for all learners, tutors/teachers and researchers who want to ask questions about this field of work. It does not matter if the questions have been asked before. We want to reflect the many voices within adult literacies work and to encourage debate.

Why not join us?

Further information can be found at our website: www.rapal.org.uk

The RaPAL Journal is also available from various subscription services: EBSCO, LMInfo and Prenax.

The RaPAL journal expresses a variety of views which do not necessarily reflect those of the editorial group. The RaPAL journal was designed by Image Printing Company, Lumsdale, Matlock, Derbyshire

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Editorial

Welcome to this edition of the RaPAL journal, which has as its focus ***Adult Numeracy as Social Practice*.**

Adult numeracy and mathematics, perhaps even more than adult literacy, is regularly the subject of a gloom-laden 'discourse of deficit' (Oughton 2007: 5). Anxieties about national rankings in international 'performance' tables (e.g. the Organisation for Economic Cooperation and Development's PIAAC rankings) inform policy makers' deliberations, and can lead to more restricted and restricting curriculum and assessment regimes. With the increasing focus (at least in England and Wales) on GCSE 'school maths' in the post-compulsory education sector, contextualised, situated and collaborative approaches to teaching maths and numeracy can seem ever more marginalised. However, as the contributors to this edition of the RaPAL journal show, researchers and practitioners continue to argue that maths and numeracy learning needs to be rooted in learners' own lives, interests and purposes.

'Top-down' approaches to maths and numeracy

In this edition, several of our contributors argue for the importance of a 'top-down' approach to maths and numeracy, starting from a real world and/or relevant context (e.g. a vocational subject) and developing the mathematical understanding and processes required to undertake meaningful tasks and solve problems. In '*Developing Numeracy in Further Education*', Graham Hall and Suzanne Slaney share insights from their numeracy work across the curriculum at Coleg Meirion-Dwyfor in North Wales. They also provide a link to their wonderful book (of the same name as their article) as a free download in English or Welsh.

In his article '*Developing Mathematics in Prison Education*', Michael Allcock presents his developing ideas for enhancing meaningful and contextualised numeracy learning at HMP Humber. Two other writers share their experiences of supporting 'top-down' or 'situated' numeracy learning in adult maths. In '*Making the Most of Measurement*', Janet Bray recounts her experiences of embedding numeracy in a horticulture workplace setting in Sheffield. She encourages all numeracy tutors to 'have a go, it's fun!' Finally, in '*Crunching the Numbers*', Sharon Murphy (who considers herself a literacy tutor) reflects on the challenge of trying to integrate numeracy learning into her classes in Co. Meath in Ireland. Sharon builds on her learners' interest in health and nutrition to incorporate the inherent maths involved.

Motivating numeracy learners

Taking a socially situated approach to mathematics teaching is likely to increase learner motivation, as it increases opportunities for collaborative and active engagement in the learning process. In his piece *'Harnessing Gaming Behaviour to Increase Resilience in Adults Learning Mathematics'* Paul Milner from National Numeracy suggests that gaming may provide a natural environment for learners to begin 'thinking like mathematicians'. Paul describes an app developed by National Numeracy which aims to engage young adults in an enjoyable game whilst building numeracy resilience. Gareth William's article *'Adult maths in college: the advantages of maturity'* considers the motivation of older adults returning to Maths in an FE college in Wales after a long break from formal learning. Gareth highlights the wealth of (particularly online) resources now available to

learners, and generously shares his own on-line (and bi-lingual) resources. He notes the added incentive for adult learners of inter-generational learning, when parents are able to help their own children with maths.

Challenges in a social practice approach to maths and numeracy

In our peer-reviewed section of the journal, Rebecca Woolley's article '*Assessment fast or slow?*' argues that a social practice approach to *teaching* maths requires a social practice approach to *assessment*, one that she calls 'connected assessment'. She critiques both the timed assessments of high stakes public accreditation (such as GCSE), and the atomised, discrete topics of continuously assessed portfolios. She suggests a new model, where learners are able to choose personally meaningful summative assessment tasks, and engage in authentic and valid mathematical assessment activities.

In our second peer-reviewed article, Mark Prendergast, Fiona Faulkner and Clare O'Hara's article *'Investigating the Impact of Literacy Skills in the Adult Mathematics Classroom'* examines the challenge of language and communication in the maths classroom. Their research with adult learners on an Access to Higher Education programme looks at how contextualising maths learning may present additional language and literacy barriers for some learners. They discuss their results data, as well as the thoughts and opinions of the learner participants themselves.

This edition also includes a *Recommended Resources* list selected by the editors, which we hope provides some inspiration and guidance for maths and numeracy practitioners, and our regular feature *'News from the Sector'*.

We hope you enjoy this edition of the RaPAL Journal!

Rachel Stubley, University of South Wales

Angela Cahill, Louth and Meath Education and Training Board

Reference

Oughton, Helen M. (2007) *Constructing the 'ideal learner': a critical discourse analysis of the adult numeracy core curriculum* University of Bolton Education: Journal Articles, Paper 15 Available at http://digitalcommons.bolton.ac.uk/ed_journals/15 (accessed 22 June 2017)

Note from the Journal Coordinator

Yvonne Spare

Yvonne can be contacted on journal@rapal.org.uk

Hello fellow RaPAL members

This our third and final edition for this year, where we have put together a collection of numeracy-based articles. This will be a chance to read about some innovative approaches to teaching numeracy.

Looking forward to later in the year, our autumn edition will be on the subject of Global Literacies, which will be our conference edition. Sadly, we will be missing Brian Street who had generously volunteered to be one of our editing team for that edition, but who passed away last week. Many of us will be familiar with him, not only as a founder member of RaPAL, but also through his work. His last article for the Journal was in our commemorative 30th anniversary edition in 2015.

The next meeting of the editorial group will be on Saturday 2nd September 2017 at UCL Institute of Education in London. During the day we make plans for next year 2017-18. This group is not just for experienced editors – we also welcome anyone who would like to gain experience by teaming up with one of our regular editors, or if you have ideas about the kind of things we could include or any other aspect of the Journals.

We feel that this face-to-face meeting is important, so we provide travel expenses and lunch for everyone. The meeting will start at 11.00 a.m. and finish around 3.00 p.m. and we hope to see as many people there as possible. If you are interested but would like to know more, please contact me on journal@rapal.org.uk for a chat at any time.

Any comments about this or other editions or ideas for future content can be sent to journal@rapal.org.uk and don't forget that most Journal editions contain articles by new writers. There are guidelines on our website on the Write for Us page and we offer as much support as you feel you need. We are also interested in hearing what you think about your Journal. There is a feedback section on the website so that you can comment on anything you have read in this or previous editions. Follow the link to our comments space at the bottom of the page, which needs the password that has been circulated with this edition. We look forward to hearing from you.

Best wishes

Yvonne

Making the Most of Measure

Janet Bray

Janet has been a Numeracy tutor since 2009 after completing her PGCE at Huddersfield University. She has worked in a variety of settings with young people aged 16 -19 with a variety of needs. Most of her current work is with small groups or individual work preparing learners for Functions Skills tests from Entry 1 to Level 2. Janet writes BTEC assignment tasks which embed tasks in vocational studies. Previous to becoming a Numeracy Tutor Janet worked as a Community Artist for many years and is a keen gardener. Janet finds her work endlessly creative and lots of fun!

Recently I have had improved opportunities to embed teaching and learning into practical courses that students are taking, working alongside vocational tutors as well as continuing to plan discrete classroom-based lessons. I have also found other qualifications, such as BTEC units, which accredit numeracy skills in the workplace and offer better opportunities for assessing numeracy skills in real life contexts.

I have found this experience both creative and rewarding, and the engagement of students has increased significantly, making all aspects of both teaching and learning considerably more enjoyable. I would like to share some of the practices which have been working particularly well.

Embedding Functional Maths and Numeracy for the Workplace in Horticulture.

I count myself very lucky in being able to work alongside horticulture staff in a working market garden. Each week I take a bag of numeracy materials on the mini-bus and join the horticulture group, working with the horticulture tutor. Throughout the day I will embed elements of the Functional Maths curriculum into student activities, working alongside students on their horticulture tasks. For example, I will use comparative language with Entry 1 learners, or weigh out orders for veggie boxes with Entry 2 learners. At the end of the session we will go to the informal classroom and consolidate the learning, writing reflections or completing paper-based worksheets to extend the learning for Functional Maths tests, for which learners will be entered when they are ready. We use the Pearson 'Skilled for Life' BTEC which contains a unit called 'Numeracy for the Workplace' at Level 1 or Entry 3, which gives lots of opportunities to write your own tasks suited to your environment.

One of my favourite skills to pass on is how to read a tape measure correctly! I was recently shopping in a local hardware shop and realised that the helpful assistant couldn't read his tape measure confidently. Suddenly I felt so proud of all the students who had worked with me to become confident in this skill. Students have repeated opportunities to measure around the site and students of all levels can be certain if they needed to read the measure in centimetres or inches. In addition, many tape measures require the skill to interpret a number pattern for counting on in hundreds and certainly reinforce that there are 100cm in a metre. Practical activities have involved students taking responsibility for cutting 22 metre lengths of fleece to cover veggies – an expensive mistake if the cut was in the wrong place, and students took responsibility for checking their reading with each other and co-operating in setting out the long lengths. By contrast, plants will be planted out according to set measurements e.g. 22cm, and getting the plant in the wrong place will result in problems later when hoeing around the rows – indeed, in the workplace environment the manager will want the plant digging out and moving – much better feedback than a red (or colour of your choice) mark on a page. These opportunities for repeated practice result in improved estimating skills and a very real experiential awareness of the difference between 22

metres and 22cm, in addition to the knowledge that 22 inches is very different to 22cm – a mistake that could result in hours of additional work to repair an error in reading the tape measure.

The work is recorded in photographs which are used as evidence in the BTEC folders. Learners enjoy annotating the photographs and this provides a great opportunity to recap learning from the previous week. They also record their work by completing tables to convert the measurements to different metric units - an essential Level 1 skill.

Recently, while placing posts for pea netting one learner commented 'Let me measure the distances, I'm a professional at this!' Needless to say, he got the job. Another student when offered the choice between working in the classroom and going out in the cold to measure said 'Let's go outside, it's more fun'

Classroom measuring activities

An alternative classroom activity involved the fictional project of designing a supermarket car park. Students have gone out to local car parks and measured the different sizes of parking space and used a box of old toy cars as inspiration to design their own car park. This tests real-life measuring skills as well as giving opportunities for developing spatial awareness and can also be extended to give practice at scale drawings. Students can be endlessly creative in designing their 'dream' car park and have always been fully engaged in the project. The question 'Could you park a Ford Fiesta in this room?' resulted in excited research on the dimensions of different cars (all given in millimetres – a perfect opportunity to practice metric conversions) and a true motivation to measure the dimensions of the room. One student was particularly proud of his finished car park design and said 'I really do think that this is one of the best things I've done' - his design is now displayed on the wall. Another student said 'I bet no one else thought of doing a Park and Ride', again showing pride in his own original design.

Measuring Skills and Assessments.

A vocational unit of assessment will enable you to write your own tasks using the opportunities around you, providing endless creative opportunities. Other tasks which I have developed for the 'Numeracy in the Workplace' units include working in our café. Learners have a task to make a sketch of the café seating area, showing all the dimensions, and designing the ideal layout of a café table with measurements such as salt and pepper pots given in millimetres. Weighing offers a similar set of opportunities and I have collected a range of weighing devices – bathroom scales, luggage scales, analogue scales with different increments … these all add variety and interest to lessons and make a considerable difference to engagement. Another popular classroom-based measuring activity has been to explore Da Vinci's 'Vitruvian Man' – after all, what teenager wouldn't be interested in finding out if they are in perfect proportion!

These measuring skills also enable progress in Functional Maths and build real confidence when solving problems which involve converting between metric units. I think it has a particular value in bridging Entry 3 to Level 1 Functional Maths and enables students to have very good access to any question involving metric units, as converting between the units becomes second nature. It also creates a context to teach decimals, and multiplying by 10, 100 and 1000. I often use place value charts to reinforce this concept and find that it also increases the learners' general sense of number and value.

Embedded numeracy activities increase engagement and interest for learners, but also make the task of planning teaching and learning more creative – have a go, it's fun!

Developing Mathematics in Prison Education

Michael Allcock

Michael Allcock is Mathematics team leader at HMP Humber and has taught maths and numeracy there for 7 years. He has taken part in the Education Training Foundation's (ETF) annual research conferences, presenting findings from a Suncett (Centre for Excellence in Teacher Training at the University of Sunderland) Research Development Fellowship (14/15) and the ETF Exploratory Research in Maths programme (15/16).

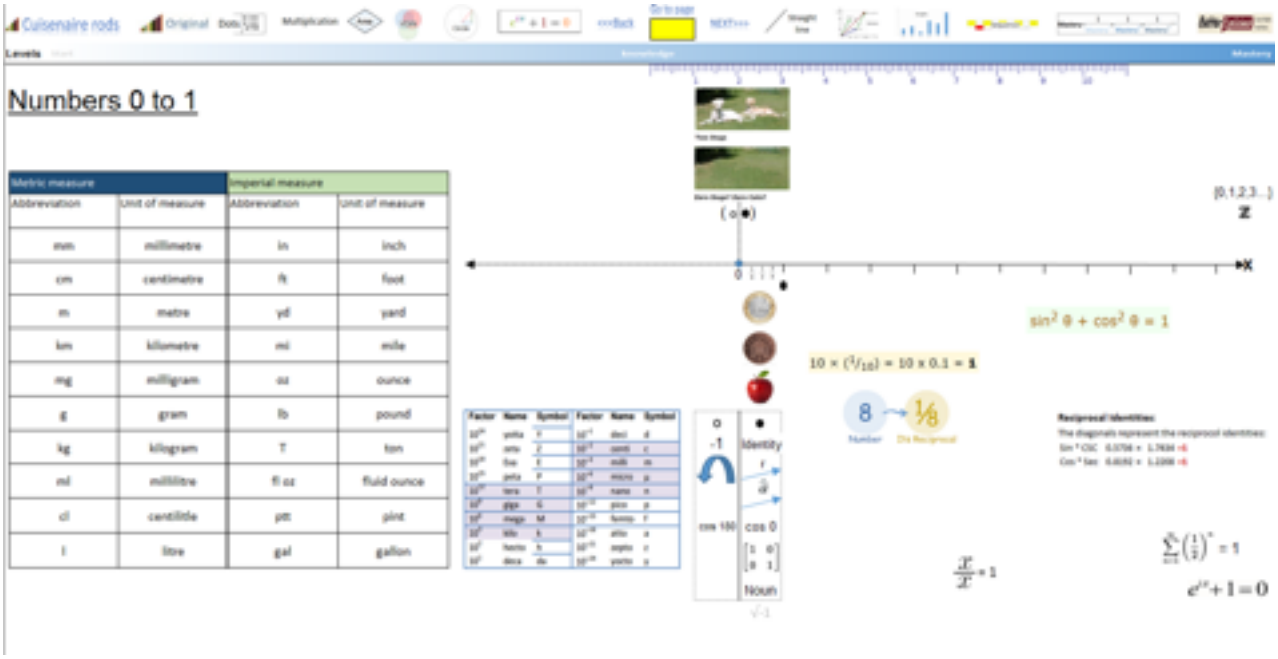
I currently work at HMP Humber, a category C male prison with an operational capacity of 1062 inmates and an average length of stay of about 12 months. Some of the inmates engage in Mathematics to improve their skills, but most see no actual benefit of education.

The journey an inmate takes into education starts with induction, which produces an assessment score (pre-entry to level 2). This score then determines if they have a need to engage in education or progress into their chosen pathway (job), for example wing cleaner. If their assessment score is below Level 1 or their job requires a Level 1 qualification, they are allocated to education. This is either a morning (8:15-11:45) or afternoon (13:30-16:45) and they must attend all week. The aim is to engage learners until they achieve Level 1 thus allowing progression to their preferred job. However, little additional support is offered outside of the classroom. I feel this classroom-based approach compounds the negative view of mathematics, which most learners already have from school.

I have decided to pilot a new approach which I have labelled as a 'top down' delivery model. First, I have introduced higher level maths courses, both GCSE and AS Level, for those who want to do maths and already understand the benefit. The idea is to have these learners act as maths mentors, who will operate both on the wing and in workshops, promoting and supporting maths. The positive impact will eventually filter through into the classrooms.

The start of this process was linked to a promotion, where people could get a calculator by completing a number of tasks. This meant that 14 wing-based mentors were able to get a calculator each. These mentors have undertaken a course on guidance and have a role to help other learners on a range of issues. The calculator will help learners calculate the total cost of extra items, such as tobacco, chocolate or biscuits, which are delivered on a weekly basis to the prison by DHL. Such activities offer a great opportunity to engage learners who would not normally attend maths classes. The mentors, who are undertaking the higher level maths, can also help with more complex maths queries on the wings as they arise. For example, level 2 learners who have chosen not to learn in a classroom could get help understanding ratios. I also intend to create greater opportunities to engage with maths for inmates who have children of school age. Being able to discuss or help with a child's homework during prison visits or by written correspondence could be a great connection or mutual bond for fathers and their children.

I will also be developing a range of resources with a firm focus on visual modelling, producing a 'link board' where images are used to link related topics and to allow links to be explored. The first example I have produced (see below) focuses on the number one and the importance it plays in a range of topics including trigonometry and vectors as well as basic number.



The link board fits the teaching approach I have chosen. This is based on a mixture of two different approaches:

- The Mastery concept, best illustrated by Singapore methodology, where no classroom streaming takes place and all learners work with the same resources. The focus is on developing understanding, rather than merely answering questions.
- The lesson study model, where tutors work together to develop resources and strategies.

I fully appreciate that this approach takes more time and is nearly impossible in a classroom only, hence the need for a whole prison approach. Time can be spent developing skills in a non-threatening environment outside the classroom, before engaging in more formal classroom-based education.

The Old Trafford visual below is an example of a resource that can be used with a range of levels, using the Mastery methodology. It could be used to calculate perimeter but can also be used to calculate arc sectors of a circle. No worksheet is produced, just a set of verbal questions, which encourage learners to carry out a range of investigations. I will also produce more complex wing-based challenges to generate discussion and allow more capable learners an opportunity to express themselves.

At the time of writing this article, I am in the early stages of the implementation of this new approach to mathematics delivery in prison. I fully appreciate that to change the mind-set of a whole prison takes time. I intend to document both positive and negative experiences, as I introduce different elements. I feel this will improve education in the long term, enabling people doing maths to enjoy it and encouraging more people to choose to engage with maths.

Adult maths in college: the advantage of maturity

Gareth M Williams

Gareth is employed by Grŵp Llandrillo Menai, which is one of the largest Further Education colleges in the UK. In his role as FE College Maths Facilitator, he supports many mature students, as individuals or small groups, who are studying towards resitting GCSE Maths. Gareth has written some interactive electronic GCSE Maths resources, specifically for resits, based on his teaching experiences: www.bitly.com/mathsfr. Mathematics is both work and a hobby to Gareth!

There are many reasons for 'mature' adults to feel upbeat about retaking their GCSE Maths nowadays. Over the past 30 years or so, changes have taken place in maths education, the exam systems and the examinations themselves, all of which tend to now favour these mature students in their endeavour to pass the GCSE in maths that eluded them in school. In my role as Maths Facilitator, I support many mature students, as individuals or small groups, who are studying towards resitting GCSE Maths. For many it is over 20 years since they last studied maths, while at school, so the experience can appear quite daunting for them. My aim is to provide them with the confidence and ability to answer exam questions and to signpost them to the many excellent resources now available to them, both electronic and in print.

It is often mentioned by these adult students, that it is the much-improved availability of resources and support they perceive as the most welcome transformation from their old school days. They often reminisce that they only had tattered textbooks to share in school. It may be suggested that the sea-change that has occurred can be directly attributed to the growth of the internet from around 1997 (see Figure 1) into the educational oracle it has become today.

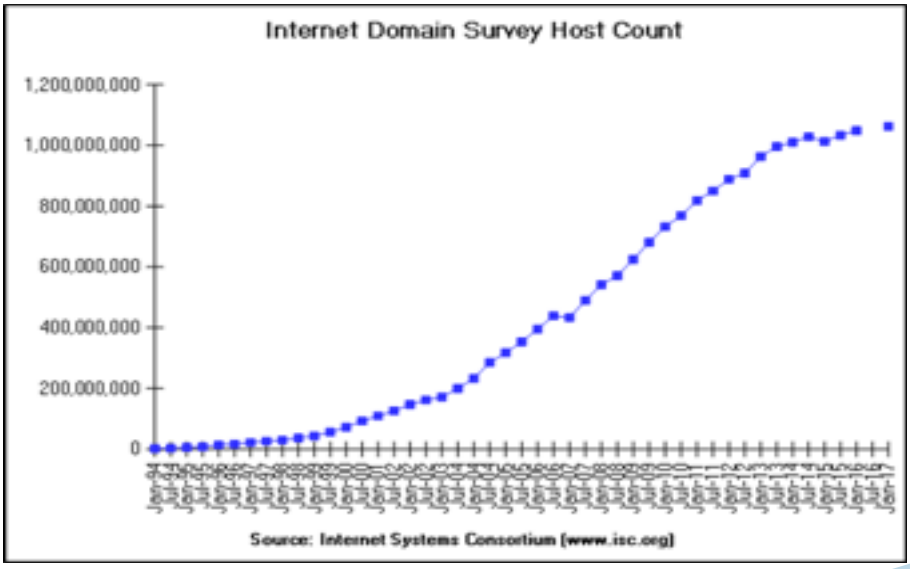


Figure 1 Internet Domain Survey Host Count (1994 – 2017)

(Internet Systems Consortium, 2017)

Consequently, adults born before around 1983, would not have had access to the immense support the internet would have provided them with, during these important years preceding their GCSE

exams in school. At best, they possibly shared a maths textbook in class, that they were maybe allowed to take home at weekend if they were fortunate.

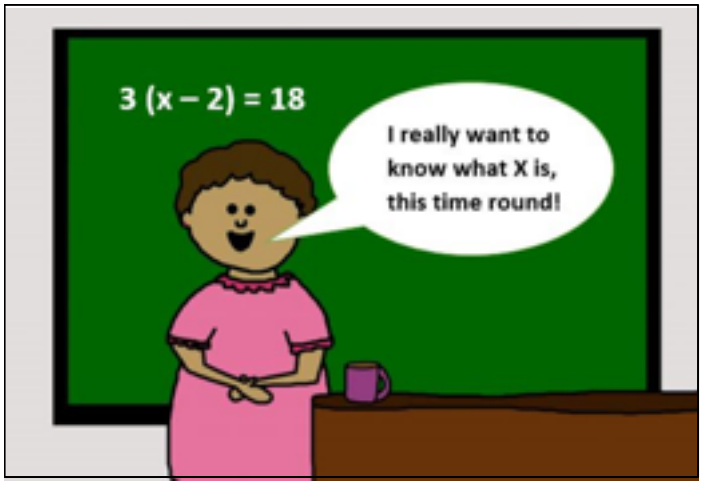
At Grŵp Llandrillo Menai (GLLM) FE college in North Wales, mature students have access to a wealth of trustworthy GCSE maths resources, including printed copies of up-to-date textbooks covering the latest WJEC (Welsh Board) GCSE syllabuses. Enrolled students also have access, while at college or at home, to electronic versions of these text books through their OpenAthens institutional subscription. Another useful resource covering the basic maths required to study for a GCSE C grade is a suite of 20 interactive bi-lingual resources (www.bitly.com/mathsfr) written by the college Maths Facilitator, produced by Heart of Worcestershire College and supported by the Welsh Assembly Government. A handy electronic 'LiveBinder' (www.bitly.com/lbmathsc) has been created as a convenient portal to access resources produced and recommended by the college's Learning Centre. The college also uses Google Classroom and Moodle VLEs to share resources with students who may have missed some lessons or who need some further guidance.

Through these electronic resources students have the opportunity to ask questions, thus enabling important dialogue between tutor and student, which is much improved from their schooldays in classes of around 30 pupils.

Students using the electronic and printed resources in the GLLM Learning Centre

There are other factors favouring the 'mature' candidates nowadays. These candidates have a real determination to pass, as they often see an immediate benefit from passing their maths or obtaining a required higher grade. They may be going on to teaching or nursing degrees where a grade B at GCSE is now almost a universal requirement. Many mature students resitting GCSE Maths at GLLM have been successful in progressing on to university nursing courses after passing their GCSE Maths exams, the gaining of this essential qualification being a catalyst to a future rewarding career.

An added incentive, is the potential for adult learners to help their own children with their maths homework/revision. Students often mention that they have been helping their children with their maths homework and find this a most satisfying by-product of their studying. This inter-generational learning can work both ways, with the adult gaining a more thorough understanding of a maths topic through explaining to their child. The mature students tend to also have a very good attitude to hard work and 'a have a go' approach which stands them in good stead when revising and tackling exam questions.



Having had more 'life experiences' adult learners are more likely to see a relevance to certain elements of the maths that they are studying, such as financial matters and numeracy around the home. On the negative side however, the mature student may have been out of education for some time and also not done much in the way of mathematical calculations for some years. There is also the 'fear factor' of maths to contend with and the negative ethos of today that it is surprisingly quite 'cool' to be poor at maths. Overall though, the balance does seem to have tipped in their favour and things bode well for these mature students retaking their GCSE Maths. Hopefully, the students can utilise all the 'positives' to generate a 'Galatea effect' where their expectation of success grows, leading to higher level of performance in the exams.

In summary, with their determination to succeed, the self-confidence obtained through the years and their aptitude to work hard, mature adults should now have a better chance of success. All these essential elements were, perhaps, lacking to some degree when they studied maths in school, thus hampering their success at the time. Today, the mature adult studying maths needs to be encouraged to seek out the enhanced help and support available, ask many questions, be confident with a 'have a go' attitude and prepare well for the exams. They must endeavour to make the most of the support from the abundance of excellent quality on-line maths resources available to them. Realisation that many things have changed in their favour since their school days, will hopefully give them that all important confidence and edge to succeed.

References

Internet Systems Consortium, 2017. *Internet Domain Survey Hosts Count* [Online] Available at: https://ftp.isc.org/www/survey/reports/2013/01/hosts.png
[Accessed 14 May 2017].

(Note: These opinions are my own and do not necessarily represent the views of my employer)

Resilience - Harnessing Gaming Behaviour to Increase Resilience in Adults Learning Mathematics

Paul Milner

Paul is the Development Manager at National Numeracy. He has overseen the creation of the National Numeracy Challenge and The Essentials Of Numeracy as well as the 'Star Dash Studios' app aimed at engaging 16 to 25 year olds in using numeracy in real situations. Paul has a maths degree and then went into management roles in the retail sector before returning to the world of mathematics.

Can computer games build resilience and support mathematical learning? Yes, they can – according to Professor Keith Devlin of Stamford University. In his book 'Mathematics education for a New Era: Video Games as a Medium for Learning', Devlin argues that 'video games' can provide a highly motivating environment for learners to interact with systems that *incorporate mathematical behaviour*.

Devlin contends that, although the great majority of people have the mental machinery required for mathematical thought, the process of mathematical reasoning is not 'natural', and requires considerable practice. He argues that the immersive and narrative-driven scenario of a game, when combined with elements such as levelling, quests and achievements can provide the motivation and foster the resilience needed to put in the required practice.

One of the strengths of Devlin's analysis is that he is a keen gamer himself, as well as being a mathematician. His understanding of how modern game design can create an immersive virtual world sits alongside a deep appreciation of *what learning mathematics is like*. For Devlin mathematics is about *doing*, not *knowing*. So, for example, the number of facts that need to be learned is small; the important thing is to be able to use these in different situations. This is what makes it possible for a game to support learning in mathematics.

The important point is that a game can provide an environment where *being a mathematician* (or more precisely the player's game character behaving like a mathematician) is a natural part of the action. In this way we can aim to get players or learners *thinking like mathematicians.*

Devlin contrasts the dedication of many teenagers to learning to master a game with the lack of enthusiasm often demonstrated by the same learners for learning mathematics. So can we design games where mathematical learning is a central and natural part of an immersive virtual world, and where learners have the resilience to engage with enthusiasm?

Devlin goes on to identify some key features of gaming:

- Risk is acceptable, and trial and error is encouraged
- Failure doesn't hurt
- Immediate feedback on performance is provided
- There is always at least one answer, and the player can always figure it out
- Competition is expected, enjoyable and non-threatening

Devlin also makes the points that having the player control an onti screen character (an 'avatar') means that there is a degree of separation between the player and any on-screen failure that occurs. This can make risk-taking more acceptable, and reduce 'maths anxiety'.

If Devlin is right, gaming provides a rich set of opportunities for developing mathematical engagement and resilience. But how do we put this theory into practice? How exactly can we harness the power of games to increase the resilience of adults learning maths? That was the question we asked ourselves at National Numeracy.

National Numeracy is a charity with a clear mission: to help improve numeracy across the UK. We work in a variety of ways. In 2014 we launched the Challenge, a website adults can use to discover what level they are working at, set targets, and find appropriate learning resources. We have 87,000 registrations so far, and are committed to developing the Challenge further.

However, although two-thirds of young people in the UK pass GCSE maths at A*-C, less than a quarter of them can demonstrate practical maths skills at the same level. Fewer than one in five 17-year-olds who retake maths GCSE after failing to get a C first time round actually succeed on their second attempt… and England is one of the few countries where on average young people *don't* do better at maths than the over-55s.

We believe that we need to try a range of different approaches to reach adults, especially young adults who after 11 or more years of traditional schooling still do not have the numeracy skills needed for daily and working life.

With support from the Ufi Trust, National Numeracy have spent the last two years designing and building a mobile app game aimed at engaging 16 to 25 year-olds. It's called 'Star Dash Studios' and is set in a film-studio. In the game, it's your first day as a runner in the studio, and you have a challenging to-do list. As you run through the various sets, you meet more experienced members of the crew, each with jobs that need your help. The action is fast and furious, the problems are highly visual and engaging, and the whole experience is served up with a large dollop of humour.

We wanted our app to show the benefits of using numeracy in real situations, including the world of work. But it is first and foremost a game, not a thinly disguised maths resource. We have made the game action as enjoyable and addictive as possible, but the best way to do well in the game is to visit members of the film-crew and help them with their chores. And to do this, you need to use numeracy skills.

On its own, 'Star Dash Studios' will not solve the numeracy issue for young adults – but we do hope that it's an example of a different approach to building the resilience that young adults need in order to engage with improving their numeracy.

'Star Dash Studios' is completely free, and it's available now to download here.

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Developing numeracy in further education

Graham Hall, Suzanne Slaney

Graham Hall has taught the numeracy components of a variety of Further Education and Higher Education courses at Coleg Meirion-Dwyfor in North Wales, particularly in the fields of Computing, Earth Science and Education. He has a Master of Education Degree specialising in mathematics education and lifelong learning.

Suzanne Slaney has taught numeracy modules on a range of vocational courses at Coleg Meirion-Dwyfor, including Construction, Business Studies, and Art and Design. She has a BA Honours Degree in Post Compulsory Education and Training, specialising in numeracy education.

Introduction

Coleg Meirion-Dwyfor is a multi-campus FE college in North Wales offering A-level, vocational and land-based courses. These are delivered at campuses in Dolgellau, Pwllheli and Glynllifon. We teach numeracy across a range of vocational areas, and have had the opportunity over several years to carry out practitioner research with our student groups.

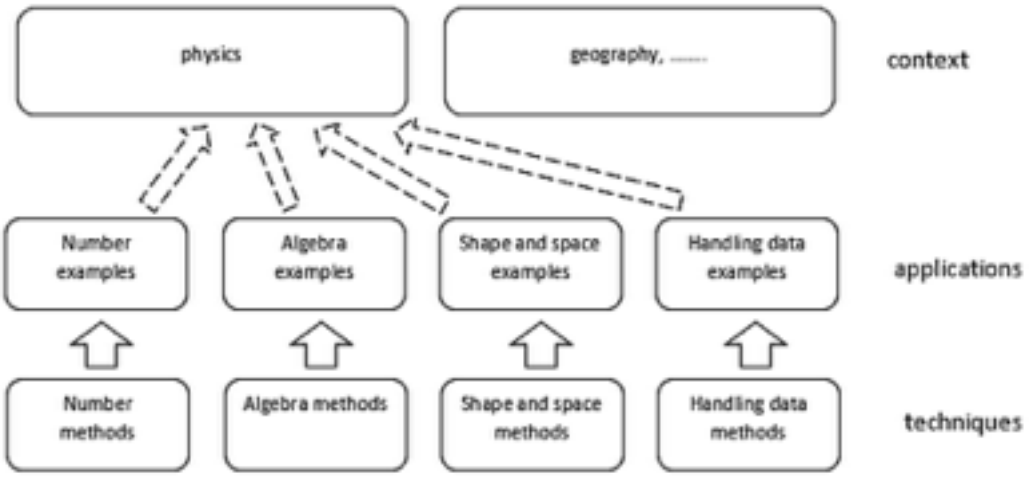
Many vocational courses in further education colleges have a significant numeracy content, and there is concern about the difficulties faced by students who failed in mathematics at school. Following a review by Wolf (2011), there has been a move away from a Key Skills award in numeracy, with the introduction of compulsory resitting of GCSE Mathematics for further education students below grade C standard. Evidence suggests that this has been an unsuccessful experiment. Bellamy (2017) found that only about 20% of her resitting mathematics students gain the required grade, and Jones (2016) found a statistically significant increase in withdrawals from vocational courses which could be linked to compulsory re-sitting of Mathematics and English. The lack of success of the current system may be attributed to poor student motivation.

The project described here is a research initiative to identify alternative, more effective, approaches for helping students to improve numeracy skills for success in their further education courses.

'Bottom up' and 'Top down' approaches to mathematics and numeracy education

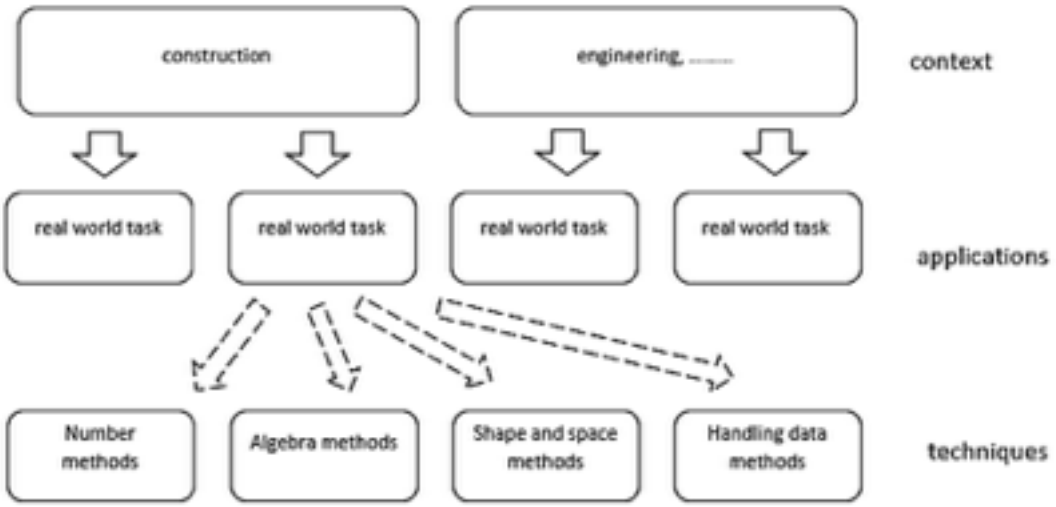
Our first objective was to identify the difficulties which school leavers were experiencing in mathematics as they began their vocational courses at college. We carried out questionnaire surveys, followed up by interviews, to determine students' attitudes towards different aspects of mathematics. We also undertook a series of 'clinical interviews' (Ginsburg, 1981) in which students were asked to explain their thought processes as they attempted to solve numeracy problems.

Students' difficulties could often be related to the structure of their previous mathematics courses. School mathematics in Britain, as in many other countries, is designed around a bottom-up academic model. Pupils learn mathematical methods within distinct topic areas such as: number, algebra and geometry, then work on example applications still within these same topic areas. The intention is that pupils will progress to study subjects at an advanced level, such as sciences, where they will be able to make use of the mathematical techniques they have learned.



This model appeared to present problems for our students who left school at the age of 16 to study a practical vocational course. They generally viewed mathematics as a series of unrelated topics, some of which had no relevance to their chosen profession. Algebra in particular was seen by many school leavers as difficult and abstract, with very little practical everyday use.

We decided to follow an alternative approach as the next stage of the project, working downwards within vocational areas to identify numeracy tasks that practitioners carry out in their everyday work. The tasks could then be analysed by the students and solved using mathematical methods. The necessary numeracy techniques might already be familiar or might need to be learned at this point. The intention was to provide learning experiences which students identified as relevant and worthwhile in their chosen fields, thereby increasing motivation.



Integrating numeracy into vocational courses

Over a period of several academic years, we experimented with the integration of numeracy activities into a range of courses including: engineering, construction, business studies, information technology, and art and design. We began by identifying realistic numeracy tasks which occur in the workplace. We adopted a broad definition of numeracy, in line with the range of numeracy skills expected and valued by employers. In addition to a knowledge of mathematical techniques, we consider numeracy to include: problem solving, especially in the design of solutions to non-routine tasks; communication of mathematical results in formats which are suitable for the intended audience and facilitate decision making; an ability to use computer technology to collect and process data; and a familiarity with number which allows appropriate levels of accuracy to be chosen, estimates made and errors detected.

We observed students undertaking the integrated numeracy activities, and carried out interviews during and after the tasks. We took a positive approach, looking for good levels of skill and motivation, but also tried to identify areas of continuing difficulty in mathematics.

Our evidence suggests that motivation in numeracy is increased by:

- solving interesting problems which are relevant to the student's course
- producing a product, either as an artefact or as a presentation or professional document
- practical measurement, or the collection of primary data through surveys
- autonomy in the specification and design of the learning activity
- working with others as a team, developing and using the special skills of each member.

Areas where students initially had most difficulty were:

- making links between different representations of a data set, for example in relating a graph or table of values to an algebraic formula
- using poorly remembered mathematical methods which had not been properly understood from first principles
- preferring to solve problems by physical measurement, rather than by mathematical reasoning, even if this involved more work
- over-reliance on calculators, and failing to carry out estimations which could identify errors in results.

We were able to specifically address these issues in the design of further integrated numeracy tasks.

Our objective was to develop numeracy activities using all three domains of our adult learning model (Hall, 2011) as shown in the diagram below:

1. **Training within a community of practice**:

   Students carried out realistic workplace tasks, often under the supervision of vocational tutors with relevant professional experience and practical skills.

2. **Formal study**:

   Practical activities were supported with classroom sessions in which we were able to discuss mathematical techniques in a context which the students found to be vocationally relevant.

3. **Learning by experience**:

   Problem solving provided an opportunity for students to gain experience in project planning, and the collection and analysis of data.

A framework proposed by Tang, Sui and Wang (2003) has been particularly successful for incorporating numeracy activities into vocational courses using this multi-component approach. Five levels of the Tang, Sui and Wang model represent a progression from applications set by the tutor, through increasing student involvement in the solution of real world problems, to totally independent project work.

Our preliminary findings from the research are that the full integration of numeracy into courses using realistic vocational activities is highly motivating, and has produced improvements in the ability of students to communicate mathematical ideas clearly and to move easily between arithmetical, algebraic and geometrical representations of sets of data. Students' critical thinking and problem solving skills have been developed.

Extending the project

After sharing the research with colleagues at training events, we found that there was interest amongst teaching staff to develop examples of good practice in integrating numeracy into vocational courses, and to contribute these as case studies for a book. The numeracy activities were not limited to simple arithmetic and tasks involving shape and space, but included more advanced topics such as statistical analysis, mathematical modelling, calculus and design of algorithms. The book has now been published in paperback format, and is also freely available at the web page:

www.grahamhall.org/FEnumeracy

Recommendations

It is recommended that a revised Key Skills qualification is introduced, to ensure that young people entering the workplace have the necessary numeracy, and also communication and ICT, skills needed for their jobs. Students would demonstrate their competence by creating a portfolio of relevant work produced during vocational courses.

The advantage of this approach is that maths and communication are being used in a practical way which will help the students when applying the same skills at work or on higher level courses. Employers have been critical of new recruits who have good maths, communication or IT skills on paper, but cannot apply these techniques to practical situations in the workplace.

The disadvantages of assessment via a portfolio of work are that it is time-consuming, works best for small groups only, and requires a lot of one-to-one discussion. Assessment can become heavily bureaucratic, with considerable tutor time and effort required to track progress.

However, based on our research and experience as practitioners, we strongly believe that the increased student motivation achieved through project work clearly outweighs any disadvantages. In addition, students gain skills in problem solving and the use of mathematics in a practical context which are highly valued by employers.

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Crunching the numbers……Incorporating elements of numeracy in the literacy classroom

Sharon Murphy

Sharon Murphy has been working in adult education for many years particularly in the area of adult literacy. A strong believer in continuing professional development, Sharon is presently pursuing a Master of Arts (MA) in Learning and Teaching through Dundalk Institute of Technology in the north east of Ireland.

Introduction

In adult basic education, literacy generally takes precedence over numeracy which can struggle to maintain its own identity within the classroom (National Adult Literacy Agency,2013). Reading and writing can be prioritised ahead of numeracy, with numeracy under-researched and underdeveloped (Corbin et al, 2007). In everyday life however, we experience numeracy, literacy and language in an integrated way rather than as separate discrete subjects. However, the teaching of language and numeracy are often treated as two separate areas of inquiry and practice (Gal, 2000) and it is difficult to imagine a situation involving numeracy that doesn't also include some aspects of literacy and language (Woolley, 2013).

During my years as an adult literacy tutor I feel that I have developed in my thinking of literacy as involving only the teaching the skills of reading and writing to appreciating that it also encompasses the capacity to read, understand and evaluate different forms of communication including spoken language, printed text and indeed digital media. However, I had recently become aware and needed to acknowledge that I still saw numeracy as a separate entity to literacy. I didn't consider myself a numeracy tutor and tended to be fearful of and consciously avoid engaging in what I would have considered to be maths or numeracy elements during my classes.

It is generally recognised that adult education should be relevant and meaningful, using contexts related to learners' lives. I decided therefore, to have a go at integrating numeracy into my lesson plans using a framework that learners could relate to, but without it being seen as a 'maths lesson'. The project below describes my efforts to do this.

In my personal life, I had recently been involved with helping a family member alter their diet having being diagnosed with type two diabetes and a heart condition. I had also embarked on a healthy eating plan myself after experiencing a couple of minor health issues. I noticed that coffee-break conversations with the learners often included similar subjects including diabetes, blood pressure, diets and weight loss (Slimming World and Weight Watchers).

I began to consider therefore, introducing 'health and nutrition' as a theme the learners might relate to both in the classroom and their personal lives.

I was working with a group of learners who were in the process of developing a portfolio to submit towards accreditation for reading at Level 2 on the Irish National Framework of Qualifications which is equivalent to Level 1 on the European Qualifications Framework for Lifelong Learning. I suggested 'health and nutrition' as a theme for the portfolio exercises and the group were happy to use this theme.

As part of their portfolio the group need to complete a selection of tasks to meet specified learning outcomes required for the reading module. Tasks included reading and interpreting recipes, sorting food items into relevant food groups/categories along with reading and understanding receipts, food labels and menus.

While working through the exercises with the group, it occurred to me that a lot of the information we were using involved some level of numeracy and it became apparent that it was impossible to examine recipes, food labels or menus without using maths or numeracy in some way. Many adult literacy tutors regard themselves as unqualified to explore discussions around numeracy with learners; however discussion by tutors and students of these views can show tutors who feel their 'technical' mathematical skills are relatively weak can nevertheless support students to develop stronger numeracy practices (NALA, 2009).

We began to talk about and examine the information contained on food labels which led to discussions on healthy eating and its impact on health and well-being. We spoke about recommended daily allowances and the number of calories that should be consumed daily. There was a lot of confusion within the group on what the numbers meant and how to interpret them. We discussed ways that this could be made easier to understand, for example 5 grams of sugar is equal to one teaspoon of sugar. Therefore, if a pot of yoghurt contains 18g of sugar there are almost 4 teaspoons of sugar in the yoghurt.

We talked about the effects of consuming more than the recommended levels of fat, salt and sugar and looked at topics such as saturated and unsaturated or good/bad fats. We examined the traffic light system for food labelling where colours are used to alert consumers to the quantities of fat, sugar and salt in products. The learners appeared to find the information both interesting and useful and commented that they would pay more attention to food labels as they shopped.

Learners were asked to bring food labels into class for the group to examine and this prompted a valuable discussion using question prompts such as:

- How many portions are in the packet?
- How much salt/sugar/fat does it contain?
- Would you consider it to be a healthy or unhealthy food?

One learner brought in the label from a packet of cupcakes and a family packet of roasted peanuts. The group helped her work out how much sugar was in each cupcake. On hearing that each cake contained 4 teaspoons of sugar she was shocked and said that she often buys these for her children who eat three or four at a time but she will be reviewing this and trying to encourage more healthy choices for her family. The group were also surprised at the high level of saturated fat in the roasted peanuts and they all agreed that as they became more aware of what was in the food, they had started to examine their choices a little closer when shopping.

By sharing food and health stories and helping each other work out the nutritional value of certain foods students were able to help one another make positive changes in their lives. The sharing of information extended beyond the reach of the literacy class and the students seemed to have an inherent ability to understand the needs of their fellow learners and share what they knew. They were engaging in both numeracy and literacy practices while also serving as 'lay health advisors' which gave them a sense of pride that in turn motivated them to continue learning during the class and sharing their knowledge with others. It is also important however for the tutor to ensure the

accuracy of the information being shared with and between learners as inaccurate information has the potential to lead to confusion or misinterpretation of data.

It was an interesting exercise for me to discover what the learners already knew about the topic of food labels and health and help them build on that knowledge. Building on the knowledge learners already have leads to more effective teaching (Swan, 2006). Engaging learners in the topic of nutrition also led them to reveal and share different recipes and methods of cooking and measuring ingredients that had been passed to them through family connections e.g. grandmother's recipe etc. and literature suggests that learners 'street' or informal maths constructed in everyday cultural practices may be stronger than their 'school' maths (Nunes et al, 1993) and tutors should try to encourage discussion of the various numeracy elements with learners.

Learners can reinterpret what they encounter within the classroom to create and instigate changes in their lives. One learner in this group stated that she had changed how she shops and cooks for her family as a result of information learned in the lessons. It is important for tutors to recognise that numeracy tasks can be performed using informal methods and by using the concept of numeracy as 'everyday numbers' tutors can demonstrate an understanding of numeracy described by research as incorporating the cultural, social, emotional and personal aspects of each individual in a particular context (Maguire and O'Donoghue, 2004)

Maguire (2003) suggests that tutors may need to 'develop their mathematical eyes', as the tutor and the students often come from very different socio-economic and life experience backgrounds, and their perception of maths in their surrounding environments tend to be different. In recognising their own everyday uses of mathematics and how this may differ from the learners' everyday uses, the tutor can attempt to find common ground which both tutor and learners can relate to in a meaningful and constructive way. This moves the view of maths from being a set of decontextualised abstract skills and formulae to seeing maths as an integral part of both the tutor and learners' lives.

There is a need for additional resources and opportunities to help tutors build confidence and cope with mathematics anxiety in the classroom. Tutors should try to recognise opportunities that present to incorporate numeracy into the literacy classroom and encourage learners to 'have a go' and try something out. This involves both tutors and learners' understanding that numeracy is not only limited to the ability to use numbers, to add, subtract, multiply or divide but encompasses the ability to use mathematical understanding to meet the demands of day-to-day living in complex social settings (PDST, 2011).

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Assessment fast or slow? Why we need a new model of '*connected assessment*' for adult numeracy

Rebecca Woolley

Rebecca Woolley is a Teacher Educator at the University of Bolton, specialising in mathematics and numeracy for the post-compulsory sector. She is a Professional Development Lead for the National Centre for Excellence in Teaching Mathematics. Rebecca is currently undertaking research for a PhD to develop and evaluate a new model of summative assessment with a group of adult numeracy learners.

In this article, I highlight the limitations of the use of 'fast assessments' such as timed tests for summative purposes in adult numeracy. I discuss how timed tests are based on a 'skills' model of numeracy acquisition that does not acknowledge the messy, open ended and collaborative nature of numerical problems outside the classroom. In addition, the widespread use of timed tests for accreditation makes achievement more difficult for those with mathematics anxiety. I suggest the need for a new model of 'slow' or 'connected' assessment that draws on numeracy as a social practice and relates summative assessment more clearly to adults' preferences, lives and purposes.

Adult numeracy learners in England often have limited choice about how and whether they are assessed. Current funding regimes encourage courses that lead to accreditation, and these are usually assessed through means of a timed test or examination such as Functional Mathematics or GCSE mathematics. I suggest that such strictly timed assessments place unwarranted emphasis on speed and I categorise them as 'fast assessments'. Such assessments are also 'fast' in that they typically consist of one-off assessment events lasting only an hour or two. In contrast, 'slow' assessment is characterised by time for reflection, choice and meeting individual needs and preferences (Gervasio et al 2015). The concept of slow assessment comes from the Slow Education Movement which opposes overuse of testing and promotes 'learning in depth, rather than a debased curriculum based on goals, inspections and unreliable standards' (Holt 2012).

Learners on non-accredited courses often build a portfolio of evidence on a continuous assessment model which can be funded through the process known as 'Recognising and Recording Progress and Achievement' (RARPA). However, this continuous assessment model can encourage the conceptualisation of numeracy as a series of disconnected 'topics' that are separately assessed on different occasions. What I propose is a new summative assessment model that would involve learners using any or all of the numeracy they have learned over a course of study. This model offers learners a choice of untimed, and therefore 'slow', assessment tasks that could take place over a series of sessions at the end of a period of study. Including choices of assessment for learners is an important facet of this model and exemplifies the idea of learners as active partners in the assessment process (National Forum 2016).

Research has shown that tutors sometimes experience a professional dilemma between the need to prepare adults to pass qualifications and to respond to them as individuals who bring their own motivations and purposes for attending numeracy classes (Ivanic et al 2006). As a teacher educator, this dilemma is part of my own practice as I see teachers and trainee teachers wrestle with this issue in our classroom discussions. Teachers do not want to limit their role to helping learners to pass numeracy tests and I, in turn, want to support teachers to improve their practice beyond a focus on better test results. It is for these reasons that I want to develop alternatives to timed tests for adult numeracy learners. There is good evidence that learners in Further Education prefer coursework and practical assessments to timed tests, and that the fear of tests can lead to learners

dropping out of education or failing to progress (Torrance and Coultas 2004, Ward and Edwards 2002). I suggest this dilemma can be partially addressed by developing a model of summative assessment that includes adults' purposes and practices. If a learner's purpose is to gain a qualification, this might involve academic, school mathematics and a timed test. For others, it could involve directly supporting their numerate practices in a job or activity outside the classroom. Swain et al (2005) remind us that learners themselves don't always want mathematics that is practical and related to their everyday lives: meaningfulness for an individual learner relates to their individual purposes and the quality of their engagement with learning.

Anxiety, speed and memory

Mathematics anxiety can compromise working memory through worries and intrusive thoughts and thus affect performance in mathematics tasks (Connors et al 2009). This is most likely to happen in anxiety-inducing situations such as high stakes timed examinations. In addition, there is some evidence that those with mathematics anxiety tend to 'sacrifice accuracy for speed' during timed examinations (Ashcraft et al 2007: 246). Unsurprisingly, research shows that people with high mathematics anxiety get lower scores on tests and are less motivated to continue to study mathematics (Hembree 1990).

I concede that taking several hours to complete a simple calculation is not going to be particularly useful in the real world. However, it is clear that timed tests place an unwarranted emphasis on speed. The assessment objectives for both GCSE mathematics and Functional mathematics make no mention of the need to achieve them within a time limit (DfE 2013, Ofqual 2011). If these objectives are the constructs we wish to measure, then a time limit is a construct irrelevant variable i.e. an element of the assessment that inadvertently tests an aspect that we do not want to measure. How often, outside an educational setting, do we need to complete calculations or solve numeracy problems under strict time pressure? This issue is particularly relevant given the negative effect a time limit can have on some people in terms of test anxiety and/or mathematics anxiety. Some learners enjoy the challenge of timed examinations and, perhaps for them, this brings out a best performance. However, this style of assessment does not allow everyone to do their best. In addition, the widespread use of time limits for mathematics examinations contributes to the commonly held belief that being good at mathematics means calculating at speed. This can lead to overemphasising speed by both teachers and learners, even though the ability to calculate quickly is just one of many aspects of learning mathematics and possibly not the most important (Boaler 2016). Consequently, some individuals decide early in their school careers that they are not good at mathematics based on 'not being fast enough' with calculations. Clearly, fast recall of facts and the ability to perform fast and accurate calculations are positive and potentially useful attributes for individuals. However, there needs to be a balance in curricula and assessment regimes in order to give learners a positive view of themselves as users of mathematics. Rethinking the widespread use of tests with arbitrary time limits might be a good start.

Numeracy as a Social Practice

There is a large body of literature commonly referred to as the 'New Literacy Studies' which suggests that literacy (and numeracy) is a social activity which cannot be disentangled from the situation in which it occurs. This view critiques government policy that conceptualises learning numeracy as the acquisition of 'skills', independent of context and value free (Street 1984, 1993). What follows from this 'skills' viewpoint is a belief that these skills can be easily measured through assessment and statistical surveys, and a tendency to see people as either 'having' or 'lacking' them. This inevitably leads to a 'deficit' model: a focus on what people *can't* do rather than on what

they can. From a social practice perspective on numeracy, it is unhelpful and inaccurate to conceive a necessarily linear progression for adults from 'basic' number work through to GCSE level mathematics. These are 'school numeracies' which reflect just one type of numeracy practice that may not be relevant for adults. A socio-cultural view would also suggest that assessment itself is a social practice and cannot be viewed as neutral (Elwood and Murphy 2015). Considering assessment in this way helps us to identify 'assessment literacies' such as: examination techniques involving understanding the allocation of marks to particular questions and the requirement to show working; knowing where to write down your answers; the need to extract information from reading the question; and working within the time limit given. Time spent acquiring these assessment literacies could arguably be better spent finding more relevant ways for adults to demonstrate what they can do using mathematics/numeracy.

A social practice view of numeracy considers the context in which numeracy is happening, and the power relations, beliefs, agendas, fears and relationships of those carrying it out (Oughton 2013). In this view, 'skills' learned in one context are not automatically transferable to another (Nunes et al 1993). The social practice model may begin to provide answers to the 'apparent contradiction between many adults being blocked in relation to mathematics in formal settings and being competent in their everyday life' (Wedege 1999: 205). Many adults do not recognise their everyday numerate practices as mathematics, and conversely, when they do successfully apply mathematics, they regard it as common sense (Wedege and Evans 2006). The unfortunate consequence is that for some adults being successful at mathematics is always out of reach; 'mathematics – that's what I cannot do' (Wedege 2002:63). This article advocates a way to 'unblock' adult learners by moving towards a model of summative assessment that more closely reflects the way mathematics is used in everyday life and helps learners 'see' the mathematics they already know and use: an 'asset' model. Such a model could reflect a social practice view of numeracy by being more clearly related to the individual purposes and interests of learners. If learners were given a choice of assessments, they could choose ones that aligned with their home literacy and numeracy practices. There may also be opportunities for learners to 'question how numbers, measurements and statistics are being used within power relations' (Ackland 2014: 17) which would also be consistent with a social practices view.

What mathematics/numeracy do we want to assess?

Every assessment has to perform 'double duty': as well as the immediate purpose intended by its creators, an assessment also communicates what mathematics is valued by those with the power to write such assessments (Boud 2000). Thus it is important that summative assessments measure what is valuable in terms of numeracy, not just what is easy to measure. Before developing new summative assessments, we need to decide what numeracy skills and knowledge are valuable. This raises the question: valuable to whom? Potential employers? The government in terms of economic performance? Providers of education in terms of examination results achieved and funding awarded? Or the individual learner for his/her own purposes?

There are differing views about what should be included in mathematics/numeracy curricula. One view is that mathematics is the performance of routine algorithms; another sees mathematics as a tool to tackle 'everyday' or 'real world' problems. The former leads to assessment of achievement with well-defined exercises, which have a single right answer, with learners inclined to think of achievement as arriving at that answer. The latter, which I would support, looks for evidence of a capacity to tackle the messy contexts which are characteristic of everyday problems: problems for which there is no right answer, and where explanation of the way the problem has been defined, and of the approach adopted, is as important as the answer itself. Such work is much more

demanding to guide, and harder to assess. Yet learners taught with this second conception of mathematics in mind achieve as well in GCSE examinations as those taught using more traditional methods. They also take more interest in the subject, are better able to see mathematics as useful in everyday life and better able to tackle unusual problems (Boaler and Selling 2017; Mansell et al 2009:14). This dichotomy of views can also be thought of as a distinction between performance and competence which mirrors the distinction between skills and social practices; skills could be said to be 'measured' by performance on a timed test but competence/practice/learning needs to be assessed in a different way, perhaps though inclusion of social practices in assessment models.

How do we want to assess?

The influence of psychometric testing on current assessment regimes is arguably still strong in the following ways: emphasising individual performance over collaboration; a preference for easily quantifiable assessment measures; the importance placed on where a learner has been ranked rather than what they have accomplished and even the idea that education can be scientifically evaluated at all (Gipps 2012).

I take a different view of assessment, one that has much in common with what has been described as 'Educational Measurement' which aims to assess individuals without reference to others and with the clear purpose of supporting future development. Wood (1986) suggests that Educational Measurement:

- deals with the individual's achievement relative to himself rather than to others
- seeks to test for competence rather than intelligence
- takes place in relatively uncontrolled conditions and so does not produce 'well-behaved' data
- looks for 'best' rather than 'typical' performances
- is most effective when rules and regulations characteristic of standardized testing are relaxed
- embodies a constructive outlook on assessment where the aim is to help rather than sentence the individual. (Wood 1986 cited in Gipps 2012:7)

The idea of aiming to capture 'best performance' is particularly appealing as one of the justifications for developing a new model of summative assessment is that so many people do not give their 'best performance' during a timed test. This approach to assessment acknowledges the complex nature of the dynamic between context, task and learner and the difficulty of generalising to other tasks or contexts. This complexity is conveniently ignored by those driving the political agenda for more rather than less testing (Gipps 2012). The idea of eliciting best performance is also an element of an approach described as the 'support model' for assessment in which one of the key measures of interest is how much help an individual needs to complete a task (Ahmed and Pollitt 2010). These approaches have potential to support the development of assessment models that reflect numeracy as a social practice with elements of collaboration and interaction between learner and assessor. For example, a project could be submitted in writing but an informal discussion between the learner and assessor could support the assessment process by allowing questioning and prompting to check understanding and elicit more detailed responses.

Maughan and Cooper (2010) discuss what makes a 'good' assessment for mathematics and they suggest features such as open-ended questions, using interesting or unusual scenarios, questions that make connections across different areas of mathematics, using real life situations, having no time limit or an extended time limit (e.g. a week). Their analysis of questions used in timed tests reveals few of these features. In fact,

> 'there was a high representation of calculating or number questions in the vast majority of assessments……a low incidence of representing, enquiring and communicating questions.' (Maughan and Cooper 2010:4).

The reason so few timed tests include open questions is that they are harder to write, take more examination time, take longer to mark and are arguably less reliable. However, assessment using open questions and extended time is likely to be a more valid way of assessing mathematics. Open-ended problem-solving potentially covering many mathematical topics and taking more than a few minutes to solve is surely closer to what we actually want our learners to demonstrate. Use of open and 'ill-defined' problems has been shown to support the development of wider numeracy skills such as effective communication of mathematical ideas and competence in data collection and estimation (Hall 2014). Furthermore, limiting mathematics learning to drill and practice - applying algorithms and carrying out calculations - is boring and is likely to turn many learners off mathematics for life, as well as leaving them unprepared for problem types they haven't seen before. It is interesting to note that some research shows that scores on a traditional mathematics test do not predict performance in tasks that involve translating real-life problems into mathematical problems (Kartal et al 2016). This implies that different skill sets are being used in each of these contexts.

Coffield and Williamson (2011) advocate basing curricula and assessment on the principles that 'knowledge, learning and understanding emerge in a social process in which people discuss, write and share ideas and expertise. They learn in the course of tackling a real problem together' (ibid: 27). This idea resonates strongly with the view of mathematics and numeracy as social practices that is the underlying theoretical framework in this article. Interestingly, Coffield and Williamson suggest that these principles are apparent in the flexible and negotiated curricula of some educational projects for excluded and disaffected young people. However, they also point out that 'the well-researched evaluations of such work rarely feed back into the practice of schools and colleges.' (ibid: 56). It seems that it is only those 'on the periphery' of formal education who are permitted to stray from the model of high stakes, timed examinations. This suggests an unacknowledged assumption that sitting such examinations is a 'normal' part of education, and alternatives are only for those who 'can't cope' with this pressure. I reject this deficit view of learners and suggest that timed tests are not an inclusive way to allow everyone to demonstrate their progress in mathematics/numeracy. There is nothing wrong with individuals who don't do well in timed examinations, it is the timed examinations themselves that are the problem. Moreover, there is a gender dimension involved in considering models of summative assessment; women and girls tend to favour collaborative, open-ended project or course work, whereas males tend to prefer a timed examination (Henningson 2008). The tendency for teachers to 'teach to the test' is well documented (for example Binkley et al 2012;) and perhaps this is inevitable to some degree. What I suggest is that tests (or alternative summative assessments) need to change so that they are *worth* teaching to, by including collaboration, promoting connections between mathematical concepts, and relating to learners' purposes and interests.

Connected assessment

I propose a model of 'connected assessment' that could be offered to adult numeracy learners as an alternative to a timed test. This model will help learners make connections between different facets of numeracy when solving problems, between numeracy and their own lives and purposes, between numeracy, literacy and the use of technology, and to make connections with other learners through collaboration and discussion.

The key features of such a model would include:

- a choice of assessment tasks
- learners developing their own assessment tasks to reflect their preferences and interests
- an extended time period for assessment to take place over several sessions/weeks
- no arbitrary time limit for individual assessment tasks
- 'open book' assessment reducing the need for memorisation
- collaboration between learners
- gathering a wide range of 'evidence' not just written work
- use of technology to support assessment.

I suggest that this model could provide a better way to assess numeracy for adults than a timed test; a more connected approach that reflects numeracy as multi-faceted, as a social practice and as a tool to support the lives and purposes of adults.

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Investigating the Impact of Literacy Skills in the Adult Mathematics Classroom

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Language, Literacy and Mathematics

Mathematics can be recognised as a language in its own right, a language which has its own vocabulary, grammar, symbols and punctuation (Ellerton & Clarkson, 1996). The teaching of mathematics, however, takes place within a spoken language, such as English (Zevenbergen, 2001). This spoken language is an essential element of the teaching and learning of the subject (Gorgorió & Planas, 2001). It is the vehicle for communication within a mathematics classroom and provides the tool for teacher-student interactions (Smith & Ennis, 1961). Language permits mathematics learners to ask and answer questions, to convey their understanding and to discuss their answers with others. It also plays a significant role in the processing of mathematical text and the interpretation of questions (Hoosain, 1991).

Changes to Second Level[1] Mathematics Education in Ireland

In September 2010, in light of a number of concerns regarding students' performance in mathematics at all levels, the Irish Government introduced a national initiative called Project Maths. This initiative was a major reform of second level mathematics education. The overall aim was to teach mathematics in a way which leads to real understanding (Department of Education and Skills (DES), 2010) and it involved changes to what students learn in mathematics, how they learn it and how they are assessed. There is increased use of problem solving and applications that enable students to relate mathematics to their everyday experiences and apply their knowledge in familiar and unfamiliar contexts (DES, 2010).

The new curriculum, which identifies five strands of mathematics (Statistics and Probability, Geometry and Trigonometry, Number, Algebra and Functions), was implemented in 2010 using a phased approach over a number of years, and the assessment in the examinations was adapted as each strand was rolled out (Prendergast et al., 2017). This adapted assessment reflects the increased prominence of problem-solving and applications in the teaching and learning of mathematics and there is a greater emphasis on reading and understanding problems. Despite emerging evidence of the positive impact of Project Maths on students' experiences of learning mathematics, concern has been expressed regarding the perceived literacy demands of the revised syllabus (Cosgrove et al., 2012; Jeffes et al., 2013; Prendergast, Faulkner & O'Hara, 2016).

Many teachers feel that students with low literacy levels and students for whom English is not a first language are struggling with comprehension of the material and the wordy nature of some of the questions:

[1] Equivalent to Key Stages 3 and 4 in the UK

> 'The language used when phrasing a question poses a major problem for students whose literacy skills would be weak, they can therefore not answer a question they are mathematically capable of doing! This is a major issue!' (Cosgrove et al., 2012, p. 72).

For example, 'John has now collected 18 tokens. That is 7 more than he had last week. How many did he have last week?' will often receive the answer '25' (Haylock & Thangata, 2007). Many students (including those studying at Higher Level) have also expressed difficulties with interpreting such word-based problems and with providing written explanations for their solutions to mathematical problems (Jeffes et al., 2013). Students also appear to lack confidence when asked to draw conclusions from a considerable amount of written information (Jeffes et al., 2013).

Widening Access to Higher Education in Ireland

For the past fifteen years, funding towards achieving a significant increase in the number of students from lower socio-economic groups participating in higher education has been provided by both public and private sources in Ireland (National Plan for Equity of Access to Higher Education 2008-2013). As a result, 15% of all first-time entrants to higher education in Ireland are now mature students, with numbers continuing to rise (Higher Education Authority (HEA), 2015). For example, the Dublin Institute of Technology (DIT)'s 'Access Student Strategy', which aims to ensure wider participation and equality of outcome in higher education, has as its target for 2020 a mature student quota of 20% of total student numbers, in addition to a young adult Access student quota of 7% of total student numbers (DIT, 2010). The growing number of Access students in higher education has also coincided with the introduction of Project Maths in second level schools with its afore-mentioned emphasis on literacy and language. This research aims to investigate the effect (if any) which Project Maths can have on Access students' mathematical performance and to view the initiative from their perspective.

The Study

Access Foundation students in the DIT are mainly mature students (23 years of age or older) and young adult students (below 23 years of age) from socioeconomically disadvantaged and educationally disadvantaged backgrounds. In essence, Access students are 'non-traditional' students. Schuetze and Slowey (2002) state that with regard to the framework of equality of opportunity, the term 'non-traditional' tends to refer to socially or educationally disadvantaged sections of the population, which includes those from working-class backgrounds, ethnic minority groups and immigrants.

Methodology

We decided to use a mixed method approach by combining both qualitative and quantitative methods of research. The use of multiple methods was decided upon in order to get an in-depth understanding of the research. The study evaluates Access students' opinions of Project Maths and compares their scores in a traditional style mathematics examination (which reflects mathematics education in Irish second level schools prior to the implementation of Project Maths) with their scores in a Project Maths style examination.

Methodological Consideration: Comparability of Test Questions?

When conducting this research the authors were conscious of the fact that the questions in the Project Maths style examination may be deemed to have a higher level of mathematical sophistication than the traditional style examination questions. The 'Adult Numeracy Concept Continuum of Development', which was developed by MaGuire and O'Donoghue (2002),

demonstrates that conceptual understanding of adult numeracy is a three-phase continuum in which the level of sophistication increases from Phase 1 to Phase 3 (see Figure 1). In the context of this continuum, the traditional style examination questions align with Phase 1 and the Project Maths examination questions align with Phase 2. We acknowledge the value of using examination questions that can be directly compared within the framework of this model, and indeed would recommend that future research incorporate such considerations. Clearly there is an opportunity here for further investigation with a focus on evaluating any confounding effect of using different phase questions on differences in performance on the two examinations. However we designed this research to mimic the current shift in State assessment of mathematics in Ireland. This shift has increased the literacy demands on second level students in an education system which is effectively labelling each style of question as the same, thus a strong case can be made for direct comparability.

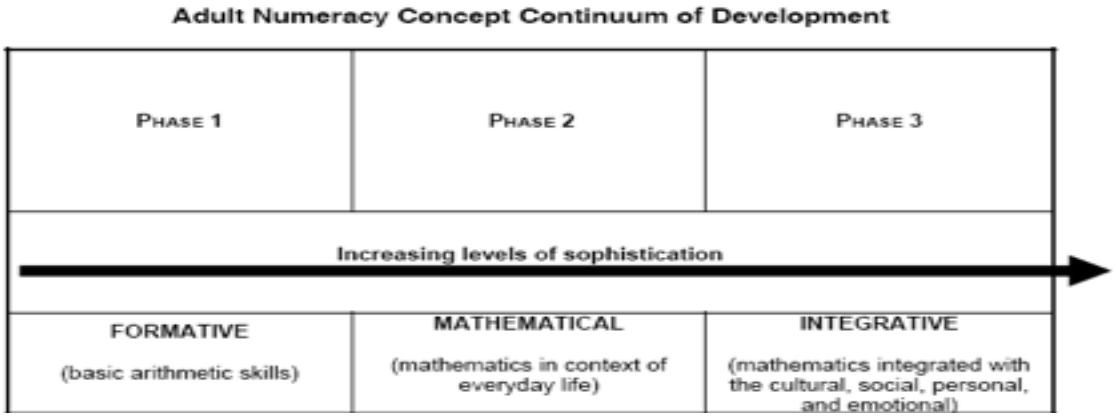

Figure 1. A continuum of development of the concept of numeracy showing increased level of sophistication from left to right (Maguire & O'Donoghue, 2002)

Participants

The participants in this study were fifty Access students who were enrolled in a year-long Foundation Programme in an Irish Higher Education Institute (HEI). The study took place in the 2014/15 academic year. Mathematics is one of six core subjects that all students are required to pass, along with two elective choices, in order to complete the programme. Upon successful completion of the programme, students are granted direct entry onto an undergraduate programme of their choice in the HEI. The aim of the programme is to equip them with the skills to meet the minimum entry requirements of such undergraduate programmes.

Of the participants, 75% were male and 25% female. The majority (78%) were Irish nationals with 71% speaking English as their first language. Other nationalities (such as German, Russian, Congolese and Somali) accounted for 22% of students. Ages ranged from 17 to 54 years with a median age of 31 years. All of the data was collected by us in 2014 in the participants' first semester of the programme.

Quantitative data

In order to get a quantitative measure of the effect of Project Maths on Access students, we decided to compare the scores of students in a Project Maths style examination with their scores in a traditional style mathematics examination. Each examination consisted of ten questions from the Junior Cycle Number strand and each question was taken from Irish second level textbooks and previous State examination papers. Students had fifty minutes to complete each examination. The

questions based on the Project Maths method of assessment reflected the emphasis on understanding, problem solving and applications. The questions in the traditional style examination were technically the same questions but had numbers changed and were mathematical procedure and skill-based only with the removal of any context or language. For example:

Project Maths Style Examination Question:

Usain Bolt, the fastest man on earth, has a stride length of $2\frac{4}{5}$ m when he is at full stride. In a 100m sprint, how many strides would Usain take to cover the final 30m when he is at full stride?

Traditional Style Examination Question:

Evaluate $46 \div 3\frac{2}{3}$

Students completed the traditional style examination first and then the Project Maths style examination directly afterwards. Ten marks were awarded per question. Each student received a mark out of 100 for each assessment.

At the end of the Project Maths style examination, there were also three closed-ended questions. The questions explored which examination the participants preferred, which examination they found more difficult and whether their English language skills had an impact on their performance in the Project Maths examination.

Qualitative data

In addition to the three closed-ended questions at the end of the Project Maths style examination, there were also a number of open-ended questions which all participants were invited to answer. The questions enquired about the main differences between both examinations, the students' opinions of Project Maths and what could be done to help Access students become accustomed to the changes brought about by Project Maths. The responses to these questions were transcribed, analysed and arranged into themes by the authors.

Results and Findings

Quantitative data

A paired-samples t-test was performed on the pairs of examination scores. The mean score on the traditional examination (M:47.44; SD:19.44) was found to be statistically significantly different ($t(df=49)=2.717$, $p=0.009$) to that on the Project Maths examination (M:41.94; SD:19.54). See Figure 2 below for a comparison of the mean scores. A 95% confidence interval for the mean difference on the tests for students on this Access programme was calculated as (1.918, 10.199). The effect size given by Cohen's d is 0.38.

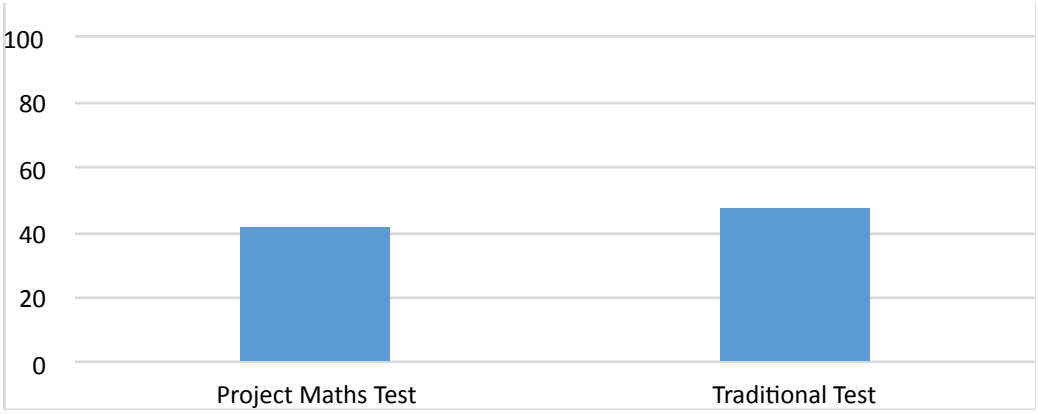

Figure 2. The mean scores on the tests were statistically significantly different. The figure shows the mean scores of Access Programme students in the Higher Education Institute on each test.

The response rate on the three closed-ended questions was between 70% and 86%. Of those who responded, 54% preferred the traditional style examination, 62% found the Project Maths examination more difficult and 89% believed that English language skills were an important factor in their performance in the Project Maths examination.

Qualitative Findings

Qualitative data analysis was carried out on the Access students' responses to the questionnaire data and several themes emerged under each question which provides further insight into students' performances in both the traditional and Project Maths examination papers.

Upon analysis of the question 'In your opinion, what were the main differences between the Project Maths and the traditional style questions?', three themes emerged from the 41 responses. The dominant distinction which 63% of students made between the two examinations, was that the Project Maths examination used words and involved analysis, thought and real- life context, while the traditional examination was seen as being much easier and 'just numbers'. One student summarised this view point by stating: 'Project Maths is full of reading and more thinking while traditional is very straightforward maths'. A smaller proportion of students (22%) noted that the Project Maths examination was better, despite the fact that it was considered more difficult: 'It's useful – it allows you to think about a real situation – traditional is the opposite'. The final theme which emerged in terms of the differences between the two examination papers was mentioned in 7% of student responses and stated that the traditional mathematics examination was familiar to them.

Students were also asked 'What is your opinion of Project Maths?'. Upon analysis of this data (for which there were 43 respondents), three major themes emerged. The dominant opinion on Project Maths (mentioned by 58% of respondents) was that it is better than the traditional style as it encourages genuine understanding of real life contexts. One student stated that 'it allows for a better understanding as you could be familiar with the scenario, it's not just symbols'. Of the respondents, 16% reported that they found Project Maths to be difficult because of the language used in it: 'I think it's good but they should use visual aids too to help people who struggle with text', with another student stating that 'It's very unhelpful if a student is dyslexic or has attention difficulties'. A similar proportion of students (17%) noted that they found Project Maths difficult for

reasons relating to basic arithmetic which makes it difficult to tackle the word problems: 'I struggle with fractions so that was an issue for me'. One student detailed their general frustration with Project Maths owing to a 'difficulty understanding what needs to be done' and finding it very 'time consuming'.

The final question that students were asked was 'What can be done to help Access students become accustomed to the changes brought about by Project Maths?'. Of respondents to this question, 71% mentioned the facilitation of more practice for Access students with this type of mathematics in the form of homework assignments or practice in class: 'We need more time to learn and lots of interaction and working together'. Two students requested that maths vocabulary could to be taught to help them decode the Project Maths problems a bit more strategically. One student suggested that basic arithmetic and algebra needed to be strong before students could tackle Project Maths problems with another student backing this up by stating that 'a mixture of both the traditional way and the Project Maths way' would be best.

The qualitative analysis of the students' questionnaire data supports the quantitative findings that students find the Project Maths examination more difficult while also providing some further insights into why this might be. Although difficulties with the Project Maths paper are expressed by many students, it should also be noted that 58% of students supported Project Maths as a better way of teaching and learning the subject. This is in spite of the many literacy and language difficulties associated with the reformed curriculum.

Challenges faced with Language and the Learning of Mathematics: Supporting our Students

Along with the findings of the 'Research into the impact of Project Maths on student achievement, learning and motivation' (Jeffes et al., 2013) and 'Teaching and Learning in Project Maths: Insights from Teachers who Participated in PISA 2012' (Cosgrove et al., 2012) reports, this study highlights concern for learners in how they manage the literacy demands of the reformed mathematics curriculum in Ireland. Statistically significant differences were found in the results of student scores in a traditional style mathematics examination with their scores in a Project Maths style examination. To support this, 89% of respondents believed that their English language skills were an important factor in their performance in the Project Maths examination. In effect, these results illustrate that students' language and literacy skills had acted as somewhat of a barrier to the learning of mathematics. The findings highlight the important role that literacy skills have in the teaching and learning process. A learner can have excellent mathematical ability but this is futile unless they can competently communicate and understand the language in which they are being taught and examined (Prendergast, Faulkner & O'Hara, 2016).

However this is not just a problem for adult learners. Primary school children's difficulties with mathematics have been summarised under four main headings: memory difficulties, language and communications difficulties, literacy difficulties and difficulties with low self-esteem (Krick-Morales, 2006). Language and literacy skills therefore play a key role in the biggest challenges for students trying to learn mathematics at any age. Much of the research in the area of mathematics education emphasises the importance of enabling students to use mathematical language effectively and accurately. The development of such a skill involves an ability to listen, question and discuss as well as read and report (Into Learning, 2015). All of these skills are now at the core of the reformed mathematics curriculum in second level education in Ireland. Hence, it is more important than ever that an emphasis is placed on the expression of mathematical ideas in order to develop mathematical concepts (Jeffers et al., 2013). One of the reported causes of failure in mathematics is

poor comprehension of the words and phrases being used. This may be because some of the language used within the mathematics classroom has dual meanings in everyday life and some of the vocabulary will only be found in a mathematical context (Halliday, cited in Pimm, 1987). Both of these vocabulary types can cause confusion to the learner in their own right. As mathematics educators we must familiarise ourselves with the mathematics register and how imperative it is to use precise language when teaching the subject (Khisty & Chevl, 2002).

It must be noted that in spite of the challenges faced with language and the learning of mathematics, a majority of respondents in this study supported Project Maths as a better way of teaching and learning the subject. Overall, they felt enabled it them to relate the mathematics to real-life contexts allowing for real understanding of the material to take place. As educators, it is encouraging to see that despite their difficulties, our students could see the bigger picture and realise that the previous focus on rote learning of material to pass examinations was not beneficial in the long term. The reformed approach has helped them realise that mathematics is about more than 'just numbers'. This is in line with adult numeracy policy in the UK which emphasises that learning mathematics should be functional and lead to increased employability and economic effectiveness (Oughton, 2009).

However, despite such welcome sentiments, the findings also highlight that there are many language-related challenges in the teaching and learning of mathematics, particularly regarding the use and potential overuse of word problems. For example, in the Project Maths examination, many students were unable to complete questions that they were mathematically capable of doing in the traditional examination. With this in mind, Zevevbergen and Lerman (2001) question whether the posing of tasks into everyday contexts serves as a distraction from the main mathematical underpinnings of the task. This is an interesting debate. While putting mathematics into context has many advantages such as making the content more meaningful and relevant to students, it often creates another layer of disadvantage, especially for students with weak literacy skills (Zevevbergen & Lerman, 2001). Another angle which may be of relevance, is the findings of Cooper and Dunne's (1999) study. They determine that those from lower socio-economic backgrounds are more likely to perform poorer than their middle-class peers on mathematical word problems which have been built around contextualised tasks. Cooper and Dunne argue that students from working-class backgrounds are often unable to recognise the specificity of the mathematical tasks when they are embedded in 'realistic' contexts. In contrast, middle-class students are more likely to identify the mathematical discourse and respond appropriately. This is an area which warrants further study and may have important implications for the teaching and learning of Access students.

Other language-related challenges such as the time-consuming nature of word problems, also have implications for practice and measures must to put in place to help students overcome such challenges. There were a number of suggestions by students in the qualitative data and some of these focused around the promotion of more 'interaction' and collaboration between students. This highlights the importance of classroom discussion in the teaching and learning of mathematics and indeed any subject. Discussion plays a significant role in the acquisition of mathematical language and in the development of mathematical concepts. Our students can clarify ideas by discussing concepts and processes with their peers. Discussion with the teacher or lecturer has also been found to be extremely useful. Research carried out by Khisty and Chevl (2002) concluded that the teacher or lecturer should assist students, as the need arises, with the mathematical language necessary for them to express or clarify their ideas more accurately (Khisty & Chevl, 2002). This enables students to clarify mathematical ideas particularly where context could be causing difficulty in the formulation of ideas (Gibbs & Orton, 1994).

Conclusions

Mathematical ideas are understood by making connections between language, symbols, pictures and real-life situations (Haylock & Cockburn, 2003). Research into young children's' mathematical development has found that without sufficient language to communicate the ideas being developed, to interact with peers and their teachers, mathematical development can be seriously curtailed (Perry & Dockett, 2005). The same developmental issues in mathematics must be considered in light of the findings within this research in which Access students, some of whose first language is not English, with others having poor literacy skills, are attempting to engage with word-heavy mathematical questions.

However despite the associated difficulties and challenges, the findings of this study emphasise that the use of contextualised tasks in mathematics should be not avoided entirely. Indeed the majority of students felt that the Project Maths approach was a better way of teaching and learning the subject. The findings do emphasise that more support is needed to help students overcome such challenges and to ensure that their language and literacy skills are not a barrier to the learning of mathematics.

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Recommended resources for adult mathematics and numeracy learning and teaching

Here is a small selection of resources from the last decade (mostly) which adult mathematics and numeracy practitioners have found supportive in inspiring fresh thinking about maths and transforming classroom practices. We hope that these resources might complement the articles in this edition of the RaPAL journal and help anyone wishing to develop learning and teaching in their own particular context.

Rachel Stubley and Angela Cahill

June 2017

Benn, R. (1997) *Adults count too: mathematics for empowerment* Leicester: NIACE

A stimulating challenge to all maths and numeracy practitioners and researchers, and educators in general, critically examining the nature of mathematics and the problems of educational inequality and power. Benn sees the low levels of confidence and knowledge of maths in society as one aspect of bigger inequalities, and argues for the recognition and valuing of diverse cultures and the development of a more emancipatory adult mathematics curriculum.

Griffiths, G and Ashton, J. with Creese, B. (2015) *Training to Teach Adults Mathematics* Leicester: NIACE

A succinct and accessible introductory text, particularly suited to trainee and newer teachers in post-compulsory education. Key concepts in maths teaching, such as the importance of mathematical thinking and the implications of embedded and situated maths learning, are introduced. There are useful links between general learning theories and maths/numeracy teaching, and key areas such as planning, assessment and classroom management are discussed in the context of adult maths and numeracy.

Griffiths, G. and Stone, R. (eds) (2013) *Teaching Adult Numeracy: Principles and Practice* Maidenhead, Berks: Open University Press

The third book in this 'Developing Adult Skills' Open University Press series (there are titles on Adult Literacy and Adult ESOL), this is an invaluable text book for trainee and practising adult numeracy educators alike. This is a collection of themed, research-informed chapters by a range of experienced researchers and practitioners (several are RaPAL members, including Rebecca Woolley who writes for this edition of the RaPAL journal!) The book offers friendly guidance on how to work with adult learners of numeracy and mathematics and comes with case studies of real learners, reflective tasks and commentary.

Hall, G. & Slaney, S. (2016) *Developing Numeracy in Further Education/Datblygu Rhifedd mewn Addysg Bellach* [available as free download in English or Welsh] http://www.grahamhall.org/FEnumeracy (accessed 21 June 2017)

This provides a wealth of inspiration, argument and practical applications for numeracy, based on the ideas in Graham and Suzanne's article in this edition of the RaPAL journal. The first part of the book considers key overarching issues such as numeracy requirements in the workplace, developing student motivation, and the use of technology to enhance numeracy. The second part of the book consists of a number of case studies in embedding numeracy in vocational courses. The diverse and stimulating topics and applications will really get the creative tutor's mind racing: from the Three Peaks yacht race, to curves in building construction, to converting opinions to quantitative data and much much more!

NALA (2013) *What Really Counts: case studies of adult numeracy practice in Ireland* Available at: https://www.nala.ie/sites/default/files/publications/numeracy_report_0.pdf (accessed 21st June 2017)

NALA (2015) *What Really Counts Next: Action learning project with numeracy tutors* Available at: https://www.nala.ie/sites/default/files/publications/action_learning_numeracy.pdf (accessed 21st June 2017)

National Adult Literacy Agency (NALA) in Ireland has collected a number of case studies and undertaken follow-up action learning projects to develop numeracy teaching practices around Ireland. The initial case study report describes examples of practice and focuses on the teaching strategies used by tutors to teach numeracy to adult learners. The follow up action learning projects disseminate and develop ideas from the initial case studies. A social practice ethos underpins many of the case studies described.

NALA (2015) *A Wealth of Practice: case studies of financial numeracy practice in Ireland* Available at: https://www.nala.ie/sites/default/files/publications/a_wealth_of_practice_financial_numeracy_case_studies_1.pdf (accessed 21st June 2017)

NALA (2016) *Making It Go Further: a financial numeracy action learning project* Available at: https://www.nala.ie/sites/default/files/publications/making_it_go_further_report_-_web.pdf (accessed 21st June 2017)

In this second pair of NALA reports (case studies and action learning projects), the focus is specifically on financial literacy.

National Centre for Excellence in the Teaching of Mathematics (2007, 2015) *Thinking Through Mathematics: the resource* London: National Research and Development Centre for Adult Literacy and Numeracy https://www.ncetm.org.uk/online-cpd-modules/ttm (accessed 22 June 2017 – registration required but it's free)

This online professional development resource grew out of the 2007 programme (a Maths4Life Skills for Life programme based at NRDC). It has been created for those working with learners from entry level to level 2 numeracy, and is also useful for maths and numeracy teachers in schools (key stages 1, 2 and 3). It provides learning activities and resources based on the principles from Swan (2005) and from Swain and Swan (2007) – see below.

Swain, J. and Swan, M. (2007) *Thinking Through Mathematics: research report* London: National Research and Development Centre for Adult Literacy and Numeracy http://dera.ioe.ac.uk/22296/1/doc_3631.pdf (accessed 21 June 2017)

Report of the 'Thinking Through Mathematics' project, a design-based research project which aimed to transform adult maths and numeracy teaching through the application of active, communicative and constructivist learning principles. The research project developed and trialled 30 activity-based maths sessions, and led to the development of the Thinking Through Mathematics resource (above).

Swan, M. (2005) *Improving learning in mathematics: challenges and strategies*, London: DfES Standards Unit. Available at https://www.ncetm.org.uk/public/files/224/improving_learning_in_mathematicsi.pdf (accessed 21st June 2017)

This excellent publication was developed by the Standards Unit Mathematics team in the UK based on their work over two years with more than 200 teachers in FE settings. Its aim was to describe effective and enjoyable ways of learning and teaching maths. The emphasis is on supporting learners to be active participants in their learning. Malcolm Swan encourages us to promote discussion in the classroom, to devise cooperative group work and rich tasks, to use effective questioning and to consider the use of posters to stimulate thinking. An inspirational, practical read and one that will make you think afresh about how you teach Maths!

WRITING GUIDELINES

Why not write something for the RaPAL Journal?

We invite contributions from anyone involved in the field of adult literacy, numeracy and ESOL education to write and share ideas, practice and research with RaPAL readers. This can be writing from learners, ideas linking research and practice, comments about teaching, training or observations about policy. Our journal is now produced online and so we welcome articles, reviews, reports, commentaries, images or video that will stimulate interest and discussion.

The journal is published three times a year and represents an independent space, which allows critical reflection and comment linking research with practice in the field of adult literacy, numeracy and ESOL nationally and internationally.

The RaPAL network includes learners, managers, practitioners, researchers, tutors, teacher trainers, and librarians in adult, further and higher education in the UK. It also has an international membership that covers Ireland. Canada, USA, New Zealand, Australia, South America, Europe and Africa.

Guidelines for contributors
All contributions should be written in an accessible way for a wide and international readership.

- Writing should be readable, avoiding jargon. Where acronyms are used these should be clearly explained.
- Ethical guidelines should be followed particularly when writing about individuals or groups. Permission must be gained from those being represented and they should be represented fairly.
- We are interested in linking research and practice; you may have something you wish to contribute but are not sure it will fit. If this is the case, please contact the editors to discuss this.
- Writing should encourage debate and reflection, challenging dominant and taken for granted assumption about literacy, numeracy and ESOL.

We want to encourage new writers as well as those with experience and to cover a range of topics. We aim to have three different kinds of articles in the journal plus a reviews section; these are slightly different in length and focus. We welcome illustration and graphics for any of the sections and now have the facility to embed audio and video files into the journal. The journal has a different theme for each edition but we welcome general contributions too.

Below you will see more details about the different themes and topics:

1. **Ideas for teaching**
This section is for descriptive and reflective pieces on teaching and learning. It is a good place to have a first go at writing for publication and can be based on experiences of learners and teachers in a range of settings. Pieces can be up to 1,000 words long.

2. **Developing Research and Practice**
This section covers a range of contributions from research and practice. In terms of research this could be experience of practitioner research, of taking part in research projects, commenting on research findings or of trying out ideas from research in practice. In terms of practice this could be about trying out new ideas and pushing back boundaries. Contributions should include reflection and critique. Pieces for this section should be between 1,000 - 2,000 words long including references.

3. **Research and Practice: multi-disciplinary perspectives**
This section is for more sustained analytical pieces about research, practice or policy. The pieces will be up to 4,000 words long including references and will have refereed journal status. Although articles in this section are more theoretically and analytically developed they should nevertheless be clearly written for a general readership. Both empirical work and theoretical perspectives should be accessible and clearly explained. Writing for this section should:

- Relate to the practices of learning and teaching adult literacy, numeracy or ESOL
- Link to research by describing and analysing new research findings relating this and any critical discussion to existing research studies
- Provide critical informed analysis of the topic including reference to theoretical underpinning
- Write coherently and accessibly avoiding impenetrable language and assumed meanings. The piece should have a clear structure and layout using the Harvard referencing system and notes where applicable. All terminology should be explained, particularly for an international readership.

Reviews
Reviews and reports of books, articles and materials (including online materials) should be between 50 to 800 words long. They should clearly state the name of the piece being reviewed, the author, year of publication, name and location of publisher and cost. You should also include your name, a short 2 to 3 line biography and your contact details. You can write the review based on your experience of using the book, article or materials in your role as practitioner, teacher trainer, and researcher or as a student.

Submitting your work

1. If you are responding to a call for articles via the RaPAL email list or directly by an editor you will have been given the email address of the editor(s) for submitting your work, together with a deadline date and the theme of the journal.
2. If you are submitting a piece of work that you would like RaPAL to consider for publication that has not been written as a result of a call for articles, please send it to journal@rapal.org.uk in the first instance. The journal coordinator will then let you know what the next steps will be.
3. All contributions should have the name of the author(s), a title and contact email address and telephone number. You should also include a short 2 to 3 line biography. Sections, sub-sections and any images should be clearly indicated or labelled (further guidance on image size is on the website www.rapal.org.uk.
4. All referencing should follow the Harvard system.
5. Articles should be word processed in a sans serif font, double-spaced with clearly numbered pages.
6. The article should be sent to journal@rapal.org.uk

What happens next?

1. Editors are appointed for each edition of the journal. They review all contributions and will offer feedback, constructive comment and suggestions for developing the piece as appropriate.
2. Articles submitted for the third category 'Research and Practice: multi-disciplinary perspectives' will be peer-reviewed by an experienced academic, research or practitioner in the field in addition to being edited.
3. The editor(s) will let you know whether your article has been accepted and will send you a final copy before publication.

If you have any questions, please contact the journal coordinator by emailing journal@rapal.org.uk


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