

# Practitioner Pack

Resources for Adult  
Numeracy Practitioners



## NUMERACY-MEETS PRACTITIONER PACK

This practitioner pack brings together resources for teaching adult numeracy that accompanied the second series of Numeracy-Meets.

Numeracy-Meets are a series of organised, informal meetings targeted at adult numeracy practitioners in Ireland to share good practice and personal insights into teaching adult numeracy. They are a professional development initiative that aims to enhance adult numeracy practitioners' understanding of numeracy and support them in developing the numeracy skills of their learners. The programme supports practitioners in developing their own pedagogical practice so that in turn, they are more effective at addressing the numeracy needs of their learners.

Series 2 of the initiative took place between October and December 2023. The series was funded through the Adult Literacy for Life Collaboration and Innovation Fund 2023 and was aimed at supporting practitioners who teach specific adult numeracy vulnerable groups.

**The contents of this practitioner pack bring together resources from each of the six Meets, namely:**

- **Numeracy-Meet 1: Teaching numeracy to people with language needs**
- **Numeracy-Meet 2: Teaching numeracy to people with dyscalculia**
- **Numeracy-Meet 3: Teaching numeracy to people from the Traveller community**
- **Numeracy-Meet 4: Teaching numeracy to migrant learners**
- **Numeracy-Meet 5: Teaching numeracy in prisons**
- **Numeracy-Meet 6: Teaching numeracy to mature learners**

We would like to thank SOLAS for funding this series of Numeracy-Meets and a special acknowledgement to all the adult numeracy practitioners who attended the Meets - we hope you find these resources useful!

The Numeracy-Meets Team in partnership with the National Adult Literacy Agency (NALA)

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# 01

## Numeracy-Meet 1

Teaching numeracy to  
people with language needs



# NUMERACY-MEETS NEWSLETTER

Teaching Numeracy to People with Language Needs

## Emergent Bi/Multilingual Learners of English in Ireland

Increased diversity among the Irish population since 2001 (McGinnity et al., 2018) has been accompanied by an increase in the number of emergent bi/multilingual learners of English nationwide. In 2011, 514,068 individuals spoke a language other than Irish or English at home (CSO, 2013), but by 2022 this number had increased by 46% to 751,057 (CSO, 2023). Findings from the Census (2023) reveal that:

- 83% of immigrants indicated that they speak English 'well' or 'very well' but this varies by nationality.
- Immigrants from Malta (98%), Denmark (97%), and South Africa (96%) were most likely to indicate that they spoke English 'well' or 'very well'.
- 57% of immigrants from Moldova, 69% of immigrants from Syria, and 71% of immigrants from China living in Ireland speak English 'very well' or 'well'.

### Did you know?

Latest figures from the CSO (2023) show that:

- 84,613 Ukrainian nationals had received Personal Public Service Numbers in Ireland by 6th June, 2023.
- 56% of Ukrainian nationals in Ireland say they do not speak English well or do not speak English at all.
- 16,504 Ukrainian nationals are in further education and training courses in Ireland.
- 20,996 Ukrainian nationals seeking employment see lack of English language proficiency as a challenge.



"Mathematical knowledge is ingrained in language, and teaching numeracy requires the use of literacy skills"  
(Condelli, 2006, p. 52)

## Implications for Numeracy Educators

Mathematical proficiency requires students to learn mathematical vocabulary (Riccomini et al., 2015), as research has shown that being able to understand mathematical language is a strong predictor of students' success in mathematics (Jourdain & Sharma, 2016).

- Mathematics learning involves moving from informal everyday language to precise formal language. However, colloquial language can enrich conceptual understanding (Ingram et al., 2023).
- Translanguaging, or using a student's full linguistic repertoire, is a resource for mathematics learning (Maldonado Rodríguez & Krause, 2020).
- Students speaking multiple languages in the same classroom may act as a resource for supporting student understanding, as different terms in different contexts and languages can provide students with insight into mathematical concepts (Ingram et al., 2023).
- It is important to introduce technical terms, but students can reveal their emergent thinking through informal language (Ingram et al., 2023).
- Games such as 'sometimes, always, never' can be used to establish maths routines (Ingram et al., 2023).

Read the following statements and decide if they are sometimes, always or never true.

Sometimes	Always	Never
<div style="border: 1px solid blue; border-radius: 10px; padding: 5px; margin-bottom: 10px;">Adding two even numbers gives an odd number.</div> <div style="border: 1px solid blue; border-radius: 10px; padding: 5px; margin-bottom: 10px;">If you add 1 to an odd number, you get an even number.</div> <div style="border: 1px solid blue; border-radius: 10px; padding: 5px;">You get an even number when you multiply a number by 3.</div>		

## Supporting Emergent Bi/Multilingual Learners of English in the Numeracy Classroom

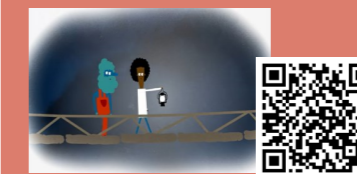
Numeracy practitioners can support emergent bi/multilingual learners of English in a variety of ways. They can:

- Help students to develop basic interpersonal communication skills and cognitive/academic language proficiency by encouraging them to communicate in scaffolded language (Caniglia, 2018), specifically chosen, used and recalled frequently by students and teachers until it can be used independently in an unscaffolded way.
- Provide opportunities for rich discourse (Ingram et al., 2023), that allows students to practice their functional mathematics skills by asking and answering questions and engaging in any type of spoken interaction, i.e. role playing, interviews and games (Caniglia, 2018).
- Move from focusing on low-level mathematical literacy, i.e. defining words and performing computations, to focus on conceptual understanding and mathematical practices and discourse (Moschkovich, 2021) by integrating the teaching of content and language.
- Educators should encourage emergent bi/multilingual learners of English to use a variety of representations, including "gestures, drawings, diagrams, manipulatives and technology" to represent mathematical solutions and communicate their thinking (National Council of Supervisors of Mathematics and TODOS, 2021, p. 3).
- Acknowledge that emergent bi/multilingual learners of English often use their first language as well as English when engaging in mathematics and encourage them to do so (Clarkson, 2007).
- Raise students' language awareness by comparing and contrasting language pieces (Erath et al., 2021).

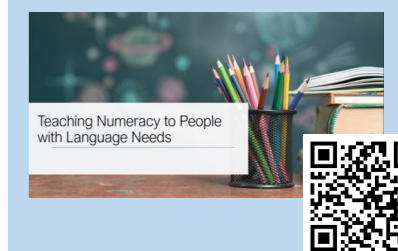
### Discussion Points

1. How do you support emergent bi/multilingual learners of English in your classroom?
2. What strategies, if any, do you use to develop your students' mathematical vocabulary?

Students can improve their mathematical vocabulary through fun activities like puzzles and games. Can your students use their numeracy and English language skills to solve "The Bridge Riddle?"



Scan the QR code for a video to accompany this Numeracy-Meet.



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## Activities

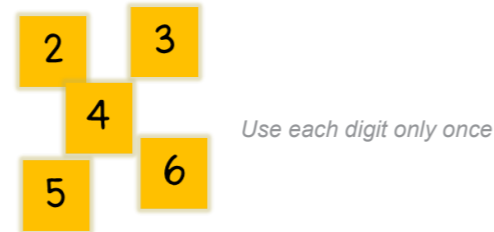
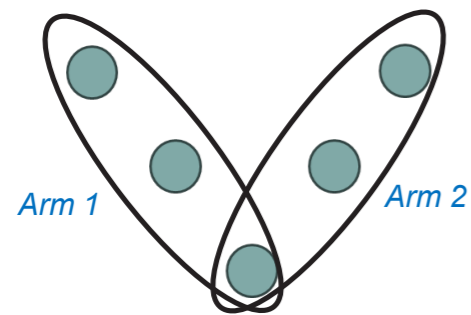
### Convince Yourself, a Friend, a Sceptic

This activity offers learners an opportunity to practice their maths-related English language skills. It requires students to:

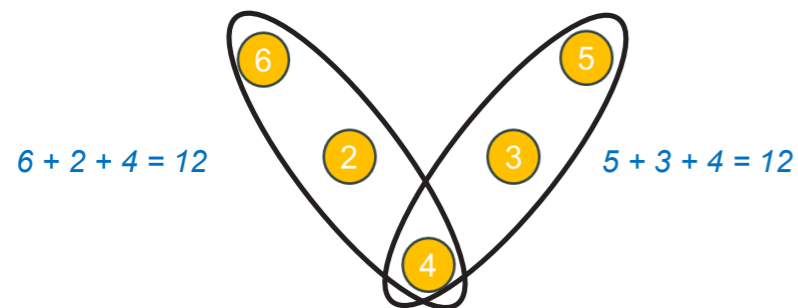
- Solve a problem and check if their answer is correct.
- Convince a friend that the answer is correct.
- Convince a sceptical classmate or the teacher that their answer is correct.

### Example

How many ways can you place the numbers 2 to 6 in the 'V', so that both arms of the 'V' have the same total? Convince yourself, a friend and a sceptic that you are correct.



If the number 4 is placed at the bottom of the 'V' and the numbers 2 and 6 are added on one side while the numbers 5 and 3 are placed on the other, both arms will total to 12.



- Can students find other solutions and convince themselves, a friend and a sceptic that they are correct.
- What happens if the number 3 or the number 5 are placed at the bottom of the 'V'?
- What happens if a different set of numbers is used, for example, what would happen if 1, 2, 3, 4, and 5 were used at the start?

Adapted from McClure, L. (2010)

### Can you reach 100 in 5 goes or less?

#### Rules

1. You can choose any number between 1 and 6. This is considered one throw of the dice. Then move the appropriate number of spaces along the board.
2. If you land at the bottom of a ladder, you must climb to the top of the ladder.
3. If you land on the head of a snake you must go back to the snake's tail.
4. Remember the game ends when you have chosen 5 numbers and you must be at 100 to win.



Adapted from Sharvan, S. K. (2021). *Can You Cheat Death by Solving this Riddle?*



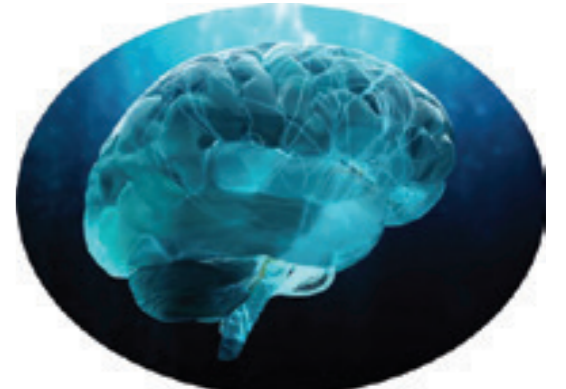


## NUMERACY-MEETS NEWSLETTER

Teaching Numeracy to People with Dyscalculia

### What is Dyscalculia?

Developmental dyscalculia (DD) is a specific learning disorder that is associated with differences in neurophysiology (Bugden & Ansari, 2015). People with dyscalculia find it difficult to grasp number-related concepts and may find it difficult to perform mathematical calculations using mathematical symbols and functions (American Psychiatric Association, 2023). Agreement on the prevalence of DD varies, with Devine et al. (2013) suggesting that it affects up to 10% of the population and others indicating that 3–8% (Dyscalculia Association of Ireland, 2023) or 3–7% (Haberstroh & Schulte-Körne, 2019) is more accurate. Some researchers contend that DD is equally likely to affect males and females (Shalev & Gross-Tsur, 2001). However, females are more likely to be diagnosed with DD than males when a deficit in mathematical reading is considered (Devine et al., 2013).

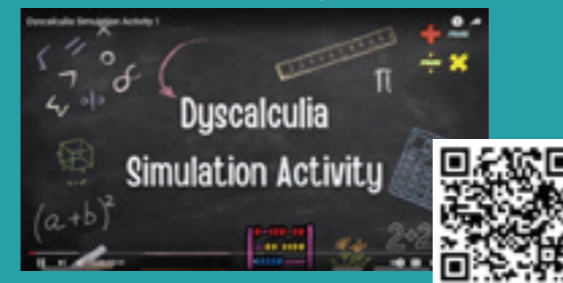


Neurophysiology focuses on nervous system function

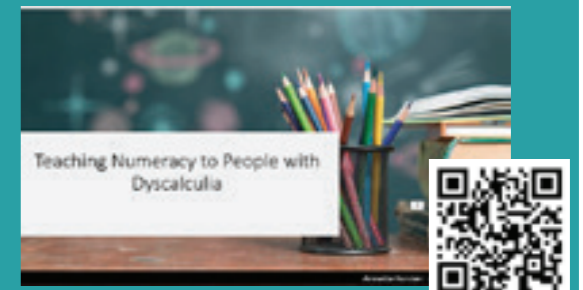
Difficulties in mathematics have long-term implications:

- There is a substantial, positive association between mathematics and reading ability at age 7 and socio-economic status in midlife (Ritchie et al., 2013).
- Individuals with DD are twice as likely to be unemployed as individuals without DD (Parsons & Bynner, 2005).
- Individuals with DD may suffer from anxiety and depression (Haberstroh & Schulte-Körne, 2019).

Scan the QR code to gain an insight into the struggles a student with dyscalculia experiences with numeracy.



Scan the QR code for a video to accompany this Numeracy-Meet.



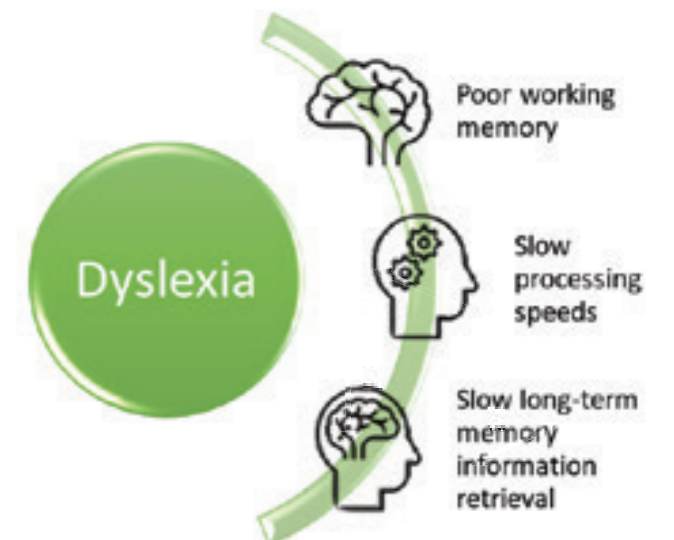
# 02

## Numeracy-Meet 2

### Teaching numeracy to people with dyscalculia

### Dyscalculia and Dyslexia

Research suggests a high comorbidity between mathematical and reading learning disorders (Snowling et al., 2021). Like dyscalculia, dyslexia is a neurodevelopmental disorder (Snowling et al., 2020). It results in spelling difficulties and difficulties reading aloud. There is an overlap between dyscalculia and dyslexia because verbal skills are very important in many areas of mathematics (Moll et al., 2018). Dyslexia may be associated with problems with working memory, processing and information retrieval (British Dyslexia Association, 2023)



## Implications for Numeracy Educators

Adults with dyscalculia may experience problems with enumeration and deficiencies in working memory (Kaufmann et al., 2020). They can have deficiencies in number sense, fact-retrieval, calculation and mathematical reasoning (American Psychiatric Association, 2013). Additionally, adults with dyscalculia may find it difficult to:

- Count backwards.
- Measure items and quantities.
- Use money, e.g. work out tips.
- Work with fractions.
- Tell the time.



This makes it difficult to perform simple calculations such as adding two natural numbers (Cleveland Clinic, 2023). For example, adding the numbers '2' and '3' involves using short-term memory, translating symbols into words, using long-term memory and determining that the numbers '2' and '3' are amounts (see figure 1).

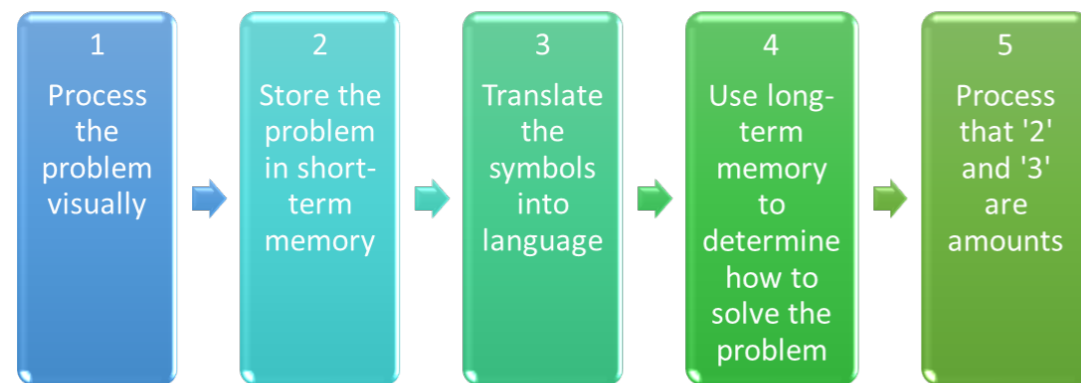


Figure 1 The Processes Involved in Adding the Numbers '2' and '3'

## Supporting Students with Dyscalculia in the Numeracy Classroom

Numeracy practitioners can support students with dyscalculia in a variety of ways. They can:

- Use manipulatives in the classroom.
- Use calculators when possible.
- Provide students with fact charts and times tables charts.
- Introduce a limited number of maths facts at a time.
- Encourage students to take their time.
- Provide students with games that reinforce the concepts they are learning.

(Dyslexia-SPELD Foundation, 2022)



### Tip

Students can learn strategies to make it easier to perform calculations. For example, subtracting 34 from 200 is difficult because it involves carrying '1's. However, it can be simplified by subtracting 1 from each number to get 199 and 33. It is easier to subtract 33 from 199, than to subtract 34 from 200.

$$\begin{array}{r} 200 \\ - 34 \\ \hline 166 \end{array} \rightarrow \begin{array}{r} 199 \\ - 33 \\ \hline 166 \end{array}$$




## Numeracy Resources for Adults with Dyscalculia

Numeracy practitioners may find the following resources useful when working with students with dyscalculia.

### Books

- *Just In Time(s): Times Tables Tips & Tricks When the Usual Methods Just Don't Stick*, by Marlene Caplan. This is a teacher resource that can be used with children and adults alike. The book provides a variety of methods for teaching times tables.
- *The Dyscalculia Toolkit: Supporting Learning Difficulties in Maths*, by Ronit Bird. This book and the accompanying downloadable teaching materials offer maths educators a variety of activities and games that they can use to support learners struggling with dyscalculia.

### Videos (Scan the QR codes to find out more)

<b>Maths Explained</b>	This series of video tutorials provides advice on teaching a variety of maths topics to students who struggle with maths.	
<b>Teaching Students with Dyscalculia</b>	This video outlines 18 strategies that maths practitioners can use to support students with dyscalculia.	
<b>What is developmental Dyscalculia?</b>	In this video, Dr Daniel Ansari introduces some of the features of developmental dyscalculia.	

## Discussion Points

1. How do you support students with dyscalculia in your classroom?
2. What resources, if any, have you found useful in supporting students with dyscalculia?



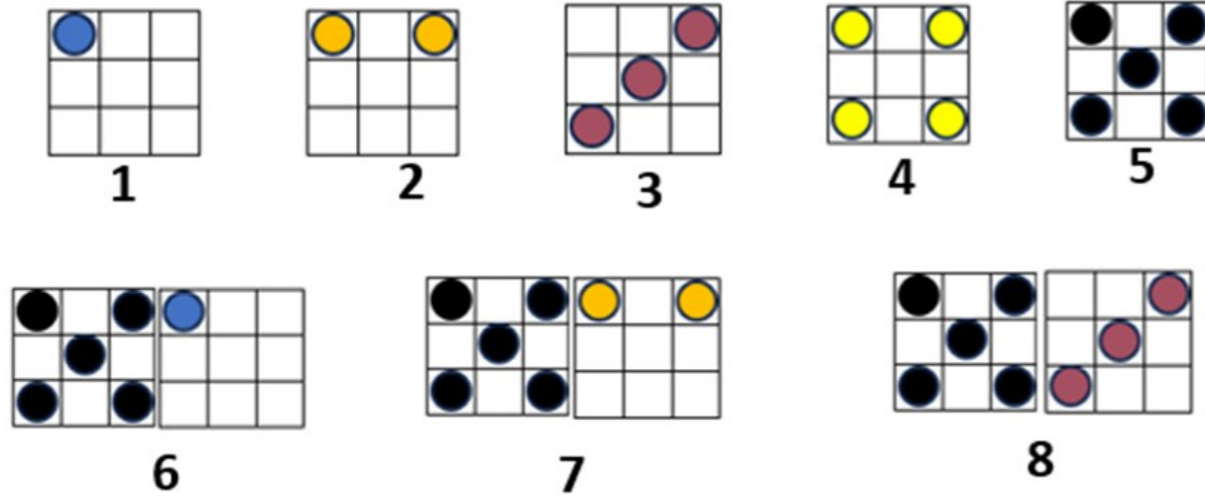
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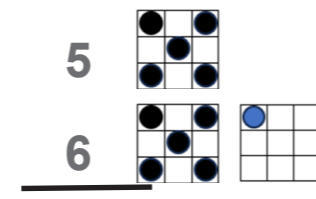
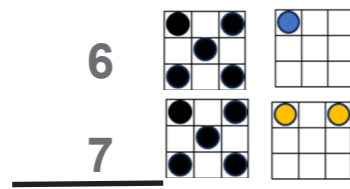
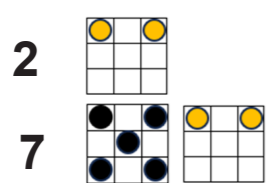
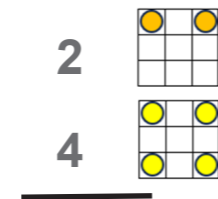
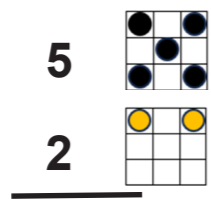
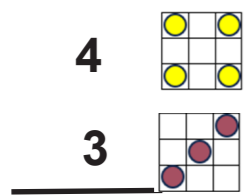
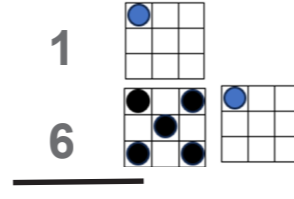
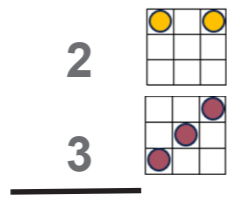
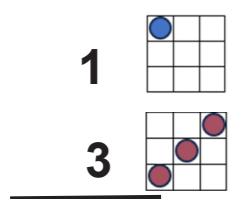
## Activities

### Adding with the Help of Dot Patterns

Dot patterns can be helpful to students with dyscalculia. The following dot patterns can be used to represent the first eight numbers.



Add the numbers below and indicate the dot pattern for the total.

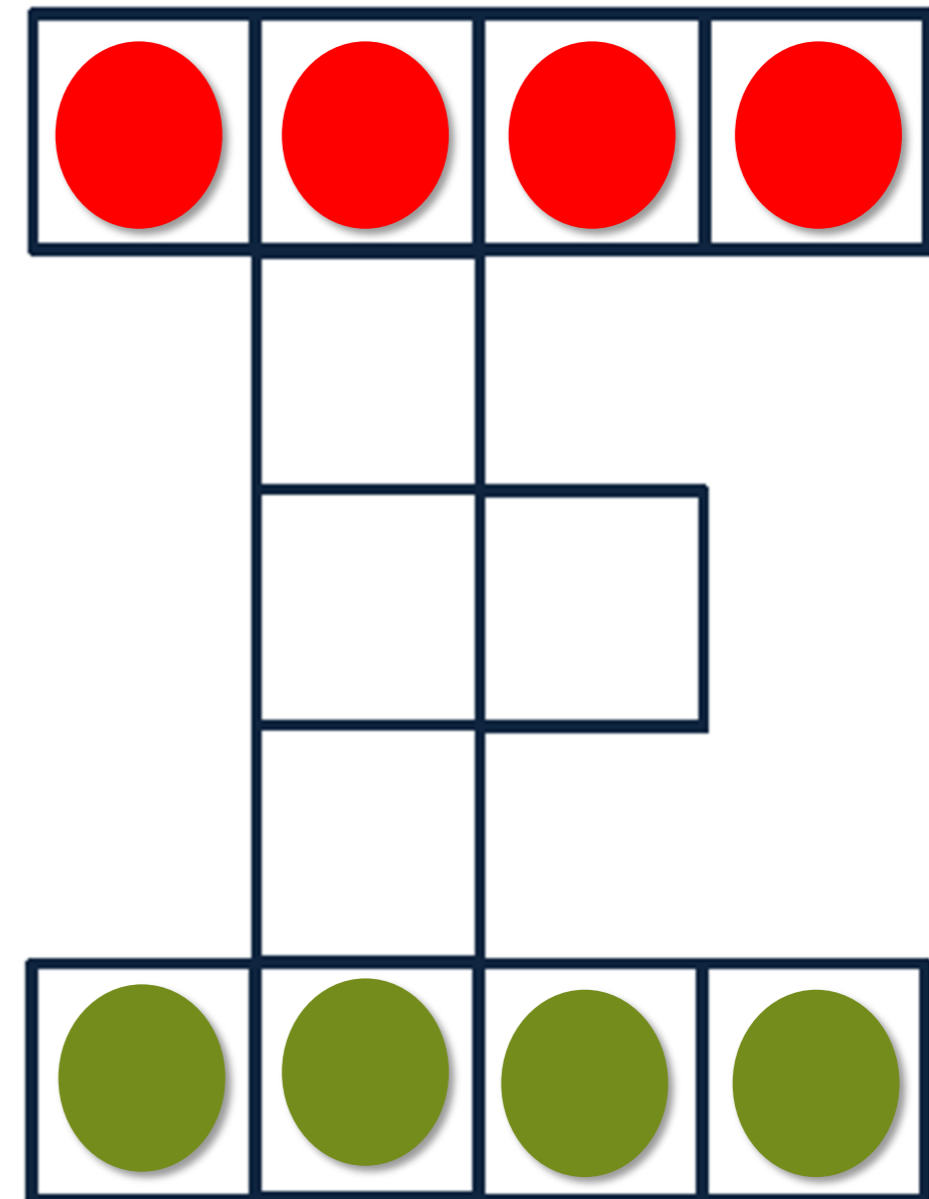


## Activities

### Henry Dudeney's E Puzzle

This puzzle can be played using a variety of manipulatives, including counters, coins or buttons. The goal is to swap all of the red and green counters subject to the following rules:

1. Only one counter can be in a given square at any one time.
2. You cannot pass or jump over another counter.





# NUMERACY-MEETS NEWSLETTER

Teaching Numeracy to People in the Traveller Community

## Demographics

According to the Central Statistics Office (2023), 32,949 people, or just over 0.6% of the population, identified as Irish Travellers on the 2022 Census, an increase of 6% over 2016. Travellers are younger than the rest of the population. Census 2016 data showed that 55% of all Travellers were under 25 years, and less than 5% of Travellers were over 65 years (see Figure 1). The corresponding figures for the rest of the population are 32% and 15%, respectively. The life expectancy of Traveller females is 11 years less than that of females in the general population, and Traveller males have a life expectancy that is 15 years less than males in the rest of Irish society (Hanafin et al., 2018).

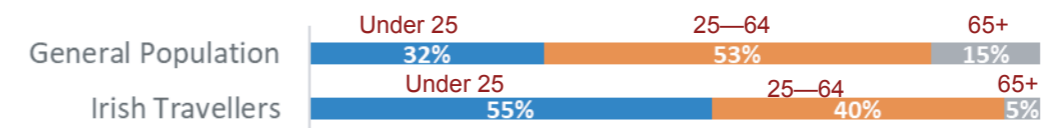


Figure 1 Comparison of the Percentage of Travellers of Different Age Groups with Those of the General Population

*To be successful you need to be supported. To be supported, the people supporting you have to have empathy and understanding and to be aware of your cultural background or your ethnicity.* (Ward, 2021)

## Education

The most recent data available (CSO, 2017) shows that Travellers have lower levels of education than the remainder of the Irish population. The findings show that 56% of the Traveller population have no formal education or at most primary education (see Figure 2). This compares to 13% for the general population of Ireland. Additionally, 22.3% of Travellers and 14.5% of the remaining population have been educated to at most lower secondary level. Meanwhile, 28.5% of the overall population but 1.25% of Travellers have been educated to ordinary bachelor's degree level or above.

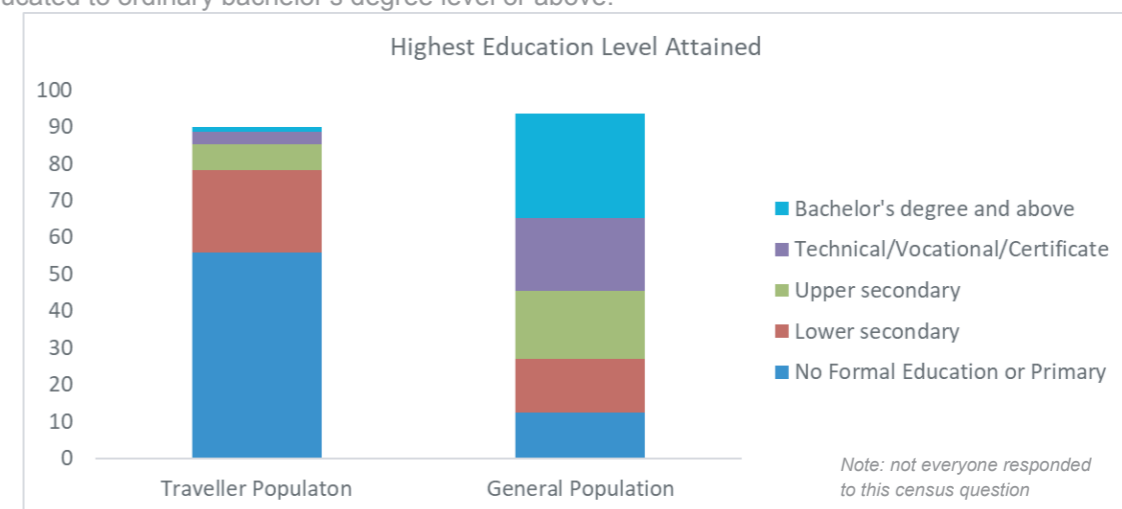


Figure 2 Comparison of Education Levels of Travellers and the General Population

Why?

Although studies have shown that Traveller parents and students value education (McGinley and Keane, 2022), Travellers cease their education on average 4.7 years earlier than the general population. Some students from the Traveller Community:

- Feel that they do not belong (Hanafin et al., 2018) or feel culturally isolated.
- Experience racist bullying at school (Bannon Ward, 2019).
- Feel that the curriculum is not relevant to them (McGinley and Keane, 2022).

# 03

## Numeracy-Meet 3

Teaching numeracy to people from the Traveller community



## Supporting Travellers in the Numeracy Classroom

Numeracy educators can engage in culturally responsive teaching by:

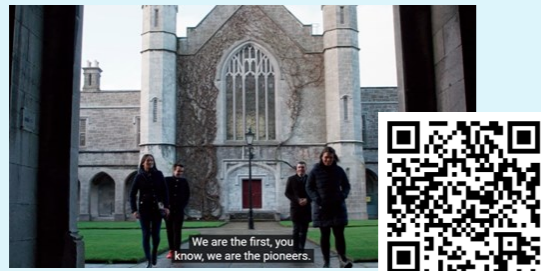
- Encouraging students to use their numeracy skills in real-life situations (Ferlazzo, 2020).
- Providing students with opportunities to collaborate.
- Encouraging oral communication using mnemonics and games that require vocal communication.
- Incorporating activities that help students and teachers to get to know each other and build trust to encourage a sense of belonging (Nash and Kallenbach, 2009).
- Using education resources on Traveller and Roma culture and history (Department of Justice and Equality, 2017).

### Did you know?

Travellers have an ancient indigenous language called Gammon or Cant:

Mincéirí - Traveller  
 ain - one  
 do - two  
 tré - three

Scan the QR code to see how Travellers at the University of Galway are 'Building a Sense of Belonging'



Scan the QR code for a video to accompany this Numeracy-Meet.



### Discussion Points

1. How do you support Traveller students in your numeracy classroom?
1. What methods have you found useful in supporting students from the Traveller community?

### Resources

- If you would like to learn more about Travellers and Traveller culture, Cork Traveller Women's Network has created a video, *A Short History of Irish Travellers*.
- In their book, *Irish Travellers: The Unsettled Life*, American Anthropologists Sharon Bonn Gmelch and George Gmelch reflect on the year they spent living at a Traveller campsite in Dublin in 1971 and the changes they experienced when they returned to Ireland 40 years later.



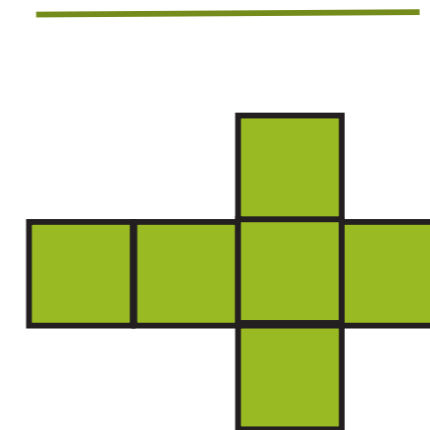
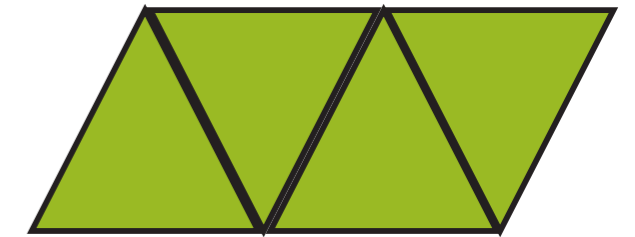
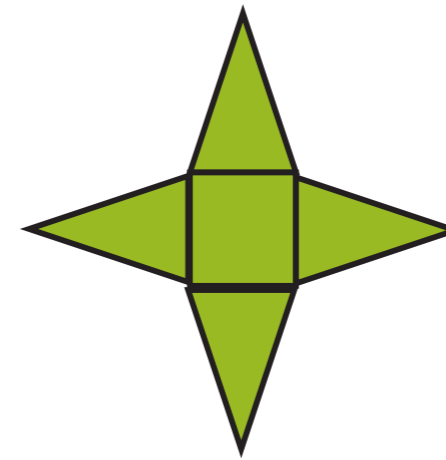
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## Activities

### 2-D nets

Can you identify the 3-D shape from its 2-D net?

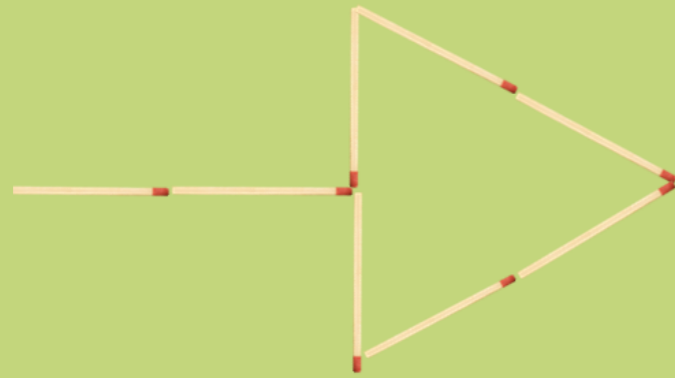


What would the 2-D nets of these everyday shapes look like?



### Match Puzzles

Can you make two smaller arrows by moving just 4 of the matches in this arrow?



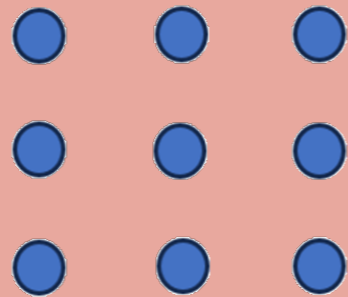
Adapted from <https://matchstickpuzzles.net/>

### Dot Puzzles

Can you connect the nine dots based on the following rules?

(i) You can use a maximum of four straight lines to connect the dots.

(ii) You cannot lift your pen from the page.



### Double Digits

Choose any two-digit number, e.g. 34

Swap the two digits, e.g. 43

Add the original number to the new number, e.g.  $34 + 43 = 77$

Add the two initial digits together, e.g.  $3 + 4 = 7$

Divide the two answers, e.g.  $77/7 = 11$

Try this for other two-digit numbers. What do you notice about your result?

Why do you think this happens?

What happens if you choose negative numbers?



Adapted from NRICH (2023). *Double Digits*, University of Cambridge, NRICH.

# 04

## Numeracy-Meet 4

### Teaching numeracy to migrant learners

# NUMERACY-MEETS NEWSLETTER

Teaching Numeracy to Migrant Learners



## Demographics

According to Census 2022, migrants comprise 12% of the Irish population, an increase of 1% since 2016 (CSO, 2023). Migrants form a diverse group and include asylum seekers, refugees and individuals who come to Ireland to study or to work. The Census shows that 31% of migrants to Ireland in 2021 came from the European Union or the United Kingdom. Polish nationals form the largest number of migrants at 15% overall (see Figure 1). However, the number of Polish nationals living in Ireland has decreased since 2016. The number of Indian, Brazilian and Romanian citizens living in Ireland increased the most between 2016 and 2022. Moreover, although there were 1,785 Ukrainian citizens in Ireland in 2016, between March 2022 and September 2023, 93,810 Ukrainian refugees came here.

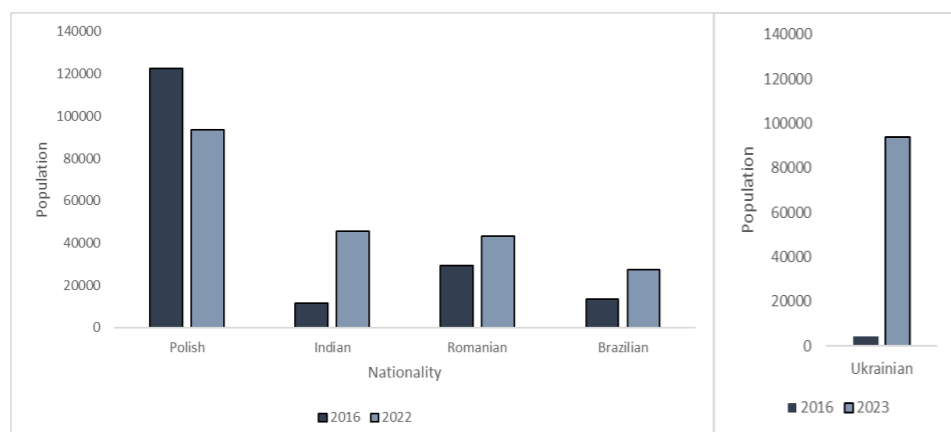


Figure 1 Comparison of the Numbers of Migrants Living in Ireland in 2016 and 2022 by Nationality

## Further Education Statistics

In 2022, there were 44,832 enrolments at National Framework of Qualification (NFQ) Level 4 and under (SOLAS, 2021). These students represented 195 different nationalities (see figure 2).

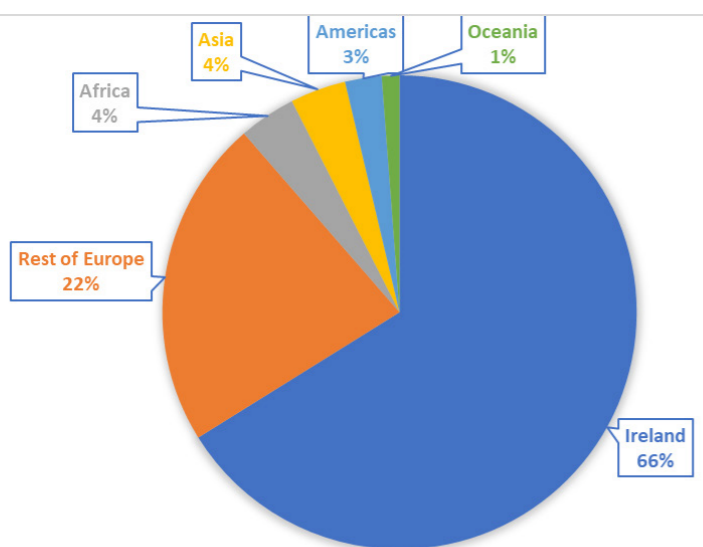


Figure 2 Enrolments at NFQ Level 4 and Under by Nationality in 2022

### Numeracy and Mathematics in the Past

Numeracy has been part of human civilisations for thousands of years. There is evidence that people in Mesopotamia used 'zero,' the number that represents no objects, 5,000 years ago (Kaplan, 1997). 'Zero' did not appear in Europe until the 12th century.

More than 3,800 years ago, Babylonians wrote numeric and advanced mathematics on clay tablets. The Rhind Papyrus, which dates from approximately 1650 BC, shows that ancient Egyptians could solve linear equations with one unknown variable (Britannica, 1999).

## Supporting Migrant Students in the Numeracy Classroom

Culturally responsive teaching requires numeracy educators to enhance students' opportunities for learning by taking into account the ways they communicate and acknowledging students' prior cultural experiences and language (Moschkovich & Nelson-Barber, 2009). Language is a cultural resource through which people learn and demonstrate what they know. In Numeracy-Meet 1, Neville and Ní Ríordáin (2023) discussed ways in which numeracy educators' can support students' development of mathematical discourse:



Although students each have a unique set of personal experiences, they also bring to the classroom a set of experiences framed by their cultural and language backgrounds. It is important that educators encourage students to draw on their previous experiences to strengthen their learning and reduce stress from differences in cultural norms (Jao, 2012).

- Some cultures value a collectivist approach that involves working together to solve problems (Veléz-Ibáñez & Greenberg, 2005), but sometimes individualism and competition are prioritized in the classroom (Abdulrahim & Orosco, 2020). Numeracy educators can support students by encouraging group work.
- Setting high expectations for students' learning and communicating those expectations to students positively affects their academic achievement (Abdulrahim & Orosco, 2020).
- Numeracy educators can support students by sharing authority and responsibility with them and treating students in a caring manner (Bonner, 2014).
- Turner et al. (2012) have found that designing mathematical problems based on students' home communities, critically evaluating classroom practices and getting to know students, their skills and their competencies can help educators to incorporate students' multiple mathematics knowledge bases into classes.

### Example

When Californian teachers heard students complaining about a lack of reception on their mobile phones, they designed a lesson to help students determine the best location for a mobile phone tower near their school. The lesson, which incorporated Pythagoras' theorem, allowed students to engage in significant mathematics learning and provided them with an opportunity to consider a real-world, social/cultural problem in the mathematics classroom (Ellis, 2019).

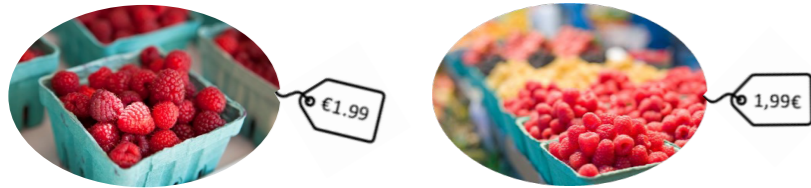
### Famous Mathematicians From Around the World

Mathematician	Nationality	Area of Study
Hypatia (born c. 350 – 370 AD)	Egyptian	Conic sections, algebraic equations and the improvement of long division algorithms.
Muhammad ibn Musa Al-Khwarizmi (780—850 AD)	Persian	Linear and quadratic equations. Considered "the father" of algebra.
Leonard Euler (1701 – 1783)	Swiss	Geometry and trigonometry. Developed Euler's formula: $e^{i\varphi} = \cos \varphi + i \sin \varphi$
William Rowan Hamilton (1805 – 1865)	Irish	Abstract algebra and quaternions
Katherine Johnson (1918 – 2020)	American	Orbital mechanics for NASA spacecraft

## Mathematics: The Universal Language?

Mathematics is generally considered 'the universal language', but mathematical conventions and methods differ from country to country.

- Prices can be confusing. In Ireland, we use a decimal point to separate the whole number from the fraction. Other countries in Europe and South America use a comma in place of the decimal point.




### Did You Know?

A mathematician working at Guinness' brewery in Dublin invented a widely used statistical test in 1908. William Stealy Gosset felt that the normal distribution was not accurate enough for the small samples he was taking and developed the Student t-test instead.

$$t = \frac{\bar{x} - \mu}{s/\sqrt{n}}$$

- Other symbols can be confusing too. Tick the box to indicate which of the following statements is true.

Which of the following statements is true?	Tick
(a) 8:2 is a ratio. The ':' means 'to'. There are eight blue squares 'to' two green squares. 	<input type="radio"/>
(b) 8:2 is a calculation. The ':' means divide $8:2 = 4$	<input type="radio"/>

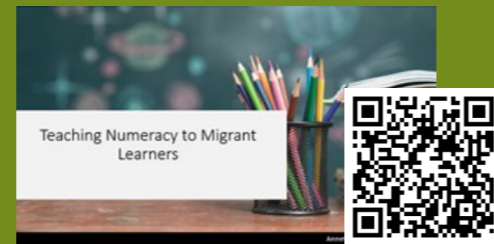
If you attended school in Ireland, you will probably have ticked answer (a), but if you attended school in some parts of South America, you would think answer (b) was correct.

- In India, 'into' means multiply. So, 5 into 10 equals 50. In Ireland and much of the rest of the world, 'into' means divide. So, 5 into 10 equals 2.

## Discussion Points

- How do you support migrant learners in your numeracy classroom?
- What methods have you found useful in supporting migrant students?

Scan the QR code for a video to accompany this Numeracy-Meet.



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## Activities

### Dan Finkel's 1-2 Nim

Dan Finkel, founder of Math for Love, offers a three-step system for engaging students in rich learning in numeracy and mathematics:

- Launch
- Productive struggle
- Wrap up/conclusion

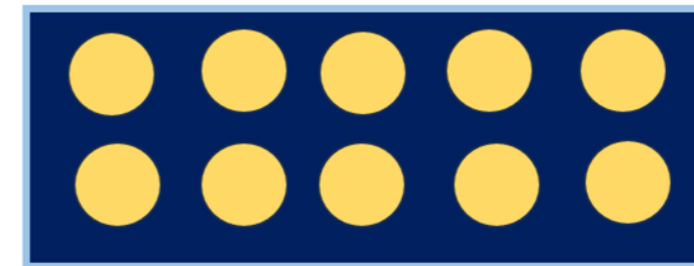
### Example

1-2 Nim is a simple strategy game involving two players and counters.

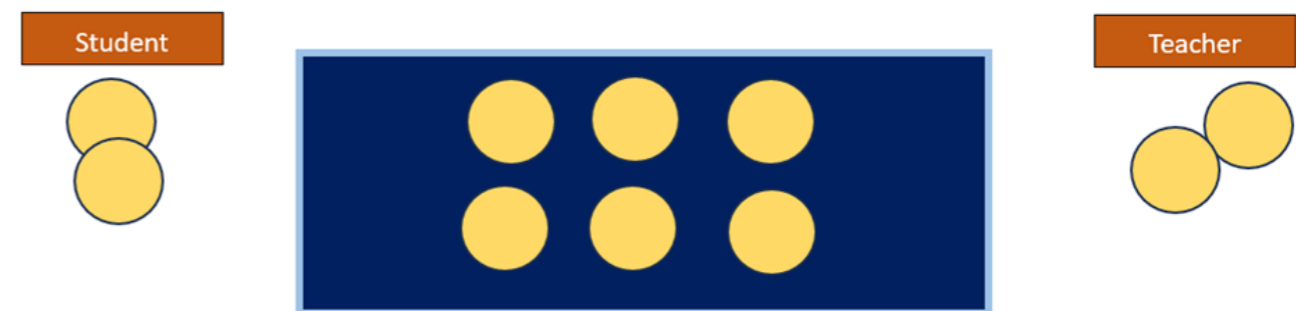
### Rules

- Players take turns at removing counters from a page.
- They can remove 1 or 2 counters at each turn.
- The winner is the player who removes the last counter(s).

**Launch:** To launch the activity, the teacher and a student play 1-2 Nim with ten counters. The board is set up as shown below.



**Round 1:** Let's say the student removes two counters in the first round and the teacher removes two counters.



**Round 2:** The student removes two more counters and the teacher removes one.



**Round 3:** The student is now in trouble. It does not matter if they remove one or two counters because the teacher is going to win. Let's say the student removes 2 counters. Then the teacher removes the last counter and wins the game.



**Productive Struggle:** Students work in groups playing the game and trying to work out a strategy to win. They might ask themselves the following questions.

1. Is it better to start first or second?
2. Should I take one or two counters?

To answer these questions, students need to simplify the game first.

They might start by considering what would happen if there was only one counter in the game.



They will probably note that with one counter it is better to go first. What about if there are two counters? With two counters it is also better to go first. However, with three counters it is better to go second and so on.

Number of Counters	Should I go first or second?
1	First (take 1)
2	First (take 2)
3	Second
4	?
5	?
6	?
7	?
8	?
9	?
10	?

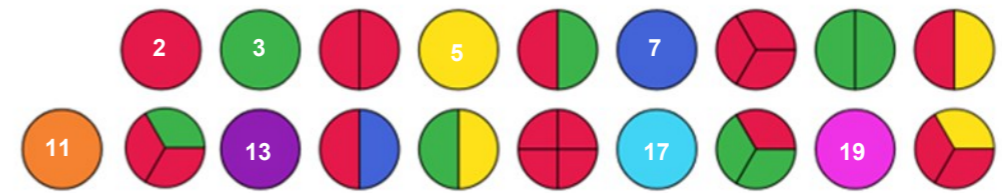
**Wrap Up:** Finally, a student replays the game with the teacher and uses the table to decide which starting strategy to use and how many counters to remove on each turn.

Adapted from Finkel, D. (2019). *1-2 Nim*.

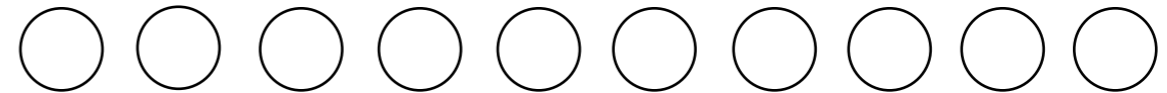


### Xavi's T-shirt

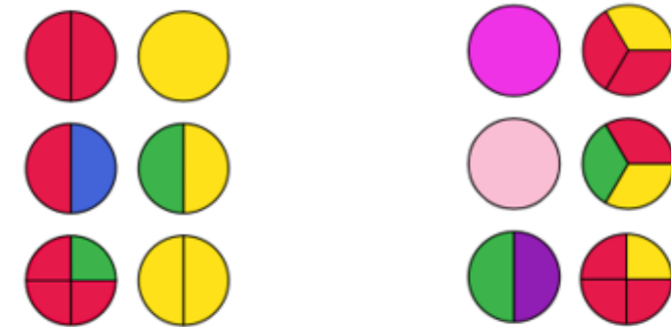
The numbers 2 to 20 can be represented as follows:



How are the circles designed? How could the next 10 numbers be represented? [Hint: look at the circles for prime numbers].



If we continue drawing circles until we have the numbers 2 – 100, and then cut out a random block of six numbers can we work out what numbers the circles represent? What numbers do the blocks below represent?



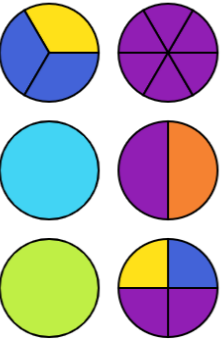
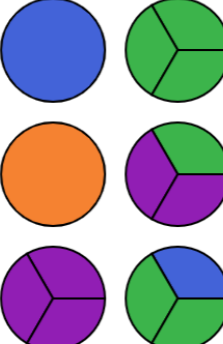
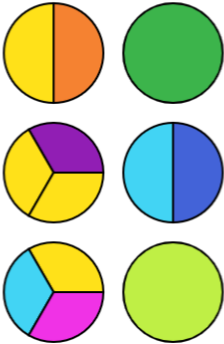
Different colours are then used to represent the numbers 2 – 100. Let's see what numbers these blocks represent. [Hint: remember once you have one number it is easy to work out the others.]

This is the one we should check first because it is divided into five sections and there are very few like that. It could be 80 i.e.

$2 \times 2 \times 2 \times 2 \times 5$

instead of 48 ( $2 \times 2 \times 2 \times 2 \times 3$ ).  
Why did we not put 80 here?

How about these blocks?

Block A (easy)	Block B (medium)	Block C (hard)
		

Adapted from NRICH (2023). *Xavi's T-shirt*, University of Cambridge, NRICH.



### Big Powers

If you add the two numbers below, is the answer divisible by 5?

$$3^{444} + 4^{333}$$

Adapted from NRICH (2023). *Big Powers*, University of Cambridge, NRICH.



### Combinatorics

Can your students solve these combinatorics problems?

1. Five world leaders meet at a summit. They each shake hands with the other four leaders. How many handshakes are there in total?
1. Five friends share a birthday and always send each other a birthday card. How many birthday cards do they send in total?

Are the answers the same? Can you model the scenarios?

# 05

## Numeracy-Meet 5

Teaching numeracy  
in prisons

# NUMERACY-MEETS NEWSLETTER

Teaching Numeracy in Prison



## Demographics

As of 1 September, 2023, there were 4,612 individuals in custody in Irish prisons, 96% male and 4% female. Data indicates that 82% of all prisoners are under 50 years (see Figure 1). Individuals who have grown up in the care system are over-represented in Irish prisons (Carr & Maycock, 2019). Additionally, prisoners are more likely to have experienced mental health problems, homelessness, addiction, and educational disadvantage than the general population (Fazel & Baillargeon, 2011). More than 70% of prisoners who were incarcerated in 2011 were unemployed and approximately the same percentage did not have any particular trade or occupation. Moreover, a recent study revealed that 20% of prisoners had completed their Leaving Certificate, 48% had completed their Junior Certificate and 26% never went to secondary school (O'Brien, 2018).

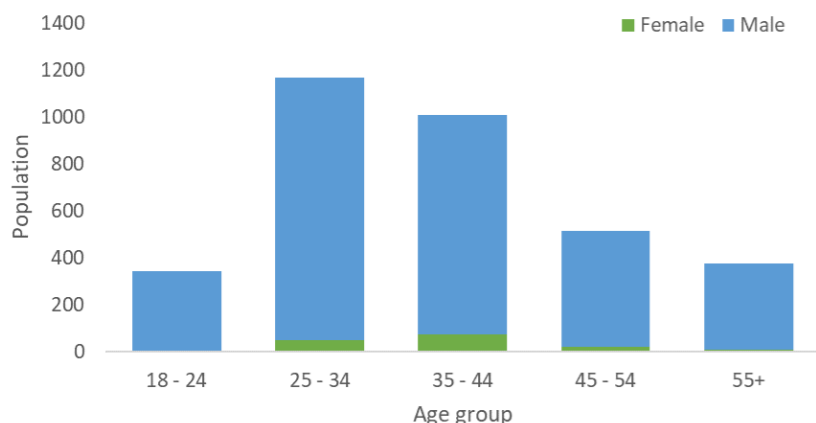


Figure 1 Numbers of Male and Female Prisoners in Ireland by Age in 2022

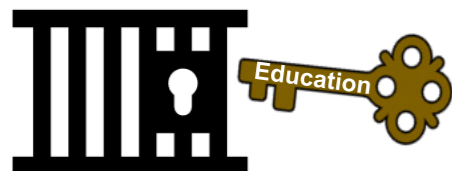
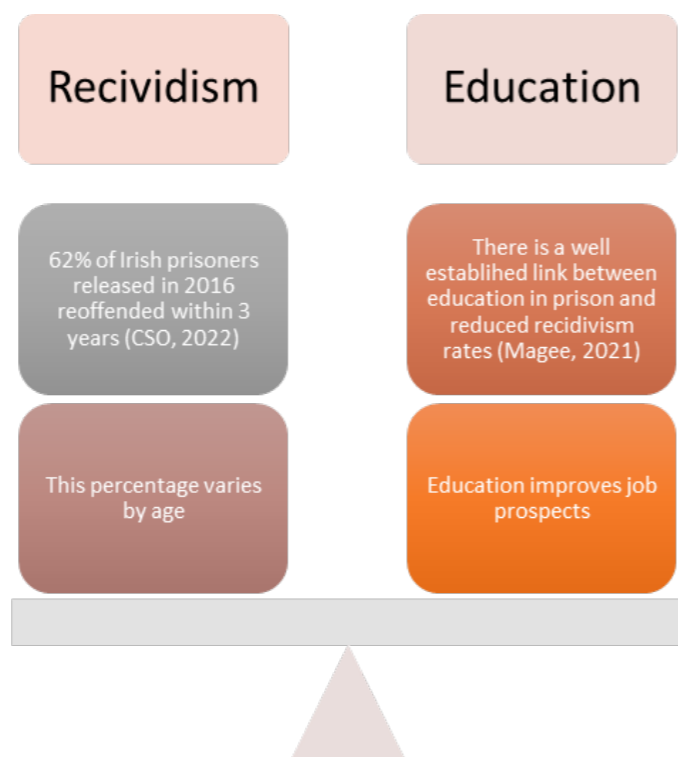
*“Prison was the best thing that ever happened to me... I went to school every day for three years solid. I think I have over 40 QQI Certs.”*

Level 6 student (2019)

## Prison Education

All Irish prisons provide educational services including literacy, numeracy and general basic education programmes (Irish Prison Service, 2023). Participating prisoners can earn Quality and Qualifications Ireland awards, study for their Junior and Leaving Certificate or avail of higher education courses. Engagement with prison education varies from prison to prison (Houses of the Oireachtas, 2018). Although 82% of prisoners at Loughan House Open Prison participate in education only 15% of prisoners at Wheatfield Prison do so.

The empirical research indicates that offenders who engage in education in prison are less likely to reoffend when they are released (Magee, 2021).



## The Challenges of Teaching in the Prison Numeracy Classroom

- In the prison system, education is secondary to staffing and security considerations, which, at times, may result in the suspension of classes (Irwin, 2008).
- On a given day, students may be absent from class because they are in court or have moved to a different prison (Byrne & Carr, 2015).
- Prisoners volunteer to participate in education and have a variety of reasons for attending classes while in prison. Some prisoners want to prepare for a productive life after prison and some are transforming themselves — adopting “a different self” (Behan, 2014, p. 24). However, others are there to kill time and to escape the prison routine.
- Many prisoners lack the digital literacy skills that are required to function in the modern world, whether that be in the workplace, in social interactions and in education. However, the Internet is not available in all prison schools, preventing some students from using online numeracy games and resources.

*“Until a couple of years ago, I had never sent an email. I had been nearly 16 years in prison. I had never used Excel in my life. I had never put together a PowerPoint slide or presentation.”*

Level 6 student (2019)

## Barriers to Participation in Prison Education

A study by Manger, Eikelan and Asbjørnsen (2018) found that three types of barriers affect participation in prison education:

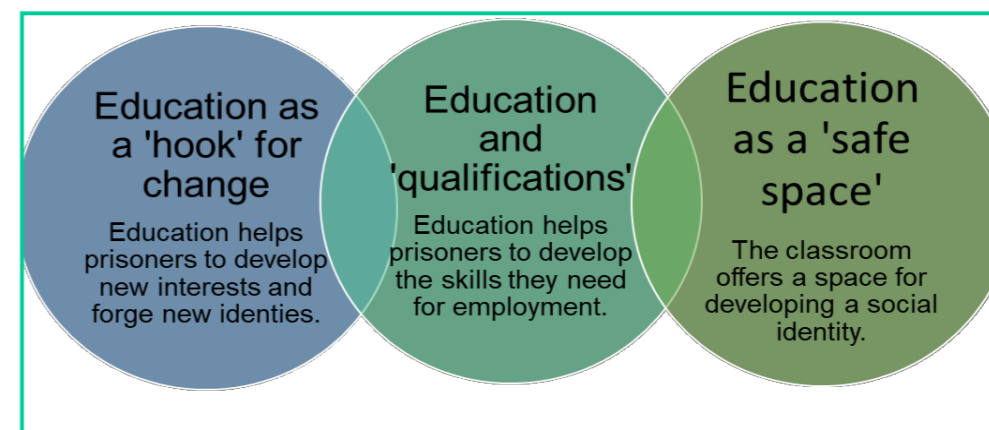
**Institutional Barriers** result from a lack of information about the educational opportunities that are available, practical arrangements that are inadequate or inadequate technical resources.

**Situational Barriers** refer to prisoners' lack of interest in the modules offered, contention that education is not worth the effort and doubts that engaging in education will help them when they are released from prison.

**Dispositional Barriers** are related to prisoners' literacy and numeracy difficulties as well as their difficulty concentrating in prison.

## Benefits of Prison Education

Prison education offer several benefits including helping prisoners to change, allowing them to acquire qualifications and offering a safe space in the prison system.



Szifris et al. (2018)

## Supporting Students in the Prison Classroom

- Numeracy educators can help to reduce the damage caused by the prison environment by adopting a pedagogy of care that convinces students that learning matters, promotes high expectations, makes the numeracy classroom a welcoming space, and engages students' interest (Wolf, 2020).
- They can encourage successful classroom learning by enabling students, encouraging personal development and building students' self-esteem (Reuss, 1999).
- Numeracy educators can encourage disaffected learners and those who have low self-esteem through problem-solving and reflection, which will allow learners to construct concepts and understandings (Bayliss & Hughes, 2012).

We can enable students by allowing them to make mistakes and learn from those mistakes and by giving them the opportunity to overcome challenges by themselves.



### Critical Pedagogy

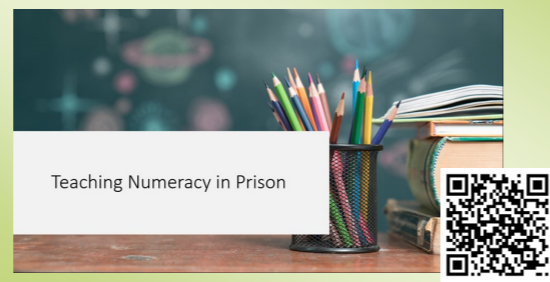
- Social justice
- Learning
- Teaching
- Democracy

Paulo Freire's critical pedagogy can link the prison mathematics classroom to the wider sociopolitical community. Critical pedagogy, which sees learning as a co-investigation between teachers and students, encourages students to think critically and prompts active inquiry (Frankenstein, 1983).

### Discussion Points

- How do you support prisoners, or former prisoners, in your numeracy classroom?
- What methods have you found useful in supporting students in the prison community, or former prisoners?

Scan the QR code for a video to accompany this Numeracy-Meet.



### References

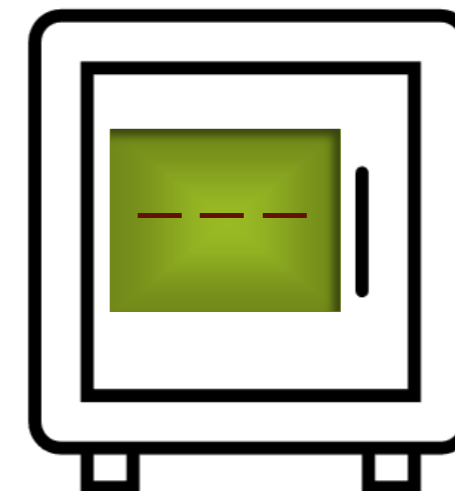
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## ACTIVITIES

### Can You Find the Code?

You have locked your passport in your hotel safe. However, you have forgotten the code. The hotel manager says that the following clues will help you to crack the code on the safe and retrieve the passport. Can you do it?

8	0	4	One number is correct and in the correct position
8	6	7	One number is correct but in the wrong position
4	2	8	Two numbers are correct but in the wrong positions
9	5	0	Nothing is correct
9	0	2	One number is correct but in the wrong position





## Minimum Wage

Your task is to work in groups, or on your own, to consider whether the current minimum wage in Ireland is fair. You should present evidence to back up your opinion.



This activity uses a critical pedagogy approach to engage students with mathematics while considering the implications of social issues. It can be completed as a part of a unit on functions and graphs and is suitable for level 3 and level 4 students.

The following information may help you to reach a decision.

- (i) The average salary in Ireland in 2022 was €52,971.
- (ii) The table below shows the minimum wage in Ireland between 2017 and 2024.

Minimum wage (age 20+)	2017	2018	2019	2020	2021	2022	2023	2024
	9.25	9.55	9.80	10.10	10.20	10.50	11.30	12.70

Questions you might ask yourself when considering this table:

- ◆ What information does the table provide?
- ◆ If you were to draw a graph using the data in this table, what would the graph look like?
- ◆ You might draw the graph to see if your assumption was correct and try to generate an equation to model the data.
- ◆ If someone worked 40 hours per week and earned minimum wage, what was their gross income per week in 2017 in comparison to 2023? Do you think this increase is reasonable? What factors did you take into account when making your decision?

- (iii) People under the age of 20 have different minimum wage rates. These rates are shown in the table below.

Minimum Wage (euros)								
Age	2017	2018	2019	2020	2021	2022	2023	2024
Under 18 years	6.48	6.69	6.86	7.07	7.14	7.35	7.91	8.89
18 years	7.40	7.64	7.84	8.08	8.16	8.40	9.04	10.16
19 years	8.33	8.60	8.82	9.09	9.18	9.45	10.17	11.43

# 06

## Numeracy-Meet 6

Teaching numeracy  
to mature learners

# NUMERACY-MEETS NEWSLETTER

Teaching Numeracy to Mature Learners



## Demographics

CSO data (2017a) revealed that the percentage of older adults in Ireland has increased in recent years. In 1986, 28% of people living in Ireland were 45 years or older, but this increased to 34% in 2011, 37% in 2016 and 40% in 2022 (see Figure 1). Moreover, the percentage of people aged 70 years and over increased by 26% between 2016 and 2022 (CSO, 2023). The average age of the population of Ireland increased from 36 years in 2011 to 39 years in 2022.

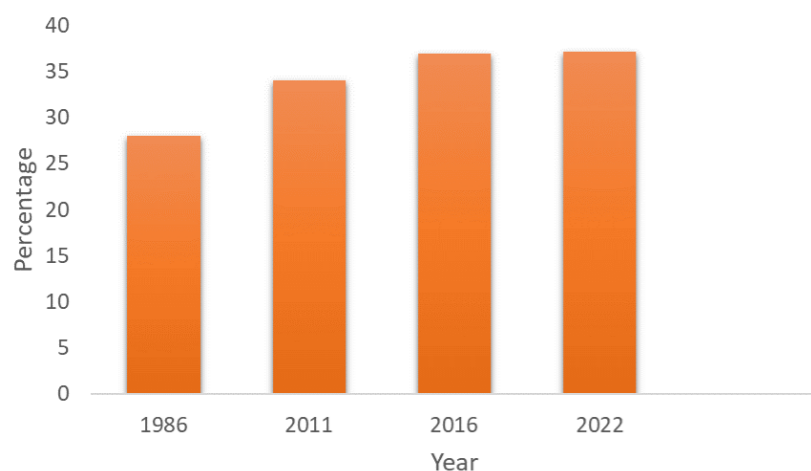


Figure 1 Increase in the Percentage of the Irish Population Aged Over 45 Years Between 1986 and 2022

Average life expectancy in Ireland

Men — 76.8 years

Women — 81.6 years

## Mature Learners and Education

Older Irish adults have lower levels of education than younger people (CSO, 2017b). Although 60% of 25–29 year olds have a tertiary education, only 23% of 65–69 year olds and 13% of those over age 85 are educated to this level (see Table 1).

Table 1 Highest Educational Attainment of Different Age Groups in 2022

Age	Level		
	No formal/Primary	Secondary	Tertiary
35 - 39	4%	37%	59%
65 - 69	33%	44%	23%
85+	50%	37%	13%

However, in Census 2022, people from all age groups indicated that they had not yet ceased their education (see Figure 2). Of the individuals aged 65 and over who were engaged in education, 78% indicated that they were retired or were taking care of the home.

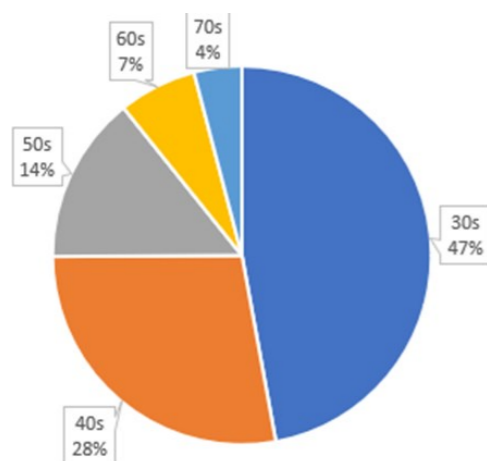


Figure 2 Percentage of Students aged 30s to 70s in 2022

## Advantages of Education for Mature learners

The National Positive Aging Strategy (2013) aims to provide people with opportunities to participate in all of the cultural, economic and social life of their community regardless of age, according to their preferences. Adult education can benefit learners in terms of socio-economic, psychosocial and socio-political resources that contribute to improved health outcomes as people get older (Gibney et al., 2018).

The benefits of education for older adult learners include:

- increased confidence and mental stimulation.
- Protection against cognitive decline.

Approximately 80,000 Irish workers are 66 years and older.

## Barriers to Lifelong Education for Mature Learners

Some mature learners do not engage in lifelong learning for a variety of reasons including:

60% of Irish people aged 75 years and over report that their health is 'good' or 'very good'.

- Caregiving duties.
- Lack of information from education providers.
- Lack of finance and study facilities.
- A weak emphasis on learning for older age-groups (only 0.8% of individuals aged 55-74 engage in learning).
- People with the lowest levels of education tend not to engage in lifelong learning.

## Mature Learners and Numeracy

Mature individuals can be vulnerable as they may experience poor health and face financial constraints. However, a study of individuals aged 64–93 years (Zenuer et al., 2020) revealed that older individuals use numeracy in a variety of ways to minimize the effects of their vulnerability.

**Financial numeracy:** The research indicated that mature individuals use numeracy skills such as calculating and estimating in order to manage their finances. Long-term strategies were also employed, including saving money, restricting shopping to the essentials, and downsizing in advance of retirement to minimize costs.

**Health numeracy:** Participants also used numeracy in managing their medicines, monitoring their fluid intake and performing exercises. They engaged in a critical assessment of their health by combining basic medical knowledge with statistical data. They made decisions about treatments and possible therapies by using numeracy skills such as calculating, counting, measuring, and estimating. They also employed their numeracy skills to stay mentally active.

**Social embeddedness of numeracy:** As well as needing the financial independence to maintain social interactions, some participants discussed numeracy problems and sought computer support from family members and friends.

## Scams

Older adults with weaker financial literacy skills are more susceptible to scams. Financially fragile individuals tend to have fewer years of education, lower incomes, lower financial literacy, and weaker financial decision making skills than their more financially literate peers (Yu et al., 2022).



## Supporting Mature Learners in the Classrooms

- Ageism has a negative effect on people's physical, mental and social well-being. Numeracy educators can help mature students by being mindful of their own ageist stereotypes and discouraging students from engaging in self-directed ageism, whereby they internalize ageist stereotypes (Age Action, 2022).
- Although performance on cognitive tasks such as quickly assessing information to make a decision declines with normal aging, physical activity and mental stimulation can decrease the rate of cognitive decline (Murman, 2015). Numeracy educators are ideally placed to provide mature learners with cognitive training in the form of games and puzzles that encourage problem-solving, reasoning and numeracy skills.
- Numeracy educators should also be mindful of
  - Mature learners' unmet needs.
  - offering meaningful contexts for students.
  - creating numeracy resources that are relevant and applicable in real life.

(Solas, 2021)

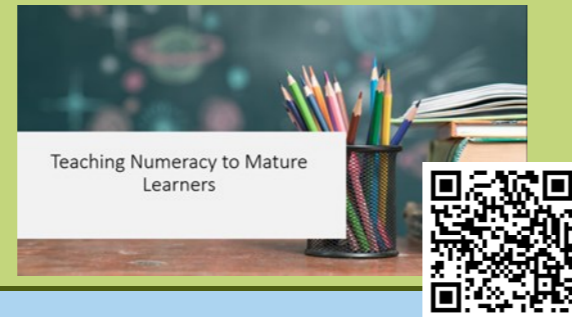
### An Age Action opinion poll (2022) revealed that:

- 67% of people in Ireland hold some ageist opinions.
- Younger people are more likely to hold ageist opinions.
- Men are more likely to hold ageist opinions than women.

## Discussion Points

- How do you support mature learners in your numeracy classroom?
- What methods have you found useful in supporting mature learners?

Scan the QR code for a video to accompany this Numeracy-Meet.



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## ACTIVITIES

### Logic Puzzles

The prefrontal cortex of the brain plays an important role in memory retrieval. Moreover, growing evidence suggests that the prefrontal cortex is involved in some forms of dementia, Alzheimer's disease and normal aging (Erberk Ozen & Rezaki, 2007). Research has shown that the cognitively stimulating puzzle Sudoku involves the prefrontal cortex and therefore may be used for cognitive regeneration training (Ashlesh et al., 2020). Staff et al. (2018) found that although intellectual engagement was associated with cognitive ability levels in late adulthood, it had no effect on the trajectory of decline over time, but a lifetime of engaging in intellectual activities could provide a higher cognitive point from which to decline.

	9	6			3	8		7
	4		9		2			5
		5		8	1	2	4	9
3		7						2
5	1			2				8
				9		7	5	1
						1		3
	2	8		3		9		4
1	7		2	4	9			

Using sudoku puzzles with older adults may help to improve their memory and cognitive functioning.

A similar puzzle called Cut Blocks (Curzon & McOwan, 2016) offers an alternative to sudoku. In a Cut Block darker lines outline different sub grids.

1. In this Cut Block, the darker lines outline four different sub grids. One of these areas contains one block, it can only contain the number '1'. Another contains two blocks, which must contain the numbers '1' and '2'. A third has four blocks and therefore must include the numbers 1, 2, 3, 4 etc.
2. When placing numbers in the block, a number cannot be next to the same number vertically, horizontally or diagonally.

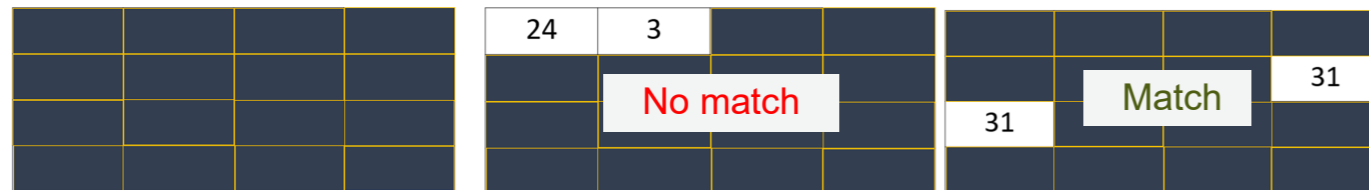
	4	
		2
	3	

## Memory and Patterns

### Go Fish/Concentration

Other games and puzzles that can help mature learners to remain mentally active include the memory game 'Go Fish', sometimes called 'Concentration'. In this game, numbered cards are placed face downward. Players take turns at turning cards over two at a time to see what number is on the reverse. The goal is to match two cards with the same number. Once the two cards are matched they are removed from the game. The player who has the most matches when all of the cards are gone wins.

It is possible to play the game as a single player. Single players can time how long it takes to make all of the matches.



### Patterns

Pattern recognition is important in maths and numeracy because it supports learners' conceptual understanding. Pattern recognition is also important in generalising solutions.

What comes next in the following pattern?

Adapted from Paul McOwan's (2023) Teaching London Computing

### Games

Games such as solitaire, bingo and chess improve memory, cognitive functions and attention span. Board games also provide opportunities for socialization.



## Budgeting

### Living on a fixed income

A report from Age Action (2021) revealed some older adults have insufficient income to meet their needs. As a result:

- 17% of adults aged 65 and older are at risk of poverty and social exclusion.
- The risk of poverty is greater for older women (20%) than older men (14%).
- The risk of poverty increases for those who live alone— 43% of people over 65 years living alone are at risk of poverty.
- Only 46% of people who have a contributory state pension receive the full amount.

### Planning for Retirement

After retirement, people probably have less money to live on, so it is important to plan in advance (Moneyhelper, 2023). This means:

- Working out the amount of money required to meet basic living needs.
- Working out the amount of money needed for discretionary spending, e.g. holidays, socializing.
- Working out retirement income from pensions.
- Working out income from other sources including, savings and investments, property rentals, part time jobs, downsizing a home or renting out a room.

To encourage mature learners to think about their own retirement plans, numeracy educators can help them to work through retirement plans for fictitious individuals.

#### Sarah's Retirement

Sarah is 55 years old and single. She has no dependents. She is currently working full-time and is thinking about retiring in 10 years. Sarah is wondering if she will be able to maintain her current lifestyle when she does so. Therefore, she is working out a budget for her retirement. Sarah owns her home just outside Dublin, which is worth approximately €350,000 and she has paid off the car loan on her 3-year-old car. So, she has no mortgage or car payments. She has savings of €30,000 and plans to save €2,500 per year over the next 10 years. Sarah does not have a private pension, but will receive a standard contributory pension of €254 per week on retirement. Will Sarah be able to maintain her lifestyle after retirement? If not, what steps can she take to improve her financial situation?

Current expenses per year	Amount (€)
Rent	0
Food	5000
Utilities (electricity, heating, bins, TV license/broadband)	4000
Mobile	300
Tennis	1000
Cinema, theatre	1000
Restaurant	3,000
Car insurance/tax/petrol	2,100
Holidays (2 per year)	6,000
Clothes	2,000
Total	

Income after retirement	Amount (€)
Pension	254 per week
Savings	55,000



