

# A comparison of the problem solving and procedural skills of those in adult mathematics education in Ireland

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# Research Context

- The desire of having *numerate citizens* and students who can *problem solve* effectively is often driven by a nations need to stay economically competitive (Perkins & Clerkin, 2020).
- Adult mathematical numeracy is essential to *ensuring job markets, economies and societies prosper* in addition to the having a key role in *improving the lives of citizens* (Gal & UNESCO, 2020).
- Much literature exists on the *importance of the development of problem solving skills in mathematics* (IBEC, 2015) and a subsequent need to use *effective pedagogical practices* to support this (Foshay & Kirkley, 2003).
- Despite these uncontested and commonly reported findings *adult mathematics education is often overlooked* when it comes to providing appropriate provision in terms of its development and improvement (Gal & UNESCO, 2020).

# The Irish Context



- Curriculum change in second level – ‘Project Maths’
  - Rote learning/procedural skills  Conceptual Understanding/Problem solving
- Same opportunity not afforded to improve mathematics education for adult learners:
  - The Access Foundation Programme is a *one year preparatory programme* for students wishing to pursue an undergraduate programme at certificate or degree level in Ireland. The programme provides a route to education for students from *communities which lack a strong tradition of participation in third level education.*

# Problem solving in mathematics: some related research....

- Much written about but not easily to effectively implement in education (Kilpatrick, 1969).
- Very much desired by both employers and those in higher education institutions (Vordermann et al., 2011).
- The desire for this problem solving skill set often stems from it reportedly not being at the disposal of many school leavers (Jones et al., 2014).
- Difficulty transferring knowledge to the workplace (Treilibs, 1979).
- This “hiatus” between formal mathematics education and the workplace has also been acknowledged in research by FitzSimons and Boistrup (2017).

# Measuring Problem Solving: The Diagnostic Test

- Diagnostic Test Design
- Contents of the Diagnostic Test
- Data Analysis
- Sample

# Diagnostic Test: Sample questions

## Section A: Procedural Question

4. What is the difference in the areas of: a circle with radius 5cm and a rectangle with a length of 12cm and a width of 10cm?

Ans: \_\_\_\_\_

Note: Area of a circle =  $\pi r^2$  where  $\pi = 3.14$ .

## Section B: Problem Solving Question

4. A swimming pool of length 15m and width 8m had a circular Jacuzzi of radius 2m put into it. How much of the surface area of the swimming pool will be left when the Jacuzzi is introduced? (HL JC 2015 P2).

Ans: \_\_\_\_\_

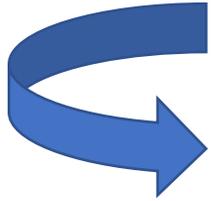
Note: Area of a circle =  $\pi r^2$  where  $\pi = 3.14$ .

# Diagnostic Test: Results

	Section A	Section B	p-value	N
All students	$\bar{x} = 57.2$	$\bar{x} = 32.3$	$p = 0.00$	87
Adult Students	$\bar{x} = 43.1$	$\bar{x} = 18.7$	$p < 0.001$	30
Engineering Students	$\bar{x} = 64.6$	$\bar{x} = 39.5$	$p < 0.001$	57

# Discussion

- Regardless of student programme, gender, nationality all students performed significantly worse in section B of the test when compared to section A.



**Challenge with applying basic mathematical concepts to applied scenarios.**

- The *concepts required* to answer the paired questions are the same.
- Possibility of some *intrinsic difference in difficulty* level between the questions in each section of the test due to the problem solving questions requiring more processing to successfully complete the questions.
- Particularly likely to be the case with adult students, out of formal education, new style of teaching and content since they were in school.

# Discussion

- It is possible that ***literacy issues*** also play a key role in the challenge that the adult learners face (Prendergast et al., 2017).
- Although the anticipated challenge of literacy was considered and acknowledged in the development stages of Project Maths it was deemed a *necessary challenge* for those wishing to be successful in problem solving across all disciplines (Foshay & Kirkley, 2003; Faulkner et al., 2021).

# So what can we learn for AME?

- **Adult learners *display similar patterns of challenges* in terms of their procedural and problem solving skills as compared with traditional students however to a larger degree.**
- Despite this common initial underperformance and categorisation of being ‘at risk’ of failing mathematics often improve to a large degree due largely to engagement with mathematical support services (Faulkner et al., 2021).
- Focus to date has been on remediation rather than ***pro-active measures*** to ensure best practice in adult mathematics education:
  - Appropriately trained tutors.
  - A focus in adult mathematics education on problem solving skills in mathematics is needed for the same reasons that it is advocated and provided for in second level education.
  - Same provision should be given to AME as primary and secondary level.
  - Continuous professional development programmes are now being put in place to upskill such teachers (Hobbs & Törner, 2019).
  - Where is the training for those in AME?

# Conclusion and Recommendations

- This research highlights the comparatively weaker skills that those in adult mathematics education demonstrate in problem solving in mathematics compared to procedural skills in mathematics.
- Challenges that are reflective of those coming directly from second level education.
- Lack of provision and investment in their mathematics curriculum and teacher training.
- The ‘Adult numeracy: Assessment and development’ policy outlines the significant numeracy challenges faced internationally and makes 3 recommendations one of which involves “investing in the development of national capacities to measure and improve adult numeracy” (Gal & UNESCO, 2020, p.3). This international and recent recommendation very clearly aligns with the research being outlined.

# Thank You!

