

RESEARCH ARTICLE

Investigating mathematics anxiety in out-of-field teachers enrolled in Ireland's upskilling programme

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Abstract

Research shows that many university students, including mature students, have debilitating mathematics anxiety (MA); and mathematics anxious teachers risk passing on MA to their students. This paper investigates mathematics anxiety (MA) among a cohort of out-of-field secondary teachers enrolled in Ireland's Professional Diploma in Mathematics for Teaching (PDMT). Prompted by national concerns regarding teacher qualifications, the PDMT was introduced to address a significant proportion of mathematics instruction delivered by non-specialist teachers. A mixed-methods design was used with 49 respondents completing both a qualitative survey and two measurement instruments: the Mathematics Anxiety Scale – UK (MAS-UK) and the Mathematics Anxiety Scale for Teachers (MAST). Findings indicated low-to-moderate levels of MA among participants, with anxiety predominantly associated with teaching contexts rather than everyday mathematical tasks. Qualitative analysis revealed recurring concerns related to content knowledge, instructional strategies, and confidence in real-time problem-solving. A strong positive correlation ($r = .852$) between MAS-UK and MAST scores highlights the connection between general and teacher mathematics anxiety. This study hypothesises that mathematics anxiety affects out-of-field mathematics teachers and considers ways to support future PDMT students in addressing and reducing mathematics anxiety. The findings underscore the importance of embedding targeted confidence-building strategies within professional development programmes to enhance mathematics teaching quality and reduce anxiety transmission to students.

Keywords: Out-of-field mathematics teachers, mathematics anxiety, professional development.

1. Introduction

Mathematics is a highly valued, foundational subject and essential to economic and educational development, underpinning advancements in science, technology, engineering and mathematics (STEM) disciplines, as well as featuring in a wide variety of academic programmes. However, research shows that persistent challenges have had an impact on the uptake of mathematics as a higher-level subject and in the pursuit of mathematics teaching as a career across jurisdictions (Goos et al. 2023; Ramirez et al., 2018; Saunders, 2025). Of significance for Ireland were the declining Programme for International Student Assessment (PISA) rankings between 2003 and 2009, where Ireland's figures dropped by 16 points, leading to a review of mathematics curricula in schools (Perkins et al., 2013). Further, the result of a national study into out-of-field mathematics teachers revealed that 48% of mathematics teachers were out-of-field, i.e. teaching mathematics without the necessary subject-specific qualifications (Ní Ríordáin & Hannigan, 2009). The findings led to the development and launch of the Professional Diploma in Mathematics for Teacher (PDMT) in 2012 as a “long-term, large scale, government-funded, university-accredited programme offered nationally” (Goos et al., 2023). A recent review of the PDMT showed that by 2020 the number of out-of-field mathematics teachers had reduced to 25% (Goos & Guerin, 2021). Initially the program

required teachers to have timetabled hours in mathematics, ensuring they had some teaching experience in the subject. Many had studied mathematics in their primary degrees; now the PDMT is available to any secondary school teacher seeking qualification in mathematics, resulting in a diverse participant profile with many having no prior mathematics teaching.

Mathematics anxiety (MA) is a well-documented phenomenon that can significantly impact both learning outcomes and teaching effectiveness. Research indicates that university students, including mature learners, often struggle with high levels of MA, which can hinder their engagement and performance in mathematics-related subjects (Ryan, Fitzmaurice & Johnson, 2023). The prevalence of MA is particularly concerning in the context of pre-service and in-service teachers who lack formal mathematics education, as they may unknowingly transfer their own apprehensions to their students, perpetuating a cycle of adverse feelings towards mathematics (Brady & Boud, 2006; Dowker, Sarkar & Looi, 2016). Given that out-of-field mathematics teachers continue to be prevalent in schools, it is important to understand the extent to which MA affects their confidence and instructional quality. This study explores the extent and manifestation of MA among out-of-field mathematics teachers and proposes recommendations to help future pre-service and developing mathematics teachers build confidence, improve pedagogical strategies, and ultimately alleviate anxiety for both educators and their students.

2. Out-of-field mathematics teachers and mathematics anxiety

Out-of-field – or non-specialist – mathematics teachers are formally qualified in subjects other than mathematics but are either currently teaching or preparing to teach mathematics (Ingersoll, 2002). The issue of out-of-field teaching is significant in education, as it can impact both the effectiveness of teaching as well as student outcomes. Teachers qualified in other disciplines may face challenges in content mastery, pedagogical strategies, and confidence when transitioning to mathematics instruction (Ní Ríordáin & Hannigan, 2009). The presence of out-of-field teachers in secondary education suggests there is a shortage of, and a need for more, specialised mathematics educators.

The PDMT has significantly reduced the number of out-of-field mathematics teachers in Ireland and has facilitated a shift toward student-centred instructional approaches. The review of the PDMT programme by Goos and colleagues revealed that graduates of the programme report increased emphasis on problem-solving, conceptual understanding, and student engagement, aligning with international best practice. However, despite this progress, 25% of mathematics teachers remain underqualified; and out-of-field teachers are still disproportionately assigned to lower-level classes, and frequently first-year classes, where the quality of mathematics teaching is crucial for a successful transition from primary to secondary education (Ryan, Fitzmaurice & O'Donoghue, 2021a). If the transitional experience in mathematics is compromised by inadequate teaching, the gap between high- and low-achieving students will widen as they progress through secondary school (Ryan, Fitzmaurice & O'Donoghue, 2021b). Further, ongoing challenges in teacher recruitment and cultural attitudes toward mathematics teaching highlight the need for continued investment and systemic change (Goos et al., 2023).

In respect of the extent of MA in Ireland, there is a lack of normative data in general among students, and specifically among mathematics teachers at all levels of education (Para et al., 2024). MA is not limited to school-going students, but is also prevalent among teachers, pre-service teachers, and mature students. Research has highlighted that many educators themselves experience MA, which can influence their teaching approaches and potentially perpetuate MA among their students (Ganley et al., 2019; Ramirez et al., 2018; Ryan et al., 2023).

International assessments, such as the Programme for International Student Assessment (PISA), have documented concerning trends in MA. Results indicate that MA levels have increased since 2003, suggesting that factors such as changing educational expectations, pressures of standardised testing, and societal attitudes toward mathematics may be contributing to this trend (OECD, 2004; 2013; 2019). Understanding these patterns provides a useful backdrop to help formulate and implement strategies to mitigate MA and support students in developing a positive relationship with mathematics. In response to the growing recognition of MA as a barrier to learning, there has been an increase in initiatives aimed at raising awareness and providing support, including educational programmes, teacher professional development workshops, and intervention strategies for students and educators (Para et al., 2024). These initiatives emphasise the importance of addressing MA early, fostering a growth mindset, and promoting positive mathematical learning experiences.

Despite increasing global awareness of MA and its effects, there is a paucity of research focusing on Irish students and teachers, particularly among mathematics educators. Without such detail, it is difficult to develop tailored interventions and policies that effectively address the experiences of individuals within the Irish education system. With this backdrop, the study aims to explore the extent of MA among out-of-field mathematics teachers and proposes recommendations to support future PDMT students in reducing their own and their students' MA.

3. Research Design

We used a mixed methods approach to investigate levels of MA during the first year of the programme, a particularly important time for students as it sets the foundation for their pedagogical development and confidence in teaching mathematics (Goos et al., 2023). A paper-based, written survey was distributed to the 2024 cohort of PDMT students ($n = 190$) by local gatekeepers in 5 higher education institutions (HEIs) across Ireland, and participation was voluntary. All PDMT students are qualified to teach subjects other than mathematics and are doing the PDMT to gain a qualification to teach mathematics. PDMT students comprise two categories:

- Category 1) those who have taught or are currently teaching mathematics and
- Category 2) those who have never taught mathematics but plan to in the future.

Understanding the backgrounds and motivations of the students is crucial to designing professional development programmes to support them in delivering effective mathematics instruction. In this regard, the survey comprised two sections. Section A was a series of open-ended questions pertaining to their study and teaching of mathematics. This section was answered by Category 1) and 2) students, and included the following questions:

- How many years have you been teaching mathematics?
- What is your subject specialism (undergraduate subject(s))?
- What is your motivation for doing this programme?
- What are your fears about teaching mathematics?
- Is there a specific mathematics topic(s) do you dislike/fear?
- How do you feel about engaging with mathematics in the PDMT?

Section B comprised two questionnaires:

- The 'Mathematics Anxiety Scale - UK' (MAS-UK) with 23 statements relating to situations in everyday life associated with the use of mathematics. For each statement students select the extent of their agreement on a scale of 1 (not at all) to 5 (very much) (Hunt, Clark-Carter

& Sheffield, 2011). Scores can range between 23 (minimum) and 115 (maximum), with low scores signifying 'low MA' and high scores signifying 'high MA' (Hunt et al., 2011). This section was answered by Category 1) and 2) students.

- The 'Mathematics Anxiety Scale for Teachers' (MAST) with 15 statements relating to the teaching of mathematics. For each statement students select the extent of their agreement on a scale of 1 (not true of me at all) to 5 (very true of me) (Ganley et al., 2019). Scores can range from 15 (minimum) to 75 (maximum), and high scores can be interpreted to reflect high MA (Ganley et al, 2019). This section was answered by Category 1) students only.

4. Analysis and Findings

The response rate was 26% (49/190). Qualitative data were managed through NVIVO and analysed using thematic analysis, while quantitative data were entered into and analysed using SPSS. Responses to Section A reveal that a majority of respondents (84%) are either currently teaching or have taught mathematics, indicating proactive engagement with mathematics instruction methods, despite lacking formal qualifications in mathematics. Of these respondents, 45% have been teaching mathematics for just one year, 21% for two years, and 18% teaching it for three or more years. The data highlights a disparity between teachers' undergraduate specialisms and the subjects they teach, particularly in mathematics where 61.2% of these PDMT candidates are assigned to teach it, despite it not being their dominant undergraduate specialism; in contrast, the percentages of this cohort teaching subjects like business (30.6%) and science (30.6%) show closer alignment with their undergraduate specialism (36.7% and 30.6% respectively).

The key motivations for doing the programme include a love of mathematics/problem-solving/working with numbers/logical reasoning (43% of respondents); job security/permanent position/career prospects (22%); the joy of teaching mathematics/helping students overcome struggles (18%); and other factors included professional development, logical appeal, and student support.

Respondents expressed a variety of fears about teaching mathematics (Table 1).

Fears about teaching mathematics – categorisation of responses and sample themes	
<i>Categories</i>	<i>Themes</i>
Teaching process and methodology (25%)	Fear of making mistakes while teaching Struggles with working out answers in real-time Worry about explaining concepts correctly Fear of lacking effective teaching skills
Understanding the content (20%)	Difficulty understanding the entire curriculum Feeling out of depth in some topics Lacking confidence performing mathematical calculations
Depth of knowledge and theory (20%)	Worry about not having thorough knowledge Inability to explain reasoning behind topics or calculations Confusing or mixing up formulas Lack of confidence covering Leaving Certificate HL content
Self-identity and confidence (20%)	Feeling not good enough or that their standard is too low Unsure how to support students effectively Lack of confidence in specific topics or calculations
Concerns about students (15%)	Fear that students might fail because of them Concern that students may develop a bad attitude to mathematics

Table 1 – Respondents' fears about teaching mathematics by category

These categorisations provide an insight into the fears associated with teaching mathematics among the cohort, with a particular recurrence of themes relating to a lack of mathematical knowledge, making mistakes in front of the students, and getting stuck or being unable to explain something.

The responses for least liked mathematics topics reveal that probability (39.1%) is the most disliked, followed by statistics (26.1%), algebra (13.0%) and geometry (13.0%). Trigonometry, vectors, indices, and calculus each yielded 8.7%, with 4.3% dislike of arithmetic, surds, and financial mathematics.

Their responses in relation to engagement with mathematics in the PDMT programme show that many enjoy the challenge, sense of achievement, and support structure through tutorials. While the course is perceived as manageable with effort, some find it 'daunting,' 'fast paced,' and 'more difficult than expected,' leading to feelings of being overwhelmed. Time constraints and limited opportunities for interaction in recorded sessions are also noted challenges.

For section B responses, Figure 1 shows the distribution of MAS-UK scores for a sample of 46 respondents with observed scores ranging from 23 to 79, indicating low to moderate levels of mathematics anxiety.

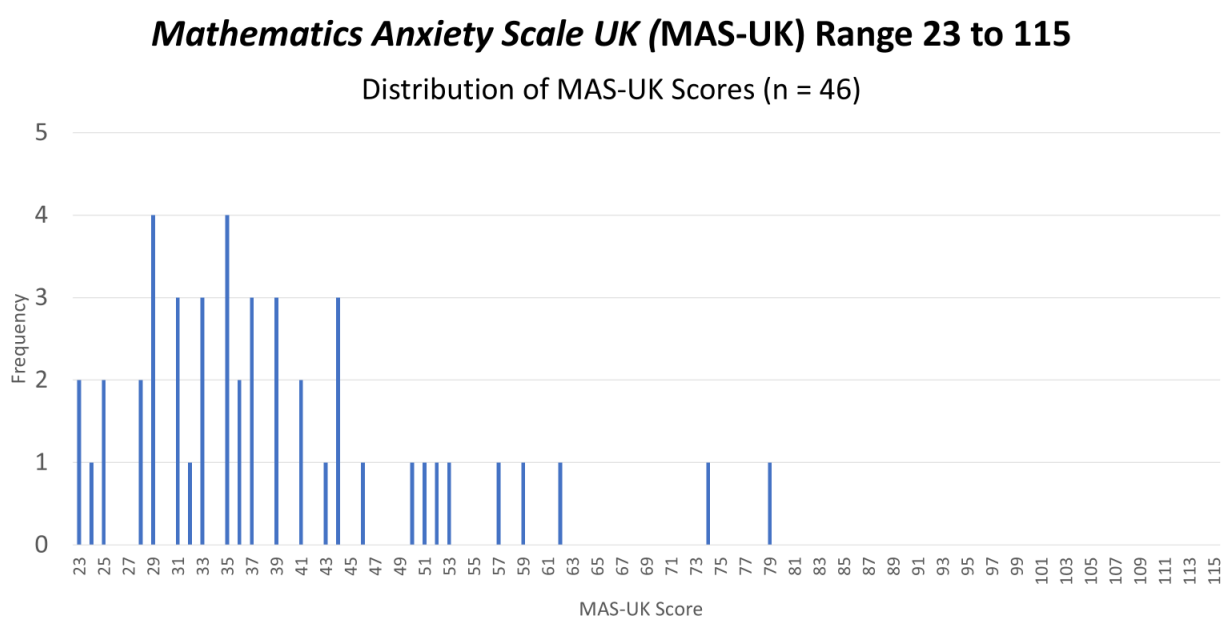


Figure 1 – Mathematics Anxiety Scale UK (MAS-UK) Scores

Most respondents scored between 30 and 40 indicating low to moderate levels of math anxiety, with a few cases above 65 and none beyond 80. This suggests that severe math anxiety is either rare or absent in this sample.

The MAST distribution (Figure 2) shows scores ranging from 15 to 73, with most clustering between scores of 25 and 40 indicating mild-to-moderate mathematics teacher anxiety.

Mathematics Anxiety Scale for Teachers (MAST) Range 15 to 75

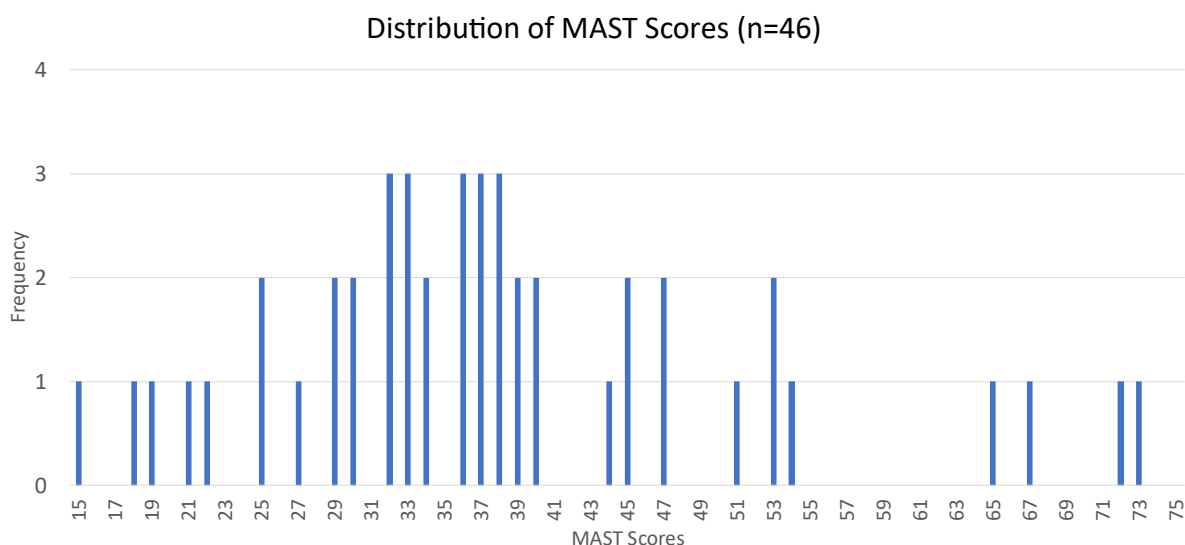


Figure 2 – Mathematics Anxiety Scale for Teachers (MAST) Scores

Peak frequencies occur at scores of 32, 33, 36, 37, and 38, while higher anxiety scores are less common suggesting that severe MA is rare in this cohort.

A strong correlation was identified between the MAS-UK and MAST scores ($r = 0.852$); this finding suggests that individuals exhibiting elevated levels of MA on the MAS-UK also tend to report similarly high levels of anxiety on the MAST. MAS-UK results for this cohort of teachers show low-to-moderate anxiety levels in evaluative situations, like testing or writing on the board, while everyday mathematics activities cause minimal anxiety. In contrast MAST scores follow a more normal distribution with teachers experiencing moderate anxiety levels particularly related to teaching and social evaluative situations. This finding demonstrates that, in contrast to the MAS-UK, the MAST reflects a broader distribution of mathematics anxiety among this cohort of practicing teachers.

5. Discussion and Conclusion

Mathematics plays a critical role in fostering STEM careers, yet in Ireland progress has been impeded by persistent challenges such as the low uptake of higher-level mathematics and a significant number of out-of-field mathematics teachers. This study set out to investigate mathematics anxiety among a cohort of out-of-field teachers enrolled in the PDMT programme across Ireland. However, despite the low response rate, the findings offer valuable quantitative and qualitative insights into this under-researched population.

Analysis of the findings revealed that, in general, MA is low among this cohort, suggesting that professional development should prioritise building mathematical confidence among teachers rather than broad anxiety reduction. The findings highlight that the majority of respondents are or have been engaged in teaching mathematics, despite lacking formal qualifications in the subject. Motivations for enrolling in the PDMT programme include a passion for mathematics and problem-solving, the desire for career stability, and the fulfilment derived from helping students succeed in mathematics. However, respondents also reiterated their fears about teaching the subject, with key concerns relating to instructional methodology, content mastery, depth of understanding, self-

confidence, and student-related worries. A recurrent theme was anxiety about making mistakes, struggling with real-time problem-solving, and insufficient mathematical confidence. Many admitted having experienced challenges with probability, statistics, algebra and geometry, suggesting a need for greater instructional support, better concept reinforcement, and the use of real-world applications to enhance engagement across mathematics topics. Despite the challenges identified, respondents reported enjoying the intellectual challenge and support provided through the PDMT.

Findings from both the MAS-UK and MAST scales suggest that MA is more pronounced in evaluative and instructional contexts compared to everyday mathematics usage, aligning with research findings on MA among teachers (Ramirez et al., 2018). While most respondents experience only mild to moderate levels of MA, the additional pressure of teaching mathematics effectively exacerbates these feelings. The strong correlation observed between the MAS-UK and MAST results reinforces the idea that anxiety patterns among teachers closely mirror those found in the general population, but with added stressors related to teaching and public performance. Addressing these anxieties through confidence building strategies, professional development, and supportive teaching environments aligns with Bandura's (1997) emphasis on mastery experiences as foundational to developing self-efficacy, and suggesting that targeted professional development interventions could mitigate mathematics teacher anxiety.

These insights into the experiences of PDMT students are significant in that they highlight the challenges they face with mathematics, their coping mechanisms, and the support they need as out-of-field mathematics teachers. Although limited by the scale of the study, the findings align with existing research (Dowker et al., 2016; Ganley et al., 2019; Ramirez et al., 2018) and underscore the importance of integrating explicit mathematics anxiety reduction strategies into national professional development programmes, such as the PDMT, as well as in policy frameworks guiding mathematics teachers qualification. In this regard, the study offers insights for addressing teacher MA in the Irish context and emphasises the importance of professional development upskilling within education policy.

The findings show that these out-of-field teachers face challenges that can be addressed by engaging with professional development and pedagogical support to enhance their mathematical confidence and instructional effectiveness. Initial teacher education programmes and in-service professional development programmes for high stakes subjects like mathematics, need to reiterate the importance of improving subject mastery, developing and implementing strategies to reduce MA and cultivate mathematical resilience, and enhancing the overall quality of mathematics teaching.

On completion of the PDMT, the researchers intend to invite this cohort of students to complete section B of the survey again in order to conduct a pre and post comparison of students' MA levels.

6. References

- Bandura, A. (1997). *Self-efficacy: The exercise of control*. New York: Freeman.
- Brady, P. & Bowd, A. (2005). Mathematics anxiety, prior experience and confidence to teach mathematics among pre-service education students. *Teachers and Teaching: Theory and Practice*, 11(1), pp. 37–46.
- Dowker, A., Sarkar, A., & Looi, C.Y. (2016). Mathematics anxiety: what have we learned in 60 years? *Frontiers in Psychology*, 7, pp. 1-16. <http://doi.org/10.3389/fpsyg.2016.00508>

- Ganley, C. M., Schoen, R. C., LaVenía, M., & Tazaz, A. M. (2019). The construct validation of the math anxiety scale for teachers. *Aera Open*, 5(1). <https://doi.org/10.1177/2332858419839702>
- Goos, M. & Guerin, A. (2021). Insights into the Pedagogical Practices of Out-of-Field, In-field, and Upskilled Teachers of Mathematics. In Y. H. Leong, B. Kaur, B. H. Choy, J. B. W. Yeo, and S. L. Chin (eds.) *Excellence in mathematics education: Foundations and pathways* (Proceedings of the 43rd annual conference of the Mathematics Education Research Group of Australasia), pp. 203–210. Singapore: MERGA.
- Goos, M., Ní Ríordáin, M., Faulkner, F., & Lane, C. (2023). Impact of a national professional development programme for out-of-field teachers of mathematics in Ireland. *Irish Educational Studies*, 42(3), pp. 401–421. <https://doi.org/10.1080/03323315.2021.1964569>
- Hunt, T. E., Clark-Carter, D. & Sheffield, D. (2011). The Development and Part Validation of a U.K. Scale for Mathematics Anxiety, *Journal of Psychoeducational Assessment*, 29, pp. 455-466
- Ingersoll, R. M. (2002). *Out-of-Field Teaching, Educational Inequality and the Organization of Schools: An Exploratory Analysis*. Seattle, WA: University of Washington. Center for the Study of Teaching and Policy.
- Ní Ríordáin & Hannigan (2009). 'Out-of-field teaching in post-primary mathematics education: an analysis of the Irish context. A research report', [report], National Centre for Excellence in Mathematics and Science Teaching and Learning (NCE-MSTL), 2009-11
- Organisation for Economic Co-operation and Development (OECD) (2004), Education at a Glance 2004: OECD Indicators, OECD Publishing, Paris, <https://doi.org/10.1787/eag-2004-en>.
- Organisation for Economic Co-operation and Development (OECD) (2013), Education at a Glance 2013: OECD Indicators, OECD Publishing, Paris, <https://doi.org/10.1787/eag-2013-en>.
- Organisation for Economic Co-operation and Development (OECD) (2019), Education at a Glance 2019: OECD Indicators, OECD Publishing, Paris, <https://doi.org/10.1787/f8d7880d-en>.
- Pará, T. S., Ryan, M., Quiceno, J.M., Yorgun, A., Mbogo, H. N., Mudadigwa, B., Figiacone, S. R., & Dillard, A. (2024). Mathematics anxiety as a global problem. In S. Johnston-Wilder and C. Lee (Eds.). *The Mathematical Resilience Book: how everyone can progress in mathematics*. London: Routledge. Chapter 13.
- Perkins, R., Shiel, G., Merriman, B., Cosgrove, J. & Moran, G. (2013). *Learning for Life: The Achievements of 15-year-olds in Ireland on Mathematics, Reading Literacy and Science in PISA 2012*. Dublin: Educational Research Centre
- Ramirez, G., Hooper, S. Y., Kersting, N. B., Ferguson, R., & Yeager, D. (2018). Teacher math anxiety relates to adolescent students' math achievement. *AERA Open*, 4(1). <https://doi.org/10.1177/2332858418756052>
- Ryan, M., Fitzmaurice, O., & Johnson, P. (2023): Investigating mathematics anxiety among mature students in service mathematics courses using the mathematics anxiety scale U.K., *International Journal of Mathematical Education in Science and Technology*, 54, pp. 1-25.

Ryan, V., Fitzmaurice, O., & O'Donoghue, J. (2021a). Investigating student knowledge in mathematics at the end of their first year of post-primary education in Ireland: a case study. *The Teaching of Mathematics*, 14(2), 55–75. [tmn47p55-75.pdf](#)

Ryan, V., Fitzmaurice, O., & O'Donoghue, J. (2021b). A study of academic achievement in mathematics after the transition from primary to secondary education. *SN Social Sciences*, 1(7), 173. <https://doi.org/10.1007/s43545-021-00177-8>

Saunders, N. (2025). England's maths teacher recruitment problem is set to worsen. Available at <https://theconversation.com/englands-maths-teacher-recruitment-problem-is-set-to-worsen-246351> [Published 25/01/2025]