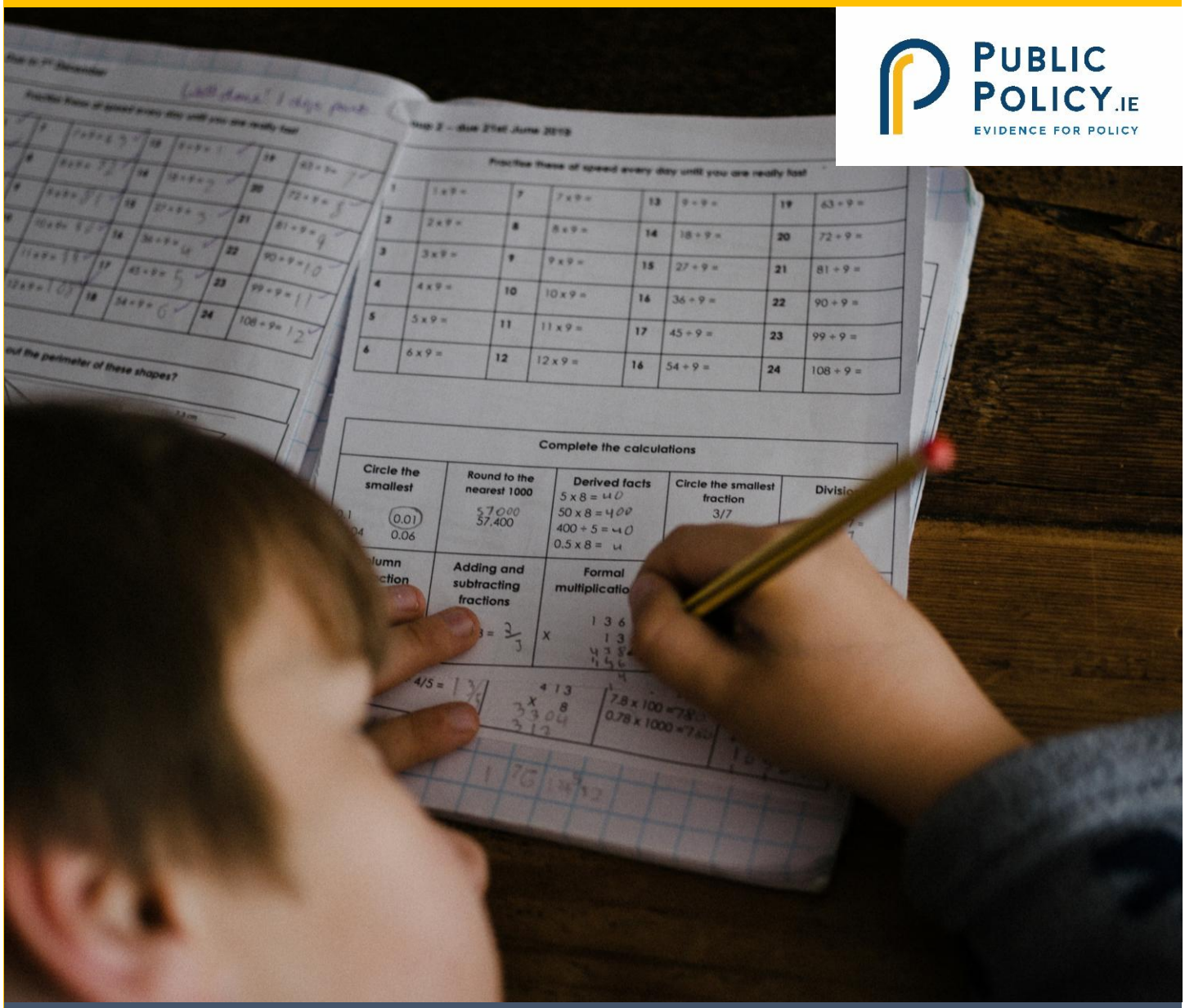

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Problem Solving in Irish Mathematics Classrooms: Supporting teachers to implement curriculum reform

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Key Messages

- The successful implementation of mathematics curricula in Ireland depends on providing teachers with purposefully designed high-quality resources and opportunities for professional learning.
- Professional learning for curriculum implementation should move away from a focus on why the curriculum is changing and instead provide opportunities for teachers to view, reflect on, consider, and discuss the relevance and practicalities of new classroom practices for their students.
- Educative curriculum materials should be designed in tandem with the roll-out of curriculum reform to ensure teachers can access mathematically coherent, cognitively relevant, and adaptive resources for use with their students.

Introduction

For over a decade, a key policy focus in Ireland has been to develop a highly educated population with a strong proficiency in Science, Technology, Engineering and Mathematics (STEM) and, in particular, mathematics (DES, 2017a). Numerous policy documents and recent curriculum reforms have highlighted the importance of developing learners' problem solving skills in mathematics (e.g. DES, 2017a & 2017b). The Project Maths reform of the national secondary-school mathematics curricula and more recent reform of the Junior Cycle Mathematics curriculum have placed a strong emphasis on the importance of engaging with problem solving as part of learning

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mathematics. This has been particularly noticeable in the compulsory classroom-based assessments (CBAs) at Junior Cycle, which were introduced in 2018. Yet, despite these major reforms of policy, research suggests that the day-to-day classroom experiences of mathematics students have remained largely unchanged, with little meaningful problem solving taking place, and a persistent focus on rote learning of procedural skills (Jeffes et al., 2013; Prendergast & Treacy, 2018). Furthermore, students' problem solving skills do not seem to have improved with the introduction of these new curricula (Faulkner et al., 2023).

In this policy paper, we consider why curriculum reforms have failed to translate into classroom practice. Based on research undertaken with mathematics teachers across Ireland (Neururer & Ni Shuilleabhain, in press), we highlight the significant challenges faced by these secondary school educators in attempting to incorporate problem solving into their classrooms. While teachers are often blamed for the failures of curriculum reform, our research suggests that mathematics teachers are committed, thoughtful professionals who are willing to embrace reform, but are not adequately or appropriately supported to do so. The barriers they face are systemic and not based on their individual willingness or level of qualification. Accountability for the gap between curriculum policy and classroom reality therefore seems to lie with the mechanisms of support that the system provides in terms of professional development and curriculum materials. Given that additional mathematics curricula at second level are currently under review, we argue that it is crucial that appropriate supports for teachers are provided to avoid future failures in curriculum implementation. To support student achievement in mathematics and to improve efficiency of resources and outcomes in curriculum implementation, we make evidence-based recommendations to address the gap between policy intent and classroom reality.

Why is problem solving so important?

Problem solving is core to the field of mathematics and reflects a key practice of the work that mathematicians and others do. Mathematics is, therefore, a subject where school students' problem solving skills can be developed and refined, equipping them to tackle complex issues and societal challenges in an increasingly data- and model-driven world (Schoenfeld, 1992; Schoenfeld et al., 2024). Education systems worldwide have highlighted the importance of students becoming capable and confident problem-solvers. Students' experiences of thinking mathematically through posing

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and solving problems provides them with the opportunity to build and develop their mathematics knowledge and skills, thereby allowing them to value mathematics as a creative, collaborative and powerful subject which allows us to model and understand the world around us. Fostering such attitudes towards the subject can encourage students to pursue STEM subjects beyond secondary school.

While educational reforms worldwide have attempted to focus on building students' problem solving skills, classrooms in Ireland have largely continued to focus on coaching students to achieve a correct answer to a routine task in the shortest period of time. While procedural knowledge is fundamental to solving problems, it is not sufficient. Instead, aligning with decades of research in mathematical problem solving, students should be supported in developing their conceptual understanding alongside their procedural knowledge, and be challenged to make connections between multiple forms of their mathematical knowledge and skills to pose and solve unfamiliar problems in both physical and abstract contexts (Schoenfeld, 1992; Chapman, 2015). Textbooks in Ireland do not currently support this (O'Sullivan et al., 2024).

To enact problem solving in the classroom, there is a need for teachers to expertly and adeptly design the learning environment to allow for exploration of mathematical thinking (Takahashi, 2021). While these practices have been established in countries such as Japan and Singapore, who consistently rate in the top five countries for mathematical literacy, in Ireland they have not yet become established norms. Our research aimed to explore, from the perspective of teachers, why this might be the case.

Key findings from the research

Complementing research based on surveys with almost 200 teachers (Prendergast & O'Meara, 2026), our research was undertaken through in-depth interviews with sixteen teachers (all names are pseudonyms) across Ireland. The findings demonstrate that there is a broad understanding of, and support for, the aims of the Junior Cycle mathematics curriculum reforms among teachers. However, our data suggests that, even when teachers explicitly want to incorporate more problem solving into their practice, they face challenges in doing this and are not supported by the wider school and educational systems to enact curriculum reform.

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1. Current models of professional development do not support reform of classroom practices

All teachers who participated in our research had undertaken the problem solving oriented Mathematical Investigations Classroom-Based Assessment (CBA) at least once with their students, and had attended the national professional development associated with the reform, which was in the form of in-service training days. Teachers reported that the in-service days had focused on the rationale of the curriculum but had not given them the skills to implement problem solving pedagogies in their classrooms. Whether fully qualified or out-of-field, teachers desired *"a bit more structure, a bit more guidance"* from their professional development experiences. Such a finding is hardly surprising, given that research on teacher professional development has explicitly demonstrated that one-off, off-site professional development days do not result in pedagogical changes (Darling-Hammond et al., 2017). Teachers expressed some frustration in reflecting on the professional development:

> *"I've done a [Professional Development programme], a problem solving one [...] I'm like oh yeah this is great, but then it doesn't get into the classroom, you know? I don't know how to bring it into the classroom." Mary*

Aligning with research findings from many educational contexts, teachers wanted to experience professional learning that provides them with opportunities to discuss, consider, and interrogate what the new classroom practices might look like in their own settings. Without tangible examples from, for example, video or classroom excerpts to discuss with colleagues, they found it difficult to translate the professional development programme into their classroom practice.

While all teachers spoke of wanting to have problem solving as a core element of their classroom practices, they did not all feel they had the relevant skills or pedagogical content knowledge to support students in their learning.

> *"I'd be afraid that if it wasn't done in a way that kind of supports the students while they're doing it, that they'll actually be really disengaged with the maths and say, 'Well, I can't even do an easy...project'" Cian*

> *"I'm avoiding [problem solving] I suppose, because I don't feel properly equipped to make it work well in the classroom." Mary*

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Teachers have had to look elsewhere for support and some spent considerable time pursuing additional professional development that could support their classroom practice.

> *"There's elective webinars which I found quite interesting to listen to. [A mathematics teacher educator] also gave a talk … that was very useful."*
> *Rory*

Unfortunately, this left these teachers exposed to burn-out and isolation from other colleagues in their school (O'Farrell et al., 2025). The centralised system to support teachers develop their pedagogical practices and implement the reform was not considered effective or useful.

2. Lack of suitable resources to support teachers' classroom practices

All participating teachers highlighted the lack of appropriate curriculum materials as a barrier to incorporating problem solving in their classroom. In the first instance, teachers noted that the sample assessments provided as part of the new curriculum documents did not demonstrate all levels of student achievement and were of poor mathematical standard, focusing only on arithmetic skill without demonstrating problem solving to any level of mathematical complexity achievable by Junior Cycle students.

Teachers also noted a lack of available suitable problem solving activities to include as part of their classroom practices. Unlike other countries, there is no centralised repository of approved mathematical content, activities, or textbooks in Ireland. Textbooks are one of the main pedagogical resources utilised by mathematics teachers, but these are not reviewed for mathematical accuracy or curriculum alignment. Research has consistently found that the mathematics textbooks do not align well with the problem solving elements of recent reforms (O'Sullivan et al., 2024). Furthermore, as outlined above, what is often defined in textbooks as a "problem" tends to reflect a routine mathematical task buried within a real-world context, but rarely contains work of mathematical value to students.

> *"I don't find the book great to be honest, particularly for problem solving."*
> *Bríd*

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As a result, teachers must look elsewhere for suitable material. Many teachers spend considerable time creating, sourcing or adapting resources to use in their classrooms. This places a disproportionate burden on individual teachers, further adding to their workload and potential for burnout (O'Farrell et al., 2025).

> *"It can be difficult as a teacher to find good problems. There are tons of resources out there but to have time… time to sit down and trawl trough stuff." Ciara*

> *"Finding the resources takes time. Examining them, making sure they are applicable to your class, how do you integrate them into lessons, that all takes up an enormous amount of time." Dara*

Many teachers end up defaulting to familiar, existing textbooks which do not support them to incorporate problem solving approaches in their teaching. Without the appropriate resources available to them, teachers do not feel empowered or supported to incorporate problem solving in their classroom practice.

3. Problem solving not seen as a core element of mathematical achievement

Teachers did not feel that students were encouraged to engage with problem solving, since their efforts were not recognised in their overall mathematics examination grades. While the CBAs are assessed, these results do not form part of students' numerical Junior Cycle grades and, as articulated by the teachers, can be seen by students as irrelevant to their mathematical achievement.

> *"They don't put much value on the classroom-based assessment because it's not worth anything to them… they don't see why problem solving is important." Lucy*

Furthermore, teachers noted that the high-stakes upper secondary Leaving Certificate examination did not reward problem solving skills, which were therefore not seen as valuable by the school community, including students, parents and teachers alike.

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Policy Recommendations to improve Problem Solving skills

With a new Senior Cycle mathematics curriculum on the horizon, there is an opportunity to ensure that teachers are provided with the system mechanisms they need to support students' mathematical achievement and enact curriculum reform. The evidence from the research literature is clear: curriculum documents alone do not change classroom practice. Teachers need both quality professional learning opportunities which offer concrete support on what reform looks like in practice, and well-designed educative curriculum materials they can adapt for their classrooms. Together these can provide teachers with sustained, practical, school-connected resources that allow for opportunities to reflect on practice, collaborate with colleagues, and engage with purposefully designed curriculum materials.

Based on the existing research we make the following recommendations:

1: Provide professional learning opportunities to focus on tangible classroom practices, promote teacher reflection, and allow for meaningful collaboration

Effective professional development demands sustained engagement over time and provides opportunities for collaboration and discussion (Darling-Hammond et al., 2017). Professional development for curriculum reform must move beyond communicating the rationale for change and focus on what the curriculum looks like in classrooms. Research on curriculum reform, explicates the need for examples of what problem solving might look like in real-time and for opportunities to observe, reflect on, and discuss new pedagogies in action (e.g. Ni Shuilleabhain & Seery, 2018; van Es & Sherin, 2010). Teachers should be supported to critically consider and discuss these practices, as well as reflect on their own beliefs and understandings of problem solving (Remillard, 2005).

2: Provide purposefully designed Educative Curriculum Materials to accompany curriculum reform

Curriculum materials, whether in the form of stand-alone resources or textbooks, are central to teachers' practices and can, when designed well, offer support for teachers in developing their knowledge and pedagogy (Collopy, 2003). A common constraint to enacting problem solving in Irish secondary-school classrooms is the lack of readily

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available, mathematically sound, appropriate tasks to use for problem solving. In comparison, Japan, as one example, has available resources which are approved by their Ministry of Education in the form of: teacher books and teacher-presentation books written alongside textbooks and student workbooks (see Takahashi, 2021).

Educative curriculum materials (ECMs), comprising of high-quality problem solving questions and accompanying guidance, such as sample student approaches, discussion prompts, and advice on how to introduce and engage students in the problem solving tasks, could offer teachers in Ireland both the concrete materials needed for use in the classroom as well as the pedagogical guidance they require. Such materials should emphasise the core principles of problem solving and be modifiable by teachers for their own contexts (see for example, Neururer, 2024). ECMs provided alongside high-quality professional development can demonstrate the concrete examples that teachers in this research consistently requested. The provision of such resources from centralised State Agencies who are tasked with curriculum reform would reduce the unsustainable burden of resource creation currently falling on individual teachers and enable teachers to sustain their pedagogical learning through continued engagement and reflection on their practice.

3: Consider how problem solving is interpreted across policy documents, curriculum resources and assessment

It is important to ensure there is a coherent understanding of what is meant by problem solving across policy documents and that the curriculum materials used in classrooms reflect this interpretation, so that it can be experienced and assessed in meaningful ways. Problem solving is clearly outlined in the current Senior Cycle Mathematics curriculum and features as part of the "Unifying Strand" within the Junior Cycle curriculum, which interprets problem solving to mean that "Students should be able to investigate patterns, formulate conjectures, and engage in tasks in which the solution is not immediately obvious, in familiar and unfamiliar contexts" (DES, 2017b). However, analysis of three of the most widely used textbooks in post-primary Irish classrooms reveals that they do not support this interpretation (O' Sullivan et al., 2024), with the majority of tasks requiring recall of a solution algorithm or similar form of rote learning (O'Sullivan et al., 2026). Moreover, qualitative research with teachers suggests that the mathematical content of the CBAs is often simplistic and repetitive, focusing on basic arithmetic rather than advanced reasoning or problem solving skills

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(Prendergast & O'Meara, 2026), further suggesting that students are not used to engaging in problem solving as part of their mathematical learning.

With the prevalence of use of generative AI in solving routine tasks, there is additional urgency and benefits to developing problem solving skills, in particular for high-achieving students who can apply it to additional contexts and may continue their pursuit of STEM beyond second level. This is especially relevant in the Irish context where a pattern of relative underachievement in mathematics among high-achieving students in international assessments, such as the Programme for International Student Assessment (PISA) and Trends in International Mathematics and Science Study (TIMSS) has been noted (Pitsia et al., 2022). While it is difficult to examine authentic mathematical problem solving in time-constrained exam-settings, there is potential to include such a focus in the new additional assessment component to be included in Senior Cycle Mathematics.

Conclusion

Our research demonstrates that Irish mathematics teachers are committed, considerate professionals who hold the interests of their students at the core of what they do. Teachers are attempting to implement a curriculum they broadly support. However, accountability for the gap between curriculum policy and classroom reality seems to lie with the mechanisms of support that the system provides and not with a broad resistance or failure on the part of teachers.

As Ireland continues to position itself as a leader in STEM innovation, and prepares for the next wave of mathematics curriculum change at Senior Cycle, it may be relevant to consider how resources in education can be best spent to ensure our learners are equipped with the mathematical skills required of them for the future. This will require additional cooperation and collaboration between the State Agencies of the National Council for Curriculum & Assessment, Oide, the State Examinations Commission, and the Department of Education & Youth. Taking time to consider how the school and education system can best support reform through the design and implementation of high-quality, sustained professional development alongside purposefully designed educative curriculum materials will see a return on investment for future generations of students.

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About this research

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