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Teaching mathematics through problem-solving: Insights from the six INSOLVU lesson studies

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Introduction

In recent years, there has been growing recognition of the need to transform how mathematics is taught in primary schools. International research and policy documents have highlighted the importance of moving beyond procedural fluency toward teaching that promotes conceptual understanding, reasoning, and problem solving (NCTM, 2014; OECD, 2016; MEYR, 2025). One promising approach is teaching mathematics through problem-solving, a pedagogy that encourages students to make sense of mathematical ideas by engaging in meaningful, challenging, and thought-provoking tasks (Takahashi, 2021). This approach shifts the focus from rote procedures to mathematical thinking and reasoning, helping students to develop a deeper conceptual understanding. Supporting this shift requires high-quality professional development (PD) initiatives (Calleja, 2022), and one initiative that is gaining ground internationally is lesson study (LS) – a structured, collaborative and research-informed process in which teachers work together to identify a teaching challenge, plan a lesson, observe its implementation, and reflect on its outcomes to improve practice (Dudley, 2015). Originating in Japan, LS has been widely adapted in various educational systems, including Malta (Calleja & Formosa, 2024; Calleja & Camilleri, 2025), as an effective form of teacher-led, practice-based PD (Lewis, Perry & Murata, 2006). It encourages deep inquiry into teaching and learning, supports collective knowledge-building, and strengthens teacher collaboration. It is within this context that the INSOLVU project was conceived and implemented, with the aim of supporting Maltese primary school educators in embracing this transformative pedagogy through the powerful professional learning tool of LS.

The INSOLVU project

INSOLVU, a project led by the Ministry for Education, Sport, Youth, Research and Innovation (MEYR) and supported by Collaborative Lesson Study Malta (CLeStuM – www.clestum.eu**)**, brought together a diverse group of educators – namely, heads of department (mathematics primary), primary mathematics support and numeracy teachers, school leadership team (SLT) members, teachers, learning support educators (LSEs) and research academics. Funded by Huawei Technologies and supported by UNESCO under the "Revitalizing STEM education to equip next generations with STEM competency" programme (UNESCO, 2024), INSOLVU engaged 15 primary mathematics heads of department, support and numeracy teachers, 18 teachers, 6 learning support educators, and 8 members of SLTs across six primary schools in Malta.

The INSOLVU project, intended to support primary school teachers to use LS as a tool for learning about teaching mathematics through problem-solving, involved the design of a PD programme based upon academic research and practice-based educator knowledge. All primary mathematics heads of department, support and numeracy teachers, in the state and church sectors, voluntarily attended a 30-hour PD programme to learn about the LS process, creating and sustaining collaborative teams, and mathematics problem-solving. 13 of the 15 PD participants then used the knowledge gained to implement LS in six primary schools (five state and one church). Over a period of eight to ten weeks, between November 2024 and February 2025, these educators worked closely with teachers within six parallel lesson studies focused on teaching mathematics through problem-solving.

With the support of at least two LS facilitators, each of the six groups of primary educators (usually made up of teachers, LSEs and at least one member of the SLT) followed a collaborative and structured cycle of professional learning. Together, educators identified an issue related to the teaching and learning of mathematics through problem-solving, reviewed relevant research, and jointly planned a detailed research lesson. The research lesson was then taught and observed, with attention to student engagement, thinking, and mathematical reasoning. Following the lesson, LS participants reflected on student learning, refined their understanding of the pedagogy, and documented their findings. This process allowed participants to learn deeply with and from each other, and to develop more robust, evidence-informed approaches to classroom practice.

On 26th February 2025, INSOLVU culminated in an end-of-project dissemination event attended by 92 educators. The event featured the launch of the project video, a keynote by Ms Laura Bortolutti from the UNESCO Office in Venice, and presentations by all six LS groups. Two panel discussions – one with the LS facilitators supporting teachers in each of the six schools, and another with teacher educators from the University of Malta and MEYR – offered reflections on the possibilities and challenges of teaching mathematics through problem-solving. The event closed with a reflection by Prof Christopher Bezzina, who spoke about the potential of INSOLVU and future PD initiatives addressing system-wide improvement.

The primary schools involved in INSOLVU – Maria Regina College, St Francis of Assisi (Qawra), San Ġorġ Preca College, J. Hookham Frere (Pietà), St Clare College, Madonna tal-Mensija (San Ġwann), Gozo College, Ġużé Aquilina and Special Unit (Sannat), St Augustine College (Marsa) and Gozo College, Karmni Grima (Għarb) – each contributed unique perspectives to the overarching question of how to design and facilitate problem-solving lessons that support all students. In total, 177 primary students directly benefitted from the INSOLVU problem-solving lessons, and many more stand to gain from the ripple effects of this professional learning initiative.

The six lesson studies

As a follow-up of the end-of-project event and to sustain the dissemination of findings and outcomes of INSOLVU, each of the six LS groups prepared a written report of their work. A brief introduction of the six lesson studies is provided below.

Budgeting with money: Maria Regina College, St Francis of Assisi Primary School, Qawra
A Year 3 class used coins and digital tools to solve budgeting problems. Students worked within a fixed budget to simulate real-life purchases. The task developed students' problem-solving skills, financial literacy, and confidence, while also highlighting the need for differentiated strategies.

Fractions and sharing: San Ġorġ Preca College, J. Hookham Frere Primary School, Pietà
Year 4 students engaged with the concept of fractions using paper models and a chocolate-sharing scenario. The lesson followed the CPA

(concrete-pictorial-abstract) approach and aimed to tackle common misconceptions about fractional parts. Tactile learning and collaborative reasoning were central, with some challenges observed in group interaction and mathematical confidence.

A €25 budget for a healthy breakfast: St Clare College, Madonna tal-Mensija, San Ġwann
Year 4 students engaged in a budgeting task framed around creating a healthy breakfast hamper within a €25 budget. Characters from a concept cartoon offered varying mathematical arguments, encouraging students to justify decisions using mathematical language. The activity was designed to address previously identified difficulties in reasoning and justification and was successful in promoting critical thinking and structured dialogue.

Mass and capacity: Gozo College, Ġużé Aquilina Primary and Special Unit, Sannat
Year 4 and 5 students investigated the relationship between volume and mass through a real-world suitcase-packing scenario. Students measured different liquids to test whether 1 litre always equals 1 kilogram. The lesson integrated inclusive pedagogies and Universal Design for Learning (UDL) principles, supporting active participation, hands-on exploration, and conceptual understanding.

Division: St Augustine College, Primary School, Marsa
A Year 6 class explored division through collaborative problem-solving. The lesson featured two tasks: reconstructing a division problem and solving a riddle. Students demonstrated increased engagement and peer-to-peer support. The experience highlighted the power of real-world contexts to move students from passive reception to active mathematical participation.

Angles, time, and turns: Gozo College, Karmni Grima Primary School, Għarb
This Year 6 lesson explored angles, time, and rotational movement through a real-life context of a cooking timer. Students used outdoor tools like a large protractor and a clock-face simulation to visualise degrees of turn. The lesson promoted spatial reasoning and collaborative learning but revealed a need for stronger scaffolding and support to clarify mathematical ideas.

Analysis of the INSOLVU lesson studies

The six lesson studies collectively showcase a rich variety of problem-solving approaches in primary mathematics. Each study places real-world contexts at the heart of learning, inviting students to explore mathematical concepts in authentic, meaningful ways. Despite the variation in topic, year level, and structure, several common themes emerge in both the design of the tasks and the findings drawn from classroom implementation.

Nature of the problem-solving tasks
All six lessons foregrounded *contextualised, inquiry-based tasks* that moved beyond textbook exercises. Tasks were framed around everyday scenarios – cooking, chocolate sharing, budgeting, packing luggage – chosen not only to motivate students but also to tackle specific mathematical misconceptions. These tasks were open-ended enough to invite exploration and justification but structured carefully to guide learners towards key mathematical ideas.

For example, the budgeting tasks (at Qawra and San Ġwann) embedded mathematics in financial literacy, prompting students to manage resources within constraints. The Sannat and Għarb lessons, meanwhile, tackled common misconceptions – volume vs. mass, and degrees vs. time – by connecting abstract concepts with tangible materials and real-life scenarios. Across the board, the lessons demonstrated thoughtful use of manipulatives, visuals, and digital tools to support mathematical reasoning and conceptual understanding.

Emerging findings across the lesson studies
The first major finding across all six reports is the *effectiveness of real-world tasks* in fostering engagement, curiosity, and deeper mathematical thinking with primary school students. Students responded positively to hands-on activities and scenarios that felt relevant, meaningful and purposeful. In the Pietà and Sannat cases, for example, concrete materials were essential for supporting conceptual understanding of fractions and measurement.

Second, the studies highlighted the *power of collaboration* – both among students and among teachers. Many lessons were conducted in mixed-ability groups, which helped promote peer learning and dialogue. However, other lesson studies (notably Pietà and Sannat) also reported challenges in group dynamics, including uneven participation and

dominance by more confident students, suggesting the need for clearer group roles and support for inclusive discussion.

Third, across multiple settings, students struggled with *mathematical language and justification*. Whether articulating fractional relationships, explaining reasoning in division, or distinguishing between mass and capacity, students often found it difficult to express their understanding clearly. This signals a need for more sustained focus on metacognitive talk, sentence starters, and structured reflection.

Fourth, the LS process itself was shown to *enhance teacher learning and responsiveness*. All LS groups identified how collaboration helped educators anticipate student misconceptions, plan for differentiation, and reflect critically on lesson outcomes. Observations and post-lesson discussions were essential in shaping revisions and in deepening educators' pedagogical content knowledge.

Finally, the *inclusive ethos* of the studies – particularly evident in Sannat – underscored the value of UDL principles and differentiated strategies. Lessons were designed to provide multiple entry points and allow all students to engage meaningfully, supporting the broader aim of equity in mathematics learning (Calleja, 2024).

Final comments

The six reports published in this issue reflect the commitment, creativity, and professional growth of educators working collaboratively to improve mathematics teaching in primary schools. As readers engage with each report, they are invited to consider not only the content of the research lessons, but also the process that made such learning possible. Together, these reports offer valuable insights into what it means to teach mathematics through problem-solving, and how LS can help bring that vision to life in classrooms across Malta.

Indeed, we feel, that these lesson studies offer compelling evidence of how problem-solving, grounded in real-world contexts and supported by collaborative teaching practices, can transform mathematics education in Maltese primary schools. They highlight not only what students learn, but how teachers grow in their understanding of both mathematical content and pedagogy. These reports, hence, serve as a resource for other teachers and schools who are interested in making problem-solving central to their mathematics teaching and in using LS to build collective professional knowledge.

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