



Developing Students' Conceptual Understanding:

Teaching Mathematics Through Problem Solving

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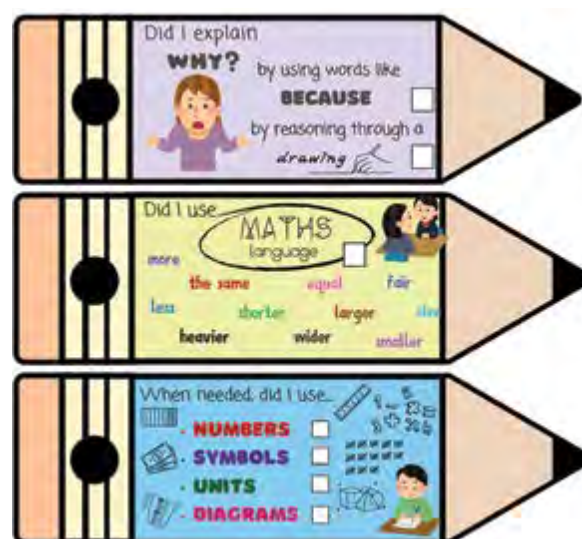
Running from September 2025 to February 2026 as a joint collaboration between the University of Malta and the Ministry for Education and Employment, **Dr James Calleja's INSOLVU Project** aims to revitalise how mathematics is taught across primary schools in Malta. Supported by UNESCO and funded by HUAWEI Technologies, INSOLVU has developed extensive resources to aid mathematics teachers in implementing a teaching approach that prioritises solving real-world problems over simply working on routine exam-type questions.

As an expert in school leadership, mathematics education and supporting teachers in their professional development, Dr James Calleja (Department of Leadership for Learning and Innovation) believes in revitalising the way mathematics is taught at all levels of Malta's education system. To do this, he calls for a thorough revamp of the teaching and learning process. The traditional way of teaching, which Calleja notes as 'transmission-based teaching', involves teachers simply communicating knowledge to their students. These students would then be required to reproduce what they've learnt in tests or exams. This approach highlights a key problem – students are prepared to pass a test, and not necessarily to apply what they've learnt to real-world situations. Moreover, this approach arguably does little to engage students and get them to think deeply about the content being taught. Instead, students often remain passive, perceived as a blank slate with little knowledge, while the teacher dominates classroom dynamics. Calleja has concerns about this approach: 'I think it is both unethical and disrespectful to treat students as though they know nothing. Like this, we are devaluing what prior knowledge they may have, and which could be useful when discussing how to solve a given scenario.'

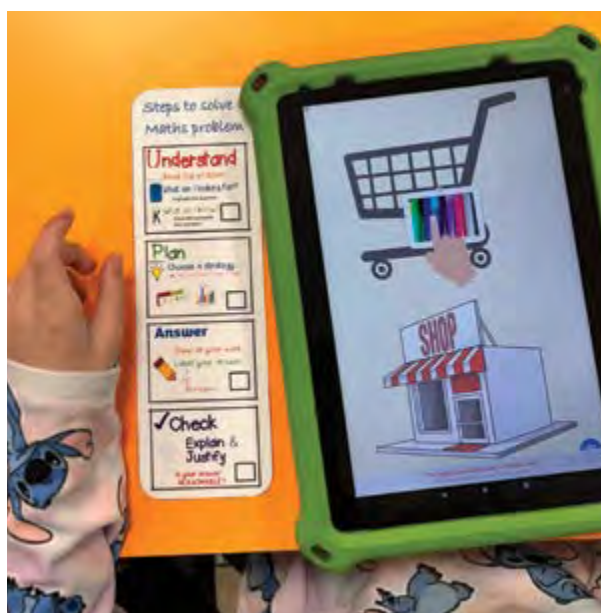
INQUIRY AS AN EXPLORATORY PROCESS FOR LEARNING

What, then, is the solution? For INSOLVU, this would be ways of teaching that prioritise student engagement in thinking, discussion and collaborative inquiry in solving problems through an approach that 'considers the importance of teaching for life rather than teaching for the test,' as Calleja puts it. In teaching through problem-solving, students are presented with

challenging and non-routine problems, also related to real-life situations, for which the solution is not known in advance. Students are then invited to examine problems independently with teacher support, discuss with their peers, and explore strategies to arrive at potential solutions. Calleja states that this typically involves presenting students with a challenging scenario at the start of the lesson, associated with, but not limited to, the mathematics topic or topics being tackled. This opposes traditional teaching norms, which often engage students with routine closed-ended problems and gradually lead them to tackle more complex ones. When faced with a challenging problem right away, students are encouraged to connect the scenario to their own life experiences and mathematical knowledge, potentially identifying links that generate ideas leading to a solution. This emphasis on inquiry, which allows students to tap into prior knowledge, enhances their exploratory skills and learning. Students are therefore



The problem-solving 'justification fan'
Photo courtesy of Dr James Calleja



The problem-solving 'bookmark'
Photo courtesy of Dr James Calleja



A post-lesson discussion at Pietà Primary School
Photo courtesy of Dr James Calleja

the ones leading the discussion. The teacher, on the other hand, acts as an observer while simultaneously stimulating students' thinking through questions and reflective prompts, closely analysing their ideas to determine how best to orchestrate the end-of-lesson discussion and guide them toward possible solutions.

The benefits of this approach to teaching and learning are numerous. Not only does it ensure engagement from both students and the teacher through dialogic inquiry, but it can also provide opportunities for students to make mathematical connections across topics and engage in deeper learning, which research shows is more transferable. This is particularly valuable for mathematics teachers due to the vast syllabus they have

to cover in a short time span. Calleja, in fact, notes that this approach to teaching requires teachers to rethink curriculum design and implementation by providing students with problems that connect rather than isolate the mathematical content in the syllabus. As Calleja notes, 'This increased connectedness is likely to help students bridge the gaps presented within problems and enhance links to other knowledge they would have already gained from their own life experiences.'

Having spent over two decades teaching mathematics in secondary schools, Calleja understands the importance of being clear to teachers about what this approach of teaching through problem solving involves. Due to syllabus and time constraints, teachers may initially be hesitant to take this approach and would tend to lead students to the answer rather than allowing space and time for students to deconstruct mathematical problems. Indeed, Calleja believes that thinking, reflection, exploration, and communication should become an integral part of the students' learning process. By allowing students to explore and recognise the connectedness between the content being taught and the real-world relevance of mathematics, the lesson's focus shifts from finding the correct answer to considering a variety of perspectives to solve the problem presented. The effect of this approach is not only beneficial to students, but also to teachers. As Calleja notes, 'students' ideas help me to notice things which I may have never considered.'

COLLABORATION AT ALL LEVELS

In implementing teaching through problem solving, Calleja sought support. By recruiting primary mathematics support teachers and heads of the primary mathematics department, Calleja formed a team of specialist teachers who could learn about and support primary school teachers. Working alongside these specialists, he designed a lesson study-based programme through which specialist teachers could guide primary school teachers on best practices and ways to improve their lessons. The programme clarified what is meant by 'teaching through problem-solving'. The approach entails grounding abstract theory in real-life scenarios that are then tackled creatively and dynamically, not by isolating areas of mathematics but instead by connecting mathematical content – for example, fractions, graphs, algebra and more – in the pursuit of more robust solutions.

Calleja strongly believes in collaboration and in the process of lesson study as a means to develop teachers' knowledge about mathematical content and pedagogy. ➤

Lesson study – a professional development process involving teachers working together to solve an issue in teaching and learning by planning, teaching, observing, and reflecting on lesson outcomes – embraces teacher collaboration and external support. In the case of INSOLVU, the external support was provided by specialist teachers. Yet, as Calleja claims, in lesson study, 'we need to treat teachers as experts', and whereas the specialists may have more expertise about mathematics as a subject, primary school teachers have more knowledge about the school context, the students and the challenges that they face in learning the subject. Hence, teachers' contribution in lesson planning is then complemented by the observations carried out by other teachers and the specialist teachers. The aim of lesson observations is not to judge, but to learn together. This stance holds greater weight when taking into account the opportunity teachers were given to share their findings at a national conference, entitled 'INSOLVU Seminar: Teaching Mathematics through Problem-Solving', held on 26 February 2025 at the University of Malta's Valletta Campus. Although some were initially intimidated by the prospect, they ultimately felt empowered as they received positive feedback and visible approval from the audience. This goes to show the positive outcomes that may come from working together.

Calleja believes that this sense of collaboration will continue beyond INSOLVU – 'I hope for us as researchers to continue collaborating with teachers, as it aids all of us in our professional growth. Just as we encourage teamwork among students, we should apply teamwork in our professional lives as well.' In this regard, Calleja hopes to lead by example through the next stage of this project, INSOLVU+, where schools are working together to educate deputy heads of school about the lesson study process and to act as lesson study facilitators. In this way, teachers will be able to find support from the deputy heads of school in designing and delivering more engaging and effective lessons for students. 

INSOLVU, a project led by the Ministry for Education, Sport, Youth, Research and Innovation in collaboration with Collaborative Lesson Study Malta, was made possible with the support of the UNESCO Office in Venice through funding from Huawei Technologies.



A lesson study observation at:
San Gwann Primary School (A)
Qawra Primary School (B)
Photo courtesy of Dr James Calleja