Scientific Literacy: The Past, Present and Future

Mary O'Donnell, Institute of Education, DCU

Scientific literacy has been a focal point of science education for over half a century. Recent calls for a refocus on the development of scientific literacy in the general population, following the COVID 19 pandemic, suggests that it is still an important goal for educators, policy makers and governments. In the Irish context, scientific literacy is mentioned 11 times in the junior cycle science specification (NCCA, 2015) and the development and advancement of scientific literacy skills is identified as a key goal in the new draft senior cycle science curricula (NCCA, 2023a; NCCA, 2023b). Despite the more prominent role of scientific literacy, confusion around the term, and how to facilitate its development in the classroom, remains a major issue. Opposing models, views, and definitions of scientific literacy have been the source of much debate and discussion. The lack of a widely accepted definition has resulted in the term scientific literacy being used as an "educational slogan" (Roberts, 2011 p.13) as opposed to a realistic goal for teachers and their students. Key findings from the literature will be examined and the gaps that exist in terms of translating research into practice will be explored. It is hoped that an explanatory mixed method study will be used to evaluate the effectiveness of a continuous professional learning programme for science teachers and investigate the correlation between teachers' understanding of scientific literacy and their classroom practice. This research aims to explore, create, and evaluate mechanisms to support teachers in developing the scientific literacy skills of their students at post-primary level.

Textbooks - Future-proofing Maths Education?

Tríona Nic Fhinn, Marino Institute of Education

When the 1999 curriculum was introduced, teachers relied heavily on textbooks to mediate the curriculum. Indeed, some teachers conflated the textbook with the curriculum itself. This is unlikely to change suddenly with the introduction of the redeveloped curriculum. Although using textbooks offers some advantages for teachers, such as translating curriculum objectives into activities, providing structure for lessons and guidance for planning, much depends on the quality of the textbook.

Previous research has raised concerns about the content of Irish textbooks and their alignment with the curriculum (Charalambous et al., 2010; Duffy & Brennan, 2022; Dunphy, 2009; Harbison, 2009). It has been observed that textbook content tends to be heavily weighted in favour of number, often including incorrect or incomplete definitions of shapes and representing them prototypically. The limitations of textbooks in this regard are particularly significant as Irish pupils consistently underperform in geometric knowledge and reasoning in national and international tests (Pitsia & Lysaght, 2021; Perkins & Clerkin, 2020). Geometry and spatial reasoning are essential in overall mathematics learning and cognitive development and in Science, Technology, Engineering, and Maths (STEM) education. This is especially crucial as STEM is vital for addressing modern social and economic challenges, necessitating the development of STEM expertise in citizens of countries like Ireland.

Though some research has been conducted on using textbooks in an Irish context, little has been written on the geometry content of these books. Such lack of research attention is surprising given Irish students' consistent underachievement in geometry assessments and the possibility of a link between textbooks and performance. This presentation contributes to this gap in the research by examining two

of the most popular textbooks for their adherence to the curriculum using a framework adapted from Charalambous et al. (2010). Using this framework, the study sought to examine the potential cognitive demand of the textbook tasks and evaluate these against the van Hiele levels of geometric thinking, a hierarchy that describes how students learn geometry.

A qualitative investigation into the attitudes and beliefs of female DEIS students around STEM education and progression in Ireland.

Neasa Boyle, Maynooth University

The pursuit of science, technology, engineering, and mathematics (STEM) education and careers is a crucial aspect of modern society, driving innovation, economic growth, and technological advancements. However, despite the significant progress made in recent years, gender disparities in STEM fields persist, particularly for women from low socioeconomic backgrounds. Ireland currently ranks highly on STEM graduates (at 40.3 per 1000 persons ages 20-29, as compared with the EU27 average of 21.9). However, Ireland also has the largest gender disparity in STEM graduates (at 25.6, with 53.0 male STEM graduates (per 1000 persons aged 20-29 compared with 27.4 females) (CSO, 2022). This skew of male graduates further highlights the need for an investigation into the STEM experiences and opinions of female students.

This paper takes the perspective of such marginalised groups and explores their perceptions of STEM within a school-based system. An intersectionality approach was employed which recognised that additional barriers arise when crossing multiple identities like gender and socio-economic status. Three schools agreed to take part in the focus groups, in total 18 students participated. The results provide insight into unique challenges faced when pursuing STEM; additionally, the motivating and inhibiting factors reported. The findings reveal how social and academic barriers prevent young women from progressing in STEM careers, highlighting how intersectional layers of disadvantage limits equal access in STEM education. Our findings will provide a nuanced understanding of the complex challenges facing women from lower socioeconomic backgrounds in STEM education and careers. By highlighting the importance of addressing these disparities, we hope to inspire policymakers, educators, and industry leaders to take action to create a more inclusive and equitable STEM ecosystem.

Building Inclusivity in Mathematics Classrooms: Effective Practices

Helen Keenan, Institute of Education, DCU

In the domain of mathematics education, the concept of inclusion holds a prominent position in research endeavours, in a policy and curriculum context, and within the practices of educators (Askew, 2015). However, students with Special Educational Needs still encounter difficulties in accessing and excelling in meaningful mathematics experiences (Tan and Thorius, 2018). Arguments highlight that due to limitations of curricula, there is a tendency towards teaching practices that prioritise rote memorisation, with limited focus on understanding of mathematical concepts and its applications

(Foster, 2013). This underscores the need for understanding effective mathematics practice in promoting IME for students with SEN.

The research described in this study explores Inclusive Mathematics Education (IME) practices for students with Special Educational Needs (SEN) at upper primary and lower secondary level. The research undertook the form of a conceptual study, via the medium of a Typology. Such studies have been noted to enrich a particular field, through systematically reviewing the existing body of knowledge, identifying areas of concern and inconsistency, highlighting critical knowledge gaps, and setting forth prospective research agendas (Hulland, 2020). The study followed a structured research methodology, aligned with the Typology framework outlined by Jaakkola (2020). For example, the procedure included Initial Categorisation, Type Identification, Critical Dimension Organisation, and Interpretation and Implications.

Analysis revealed four dominant types of practice: Teaching for Understanding (TfU), Constructivist Teaching (CT), Differentiated Instruction (DI), and Teaching for Procedural Fluency (TfPF). Findings in relation to these types of practice offer valuable insights into effective types of practice, and also the context of inclusion and SEN in which they are most applicable. Among these, the CT practice Utilisation of Universal Design for Learning, and the versatility of DI, emerged as particularly effective teaching approaches.

Mathematical Modeling, explained.

Laura Durkan, Institute of Education, DCU

This project aims to investigate the integration of mathematical modelling in primary education to foster critical thinking, problem-solving skills, and real-world application of mathematical concepts. Through hands-on exploration, pupils identify real-world problems, formulate mathematical models, analyse data, and communicate findings effectively.

As elucidated through literature on this topic and conversations with practitioners, teacher professional development workshops support educators in integrating mathematical modelling into teaching practices, providing strategies for scaffolding learning, facilitating discussions, and assessing modelling skills. Thus, it is evident that ongoing support and mentoring foster a community of practice for continuous improvement.

Preliminary findings and research conducted in this field indicate increased pupil enthusiasm for mathematics, improved problem-solving abilities, and deeper understanding of concepts. The literature also highlights how teachers report enhanced confidence and recognise mathematical modelling's potential to enrich instructional practices.

This presentation and project draws upon a literature review and study, encompassing dialogue with fellow students and teachers, conducted for my final year mathematics specialism module assignment. Through my participation in this event, I hope to contribute to effective pedagogical approaches in primary mathematics education and highlight the benefits of integrating mathematical modelling to cultivate 21st-century skills. By empowering pupils to actively engage in mathematical learning, I aim to nurture a lifelong appreciation for mathematics and cultivate the next generation of problem solvers and innovators.

Breaking Barriers in Primary Maths: The UDL Approach

Jennifer Holligan, Lisa Walsh and Deirbhile Travers, Institute of Education, DCU

Professional Learning Communities (PLC) are collaborative groups aimed at improving teaching practices and pupil outcomes. In this context, three primary teachers established a PLC with the support of Maths4All, focusing on integrating Universal Design for Learning (UDL) into their mathematics lessons. The teachers regularly convened online to exchange research findings, share pupils' work samples and reflect on classroom experiences. Their approach aligns with the UDL framework (CAST, 2021), emphasising multiple means of representing information, expressing knowledge and engaging diverse learners. Approaching mathematics through the framework of UDL revealed a discernible contrast in the pupils' learning outcomes and attitudes toward mathematics.

This session, designed to be highly practical, will present the experiences of the three primary teachers engaged in a PLC committed to enhancing UDL practices in primary mathematics education. The teachers will explore pragmatic classroom strategies for implementing UDL principles, encompassing lesson design, execution and reflective practices to support all pupils. In demonstrating their practical approach, which encompasses using virtual manipulatives, setting attainable objectives, posing open-ended inquiries and employing diverse assessment methodologies, the presenters aim to motivate and empower other educators to implement UDL principles within their teaching environments.