

Thematic Working Group on Mathematics for Work, Society and Personal Development: Lifelong Learning, TWG7

ERME column regularly presented by Andreas Stylianides and Florian Schacht

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CERME Thematic Working Groups

We continue the initiative of introducing the CERME Thematic Working Groups, which we began in the September 2017 issue, focusing on ways in which European research in the field of mathematics education may be interesting or relevant for people working in pure and applied mathematics. Our aim is to disseminate developments in mathematics education research discussed at CERMEs and enrich the ERME community with new participants, who may benefit from hearing about research methods and findings and contribute to future CERMEs.

Introducing CERME's Thematic Working Group 7 – Mathematics for Work, Society and Personal Development: Lifelong Learning

The Thematic Working Group 7 (TWG7) investigates how mathematics is encountered, learned, and used across the entire life course, in evening schools, in workplaces, communities, homes, and informal environments, and how these encounters shape people's participation in social, economic, and cultural life.

Mathematics takes different forms across communities [9]. For instance, within the international community of research mathematicians, mathematics is both the object of research, the tool, and the result of it, whereas in medical research, mathematics serves as a methodological tool for improving health care. In compulsory schools, mathematics is experienced by many students as a list of ready-made rules, as rather alienating and feared, and as a threshold to further studies [1, 6]. Likewise, in daily life and in vocational workplaces, mathematics is a tool for finding practical solutions and for adequately participating in society.

Because of the different goals, rules, language, tools, and people in these environments, the mathematics differs across environments. In university mathematics research, there is rigour and more esoteric content. By contrast, within vocational practices, numbers and variables always have concrete meaning (measured in meters, hours, euros, etc.). Also, there is responsibility associated to the mathematical answers, for instance, a nurse's calculation errors can be a matter of life and death, whereas an incorrect proof

of inapplicable mathematics will be sad, but not a matter of life and death. Within daily life, mathematics is embedded in routines and is so deeply internalised that it is hidden or perceived as intuitive.

The establishment of TWG7 arose from a shared social motivation: to make mathematics socially useful and accessible to everyone beyond compulsory education, especially in fragile contexts with vulnerable groups. Across Europe and globally, deep inequalities persist in who benefits from mathematical knowledge and how it is valued [2, 3]. The group's focus reflects the conviction that mathematics education can play a transformative role in empowering individuals, supporting employability, and enabling informed citizenship.

This perspective resonates with wider educational movements for lifelong learning and social justice [4, 8]. It positions mathematics not as a gatekeeper of privilege but as a shared resource for personal and societal development. Consequently, TWG7 engages with research exploring mathematics in adult education, everyday life, at work, and in community settings, where learning and using mathematics can become an instrument for participation, dignity, and well-being. For example, a citizen needs to understand graphs and percentages to critically assess government spending proposals for community needs. Although this may look like 'simple' mathematics to research mathematicians, approximately one in four citizens worldwide struggles with this, which makes them susceptible to manipulation and can hinder meaningful participation in public debates about local budgets, health policies, or transportation planning [7]. Dignity can be upheld when marginalised individuals gain mathematical skills that open access to better employment opportunities or empower them to navigate bureaucratic systems and assert their rights. Well-being is supported when learners experience increased confidence and autonomy through understanding and applying mathematics in their daily lives, such as managing healthcare information or navigating digital technologies.

Conceptualising the domain

TWG7's research is grounded in the idea that mathematical practices are deeply intertwined with human experience and that access

to them is socially distributed. Across diverse contexts, people face mathematical challenges that can lead to empowerment or exclusion. The group explores how the use of mathematics emerges in everyday situations, such as professional problem-solving, household budgeting, health decisions, and leisure activities, and how individuals make sense of these experiences. The notion of vulnerability is central, highlighting how precarious life conditions and limited learning opportunities affect engagement with mathematics, as well as how creativity and resilience emerge in such contexts.

Topics in the domain of TWG7 are researched through a variety of theoretical and methodological approaches, including critical mathematics education, socio-cultural theory, design-based and action research, all of which reveal mathematics as a lifelong and life-wide human practice.

The work of TWG7 revolves around three main themes, closely connected through the idea of lifelong engagement with mathematics.

1. Adults learning mathematics

This theme examines how adults return to mathematics education in formal and informal settings such as evening schools, community programs, or correctional institutions. Adult learners often bring diverse experiences, motivations, and emotions, including anxiety or prior failure, as well as curiosity, agency, and unexpected ways to use mathematics based on their informal experiences.

Research in this area highlights the importance of creating learning environments that are flexible, inclusive, and responsive to adult learners' personal circumstances. Studies also show that adult mathematics education contributes not only to individual empowerment but also to social well-being, intergenerational learning, and family support.

2. Mathematical literacy and numeracy

Mathematical literacy and numeracy are the mathematical capabilities essential for citizens navigating contemporary societies shaped by data, digital technologies, and quantitative information. Research presented in TWG7 emphasised how these competences influence people's employment opportunities, health-related decisions, and their ability to participate in civic life.

Studies in TWG7 explored conceptual frameworks for mathematical literacy, numeracy, large-scale assessments of adult numeracy, and ways to integrate numeracy into professional education. A recurring concern is that numeracy is often perceived only as basic arithmetic, rather than as reasoning and problem-solving situated in real-life contexts, as described in the research literature (see for example [5]). Our research reveals widening numeracy gaps (e.g., between countries, between men and women, etc.) and we observe political tensions when calls for improving numeracy

is motivated by economic productivity rather than the learners' personal and social needs. This also points to the complex and sometimes conflicting interests of policymakers, balancing economic productivity with broader aims of social participation and civic inclusion.

3. Vocational and workplace mathematics

Research in vocational and workplace mathematics examines how mathematics operates within professional practices and is taught in vocational education. Across countries, vocational curricula vary widely in content and emphasis, from academically oriented to practice-based or hybrid models.

Findings indicate that learners engage more meaningfully with mathematics when they recognise its relevance to their vocational identities and future work. Collaborative teaching between mathematics and vocational educators, as well as the use of authentic artefacts and workplace scenarios, has been shown to enhance motivation and perceived usefulness.

Cross-cutting perspectives and future directions

A defining feature of TWG7 is the interconnection between its themes. Research on numeracy often overlaps with studies on vocational learning or adult education, showing that mathematical literacy, workplace mathematics, and lifelong learning are not separate fields but parts of a continuous spectrum of mathematical activity. This interconnectedness encourages not only advancement of practice but also theoretical innovation. Within TWG7, new concepts have been developed to describe how mathematics circulates between experts, workers, and citizens, how authenticity is negotiated in learning tasks, and how artefacts mediate between vocational and mathematical domains. Such conceptual work demonstrates the group's contribution to advancing both theory and practice in mathematics education.

Methodologically, TWG7 features remarkable diversity. Large-scale quantitative surveys, qualitative case studies, design experiments, and theoretical analyses coexist and complement one another. This variety reflects the richness of the research field and its openness to interdisciplinary dialogue.

Looking ahead, TWG7 recognises several directions for future work:

- developing research-based approaches to teaching mathematics for adults and lifelong learners;
- integrating numeracy and critical mathematics education into vocational and professional contexts;
- strengthening collaboration between mathematics educators, industry professionals, and policymakers;
- and deepening theoretical models that link personal development, social participation, and work through mathematics.

Concluding Remarks

Mathematics accompanies people throughout life as a tool for understanding the world, making decisions, and building identities. The research within TWG7 explores how mathematics education can respond to this lifelong presence by addressing issues of equity, relevance, and meaning.

By connecting mathematics with work, society, and personal development, TWG7 contributes to a broader understanding of what it means to learn, use, and live with mathematics in the 21st century.

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