Topic Study Group 1.5: Teaching and learning of measurement

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Overview

The fundamental problematic of measurement can be seen as inventing symbolic means for describing and quantifying attributes of objects and of quantitative relations among them. The measure of an attribute and understandings of the nature of the attribute are co-constituted. Expressions of and work with measures require development of means, notably more elaborate systems of units and of numbers, scales, compound measures, experimental methods and statistics. It covers the tangible quantitative to intangible measures even formulae such as trigonometry ratio.

Topics in this TSG include measuring the geometric attributes of length, area, volume and angle. It also includes the measurement of non-geometric attributes such as weight, mass, time and money. Measurement typically produces data that is continuous rather than discrete. The topic has strong

connections to the mathematical domains of geometry (e.g., planar and spatial geometric objects and their properties), number (e.g., fractions and ratios, decimal numbers and significant figures, properties of multiplication, squared and cubed numbers, and also proportional reasoning), algebra e.g., the meaning of variables and algebraic expressions), and statistics (particularly the variability of data and measurement error) as well as connections to the STEM disciplines of science, technology and engineering. Not all mathematics curricula give the same role to measurement. Some, for example, do not include the measurement of non-geometric attributes. And, in practice, explicit or effective links between measurement and other topics vary widely.

Internationally, there seems to be an overall lack of attention paid to instruction in measurement at both primary and secondary levels, despite there being extensive links of the topic of measurement to everyday contexts. Although the historical status of measurement has dramatically declined in some mathematics curricula, substantive informal mathematical knowledge is still based on measurement knowledge. Moreover, it seems that weak knowledge of measurement concepts and skills becomes problematic while studying other disciplines e.g., students in science not understanding the difference between mass and volume and their units of measurement.

Areas of interest

The main objective of this TSG is to better understand the conditions and constraints on teaching and learning measurement in international contexts and to consider some possible changes. This objective has five main sub-themes:

1. **Connections between measurement and other mathematical topics**. This sub-theme includes reports on insufficient knowledge in measurement that constitutes obstacles to learning other mathematical topics. Conversely, it includes an examination of the extent to which other mathematical topics support the development of measurement concepts, for example in the use of geometrical construction to solve problems of measurement.
2. **Connections between measurement and everyday life**. This sub-theme relates to the kinds of knowledge about measurement that are required in the workplace and that students acquire outside of school, as well as forms of teachers' knowledge that support effective teaching of measurement.
3. **Development of conceptual understanding of geometric measurement**. This sub-theme includes reports, theories and learning progressions or learning frameworks concerning the teaching of geometric measurement (length, area, volume and angle) and whether the teaching supports conceptual understanding.

4. **Measurement estimation skills**. This sub-theme is about how researchers, teachers, or curricula deal with the development of measurement estimation skills, or, in general, the skill of estimating quantities. It also concerns the extent to which the skill of estimation nurtures conceptual understanding of units of measurement and relationships between subunits of measurement such as metres, kilometres and millimetres. Estimation has become a more important skill as students measure using electronic devices (which can often measure more than one attribute) and, consequently, need to determine whether a measurement and its units are believable or if there is a problem with the measuring device or the setting on the device.
5. **Connections between measurement and other STEM disciplines**. This topic includes examples of powerful connections between learning and teaching measurement and education in science, technology and engineering, referred to together with mathematics as STEM. For instance, conflicting perspectives between mathematics and physics and between mathematics and chemistry have been identified. Examples could be presented as well as ways to overcome such conflicts. Other interdisciplinary approaches in mathematics education may also be relevant.

Perspectives on these sub-themes could be theoretical, methodological, historical, epistemological or empirical, and they could emerge from various points of view, such as teacher practices, student learning, the mathematical topic itself, teacher education, or curriculum development.

How to make a submission to this Topic Study Group

Submissions for Topic Study Group Papers and proposals for Posters open 28 April 2023 via the official ICME-15 website, icme15.org. The website also contains a timeline of dates for the activity of the Topic Study Groups in the lead up to the Congress.

For questions about this TSG, please contact the Co-Chairs using the email addresses provided.