

Analysis of the teacher's specialized knowledge: A case study in mathematical modelling

Edgar Roberto Rossainz Montiel ¹ 

Estela de Lourdes Juárez Ruiz ² 

Problem addressed

The problem addressed is the difficulty that mathematics students have in solving contextual problems or mathematically modelling a situation that interests them. This is due to the lack of content that promotes the development of reasoning, problem solving, and modelling skills (SEP, 2022).

The responsibility does not lie solely with the students, as the teaching-learning process involves the students, the teacher, the mathematical content and the learning environment (SEP, 2019).

In this sense, the teaching-learning process reveals, among other things, how teaching is done, how learning is done, who learns and how learning is done; this is what research in mathematics education seeks to investigate.

¹ edgar.rossainz@alumno.buap.mx

Benemérita Universidad Autónoma de Puebla, Puebla, Mexico

² estela.juarez@correo.buap.mx

Benemérita Universidad Autónoma de Puebla, Puebla, Mexico

Rossainz Montiel, E. R., & Juárez Ruiz, E. L. (2026). Analysis of the teacher's specialized knowledge: A case study in mathematical modelling. In M. S. Aguilar & M. Misfeldt (Eds.), *Proceedings of the First Implementation and Replication Studies in Mathematics Education Conference: IRMEC 2025* (pp. 173–176). Editorial SOMIDEM. <https://doi.org/10.24844/SOMIDEM/S3/2026/03-25>

This particular research examines the mathematics teacher as they take on the role of a student and solve mathematical modelling problems, and then analyses them from the teacher's perspective, asking how they would implement them in the classroom and what problems students would have in doing so. For this reason, the general objective of this work is to identify the specialized knowledge that a mathematics teacher displays when solving and analysing a verbal problem in the different phases of a mathematical modelling cycle.

Framework

The research was conducted within the framework of qualitative methodology through an instrumental case study; the participating teacher was a master's student of mathematics education and a teacher of primary and upper secondary education. For the research, the theoretical bases of the Mathematics Teacher's Specialized Knowledge (MTSK) model proposed by Carrillo et al. (2022) were used, which is a theoretical proposal but at the same time a methodological tool that can be used to study the teacher in their teaching practice. The other theoretical basis that frames this research is the mathematical modelling cycle proposed by Borromeo Ferri (2018). This modelling cycle is considered a variant or extension of Blum and Leiß (2007) approach, where Borromeo Ferri explores the cognitive and didactic aspects of modelling. Her work focuses on how students and teachers think and act during the modelling process, i.e., Borromeo Ferri has made a refinement that places particular emphasis on the internal processes (transitions and metacognition) and mental representations of the individual.

What is implemented?

This research paper examines the implementation of an innovation in a mathematical modelling workshop from a cognitive perspective. According to Century and Cassata's (2016) classification, the innovation analysed is simple, as it involves a procedure to demonstrate the mathematics teacher's specialized knowledge when modelling a problem mathematically. The objective of this research is to understand the extent to which the innovation achieves the intended outcomes in the target population, specifically to determine the results for students and teachers in a secondary school setting.

The workshop for the mathematical modelling course was conducted, consisting of 16 two-hour sessions. The following data collection instruments were used: participants' modelling work on seven problems, a script with questions adapted from the version by Montes et al. (2021) to demonstrate their specialized knowledge, group discussions among

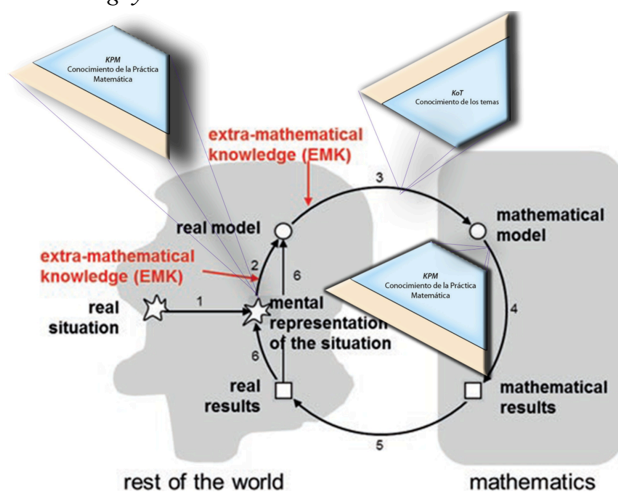
participants in class, and a semi-structured interview to reinforce the questionnaire responses. The instructors developed a mathematical modelling plan, which was implemented in their classes.

The potential importance and significance

The results presented by the teacher in solving one of the mathematical modelling problems, considering the subdomains of the MTSK model and following the phases of Borromeo Ferri's modelling cycle, show an intrinsic relationship between her mathematical knowledge of the topics in the different phases of modelling (see Figure 1). The teacher showed no evidence of didactic knowledge, only hints. These results suggest that the modelling process requires the teacher to apply the different mathematical knowledge described in the MTSK model.

Figure 1

Specialized knowledge of the mathematics teacher evidenced in the phases of the mathematical modelling cycle



This relationship opens a new line of research with a clear didactic goal: to propose a change in the curriculum for the training of future mathematics teachers. This proposal would allow them to specifically develop their mathematical modelling skills based on the structure of subject knowledge defined by the MTSK model, in this particular case subject knowledge.

References

- Blum, W., & Leiß, D. (2007). How do students and teachers deal with modelling problems? In C. Haines, P. Galbraith, W. Blum, & S. Khan (Eds.), *Mathematical modelling (ICTMA12): Education, engineering and economics* (pp. 222–231). Horwood Publishing.
- Borromeo Ferri, R. (2018). *Learning how to teach mathematical modelling in school and teacher education*. Springer.
- Carrillo, J., Montes, M. A., & Climent, N. (2022). *Investigación sobre conocimiento especializado del profesor de matemáticas (MTSK): 10 años de camino*. Dykinson
- Century, J., & Cassata, A. (2016). Implementation research: Finding common ground on what, how, why, where, and who. *Review of Research in Education*, 40(1), 169–215. <https://doi.org/10.3102/0091732X16665332>
- Montes, M., Pascual, M., & Climent, N. (2021). Un experimento de enseñanza en formación continua estructurado por el modelo MTSK. *Revista Latinoamericana de Investigación en Matemática Educativa*, 24(1), 83–104.
- Secretaría de Educación Pública. (2019). *Rediseño del Marco Curricular común de la Educación Media Superior 2019–2022*.
- Secretaría de Educación Pública. (2022). *Progresiones de aprendizaje del recurso sociocognitivo de pensamiento matemático*.