SECONDARY TEACHERS' PRACTICAL RATIONALITY OF MATHEMATICAL MODELING

Wenmin Zhao
University of Missouri
wenminzhao@mail.missouri.edu

Samuel Otten
University of Missouri
ottensa@missouri.edu

Keywords: Mathematical modeling, practical rationality, norms, obligations

Various policy leaders and educational scholars have advocated for teachers to implement mathematical modeling in their classrooms (e.g., Common Core State Standards in Mathematics, 2010). In spite of arguments in favor of modeling, the implementation of modeling is still relatively rare in teaching practice in most countries including the United States (Blum, 2015). What makes modeling not viable or desirable from the perspective of secondary mathematics teachers? In what ways do teachers' day-to-day routines or views of their professional responsibilities align or not with modeling? In this study, we employed *practical rationality* as a framework for examining how teacher decisions are rationalized at the level of the instructional situation and to further understand the potential challenges of enacting modeling in classrooms.

The *practical rationality* approach suggests that instructional norms and professional obligations come into play in teachers' instructional decisions (Herbst & Chazan, 2012). Teachers view their role as entwined with obligations to different stakeholders corresponding to four sources of obligations: *disciplinary obligation*, *institutional obligation*, *individual obligation*, and *interpersonal obligation*. This study presents an analysis of the norms that are perceived by secondary teachers in relation to modeling and the professional obligations that they use to justify their departure from or alignment to the associated norm through the use of a scenario-based survey.

Secondary mathematics teachers (n=176) from the Midwestern United States participated in the study, varying in terms of their experience of teaching different courses and experience of enacting modeling tasks. They were randomly assigned to one of two groups. Each group includes four narrative sets in the situation of modeling. Within each narrative set, teachers were asked to choose what they would do next, presenting three options that included a hypothesized normative instructional action (e.g., close off the opportunities for students to use their everyday life knowledge) and two less typical actions (e.g., encourage students to bring in their background experiences). These hypothesized actions are based on prior studies of the enactment of modeling tasks (e.g., Leiß, 2007), non-traditional tasks (e.g., Herbst, 2003), and word problems (e.g., Chazan, Sela, & Herbst, 2012), and classroom observations in the United States.

Our findings show that while 68.2% of teachers chose to give clear directions for factor selection for their students and 94.3% of teachers expected students to find a symbolic representation (e.g., functions) as their final product of modeling, these teachers felt strongly obligated to teach the underlying mathematical concepts and the properties. In addition, only 34.1% of teachers were amenable to emphasize the social justice aspect of the task. However, for those who chose not to attend to social justice issues, they felt strongly obligated to interpersonal obligations (e.g., maintain a classroom environment that is conceived to learning) and disciplinary obligations (e.g., teach a valid representation of the mathematical knowledge and practices). The findings imply that the environmental impacts (e.g., disciplinary obligations) on the instructional practice of mathematical modeling should be taken into account. In the poster session, we will further illustrate how practical rationality can be used to better understand how teacher decisions are rationalized in mathematical modeling.

In: Sacristán, A.I., Cortés-Zavala, J.C. & Ruiz-Arias, P.M. (Eds.). (2020). *Mathematics Education Across Cultures: Proceedings of the 42nd Meeting of the North American Chapter of the International Group for the Psychology of Mathematics Education*, Mexico. Cinvestav / AMIUTEM / PME-NA. https:/doi.org/10.51272/pmena.42.2020

References

Blum, W. (2015). Quality teaching of mathematical modelling: What do we know, what can we do? In S. J. Cho (Ed.), *Proceedings of the 12th International Congress on Mathematical Education* (pp. 73–96). Berlin: Springer.

Chazan, D., Sela, H., & Herbst, P. (2012). Is the role of equations in the doing of word problems in school algebra changing? Initial indications from teacher study groups. *Cognition and Instruction, 30*(1), 1-38.

Common Core State Standards Initiative. (2010). *Common Core State Standards for Mathematics.* Washington, DC: National Governors Association Center for Best Practices and the Council of Chief State School Officers. Retrieved from http://www.corestandards.org.

Herbst, P. (2003). Using novel tasks in teaching mathematics: Three tensions affecting the work of the teacher. *American Educational Research Journal, 40*(1), 197-238.

Herbst, P., & Chazan, D. (2012). On the instructional triangle and sources of justification for action in mathematics teaching. *ZDM, 44*, 601-612.

Leiß, D. (2007). *Hilf mir es selbst zu tun*. Franzbecker: Lehrerinterventionen beim mathematischen Modellieren. ["Help me to do it myself". Teachers' interventions in mathematical modelling processes]. Hildesheim: Franzbecker.