A comparison of two frameworks for the analysis of knowledge and skills for teaching statistics – MKT vs. RCM for PCK

Per Blomberg
Halmstad University and Karlstad University

This presentation is part of a Ph.D. project that aims to increase knowledge about how to support the development of teacher students' pedagogical content knowledge (PCK) for teaching statistical inference. Dealing with the existing diversity of theoretical approaches is a well-known challenge for the research community. The focus of this short communication is to compare two reputable frameworks: Mathematical knowledge for teaching (MKT) and Refined Consensus Model (RCM) for pedagogical content knowledge. This comparison will highlight their contributions, merits, shortcomings, and possible connections to evaluate and guide an ongoing teaching and learning design in teacher education for primary school.

Introduction and background

Research in statistics education draws attention to the introduction of statistical inference (SI) for all ages (e.g., Makar & Rubin, 2018). The research community put forward that it is necessary, but not sufficient, to master the content for effective teaching. Hence, to enable the vision of teaching SI in primary school, strengthening teacher students' subject knowledge (SK) and PCK about SI must be a high priority (Groth & Meletiou-Mavrotheris, 2017). The project adopts a design research approach that aim to generate a theory-based development (Bakker, 2018). Using a theoretical framework is advisable to guide and evaluate the quality of a teaching and learning design. Such a framework should expose both the design characteristics and how intended results are achieved in the design.

Theoretical frameworks

Shulman (1986) introduced a new way of thinking about teacher knowledge by proposing that we distinguish teachers' knowledge base into three categories: subject matter content knowledge, PCK, and curricular knowledge. Within the category of PCK, Shulman (1986) include "… for the most regularly taught topics in one's subject area, the most useful forms of representation of those ideas, the most powerful analogies, illustrations, examples, explanations, and demonstrations - in a word, the ways of representing and formulating the subject that make it comprehensible to others." (p. 9). Since Shulman introduced PCK, educational researchers have used the construct

extensively. Their work has resulted in different perceptions of PCK - two of which are presented here.

In the domains of mathematical knowledge for teaching, based on the ideas of PCK, Ball et al. (2008) presented a refined framework (MKT) including additional categories of the content knowledge for teaching. The MKT framework is widely used in mathematics and statistics teacher education research (Groth & Meletiou-Mavrotheris, 2017). Three features characterize MKT: 1) PCK appears as a separate category from SK, 2) the SK consists of three sub-areas: common content knowledge, specialized content knowledge, and horizon content knowledge, and 3) PCK is conceptualized as pieces of knowledge in the form of combination or intersection between knowledge of content and students, knowledge of content and teaching, and knowledge of content and curriculum.

To reduce the diversity perspective on PCK and to better situate teacher education research studies, Carlson and Daehler (2019) developed the RCM. Briefly, the RCM visualizes the interconnected layers of knowledge and experiences that shape and contribute to teachers' practice and mediate students' outcomes. The model consists of three distinct main areas of PCK; collective PCK, personal PCK, and enacted PCK. In addition to these central realms, attention is also paid to PCK components such as Knowledge of Content, Pedagogical Knowledge, Knowledge of Students, Curricular Knowledge, Assessment Knowledge, and how Learning Context enters among the layers of PCK. Another key component of the RCM is the flow of knowledge and skills. Knowledge flows in and out through different layers of knowledge and between an individual teacher in interaction with students and others.

References

Bakker, A. (2018). *Design Research in Education: A Practical Guide for Early Career Researchers* [Book]. Routledge.

Ball, L., Thames, D., Hoover, M., & Geoffrey, P. (2008). Content Knowledge for Teaching: What Makes It Special? *Journal of Teacher Education*, *59*(5), 389-407. https://doi.org/10.1177/0022487108324554

Carlson, J., & Daehler, K. R. (2019). The Refined Consensus Model of Pedagogical Content Knowledge in Science Education. In A. Hume, R. Cooper, & A. Borowski (Eds.), *Repositioning Pedagogical Content Knowledge in Teachers' Knowledge for Teaching Science* (pp. 77-94). Springer. https://doi.org/10.1007/978-981-13-5898-2_2

Groth, R., & Meletiou-Mavrotheris, M. (2017). Research on Statistics Teachers' Cognitive and Affective Characteristics. In (pp. 327-355). https://doi.org/10.1007/978-3-319-66195-7_10

Makar, K., & Rubin, A. (2018). Learning About Statistical Inference. In D. Ben-Zvi, K. Makar, & J. Garfield (Eds.), *International Handbook of Research in Statistics Education* (pp. 261-294). Springer. https://doi.org/10.1007/978-3-319-66195-7_8

Shulman, L. S. (1986). Those Who Understand: Knowledge Growth. *Educational Researcher*, *15*(2), 4-14.