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Melhuish, K., White, A., Sorto, M. A., & Thanheiser, E. (2021). Two replication studies of the relationships between mathematical knowledge for teaching, mathematical quality of instruction, and student achievement. *Implementation and Replication Studies in Mathematics Education*, *1*(2), xx–xx. 10.1163/26670127-01010007

Problem Addressed

The replication study reported in this paper is developed around the fundamental question: *What is the mathematical knowledge that teachers need to provide good quality mathematical instruction?* This question has been approached from different perspectives and with different methods. In particular, some researchers have developed instruments focused on measuring this specialized knowledge for teaching along with corresponding instructional practice, among which the Mathematical Knowledge for Teaching (MKT) measures and the Mathematical Quality of Instruction (MQI) instrument stand out.

These instruments are aligned with a standards-based approach to instruction, and therefore they are widely used in the United States – and beyond. However, as the authors of this paper point out: "Underlying the use of these instruments are some fundamental assumptions about how knowledge, instruction, and student learning relate. In particular, researchers who have developed these instruments posit that the items and constructs from the test/observation protocol reflect the types of knowledge and instruction that leads to student mathematical learning".

The authors of this study revisit these unchallenged assumptions through two conceptual replications that are intended to explore the generality of the claimed links between MKT, MQI and student learning outcomes.

What is Replicated?

The paper reports two conceptual replications of Hill et al.'s (2012) study linking Mathematical Knowledge for Teaching (MKT), Mathematical Quality of Instruction (MQI), and student assessment scores. These conceptual

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replications differ from the original study in that they were developed using different samples with slightly different demographic variables, and slightly modified versions of the underlying measures.

Despite these variations in the conditions of the original study, the authors of this article argue that their analyses share enough commonalities with the original study to still test the underlying theoretical relationships which are key to conceptual replications. In particular, three replication hypotheses are tested:

> **Replication Hypothesis 1:** MKT, as measured by the MKT measure, is Positively Correlated with MQI as measured by the MQI Instrument.
>
> **Replication Hypothesis 2:** MKT and MQI are Positively Correlated with Value-Added Scores (as reflected in state standardized assessments).
>
> **Replication Hypothesis 3:** Cutoff scores for MKT can be used to identify teachers with 'problematic practice' and teachers for leadership roles.

Implications and Significance

This is a replication study that empirically explores the extent to which a theoretical relationship is maintained across different settings. This research paper illustrates how a replication study can be used to identify where the limits of a theoretical relationship lie, and to study its generalizability.

The replication study reported here also has implications for the practice of mathematics teacher education. The authors provide evidence that the acknowledged relationships between MKT, MQI and student assessment scores are not always warranted across different settings. Thus, the authors of this study call on policymakers and researchers to proceed with caution when using MKT and MQI measures to evaluate program initiatives, and identify teachers for remediation or leadership positions. The researchers warn that it is necessary to situate the effects of such measures within a particular context, and even complement them with other measures or analysis foci that may account for other components of teachers' knowledge.

Reference

Hill, H. C., Umland, K., Litke, E., & Kapitula, L. R. (2012). Teacher quality and quality teaching: Examining the relationship of a teacher assessment to practice. *American Journal of Education*, *118*(4), 489–519. https://doi.org/10.1086/666380.

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