Mathematical Knowledge for Teaching in Undergraduate Contexts: A Literature Review

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Understanding what teachers must know to teach effectively has consistently been a central focus in educational research. The Mathematical Knowledge for Teaching (MKT) framework is one of the foundational models to explore professional knowledge of mathematics teachers (Ball et al., 2008). The MKT framework comprises two groups—subject matter knowledge and pedagogical content—each containing three domains of knowledge, for a total of six knowledge domains. Subject matter knowledge includes common content knowledge, horizon content knowledge, and specialized content knowledge. Pedagogical content knowledge (PCK) includes knowledge of content and students, knowledge of content and teaching, and knowledge of content and curriculum. Originally, the MKT framework was designed and has been extensively applied for elementary education (Hoover et al., 2016). Over time, the framework has been utilized for higher grades. This review asks: What patterns emerge regarding the theoretical frameworks utilized, methods employed, purposes, and participant selection in MKT studies focused on university-level teaching? The review results are: (1) conceptualization of MKT domains, (2) diversity in participants and instructional contexts, (3) methodological innovations. Only the first two of them are briefly discussed below due to space constraints.

Several studies in the MKT literature focus on defining and making sense of the MKT knowledge domains in typical or new undergraduate contexts (Hauk et al., 2014; Speer et al., 2015; Johns & Burks, 2023). For example, Speer et al. (2015) argued that the distinction between CCK and SCK became blurred as we move beyond elementary teaching to higher educational contexts. Many tasks identified as SCK (e.g., evaluating student-generated solutions) for mathematics instructors appear in everyday research practices of mathematicians (e.g., evaluating a proof in a manuscript for publication). Future studies in the undergraduate context need to clarify what SCK means.

This review highlights diverse participants type: from university mathematics faculty (Speer et al, 2013), community college faculty (Hauk et al., 2014; Nabb & Marawska, 2020), dual enrolment in high school and community college (Beckford et al., 2023), and graduate students as tutors (Johns & Burk, 2023). An interesting trend emerged in many studies involving non-university mathematics faculty participants, which focused on relational and socio-cultural aspects (e.g., caring, trust, affective, cultural, practical, and contextual) of teaching, and suggested that these be incorporated into MKT.

Many studies draw heavily on self-reported data such as interviews (Nabb & Murawska, 2020), online working group sessions (Kim & McCrackin, 2024), and surveys (Beckford et al., 2023), which focus on what these participants say they know or do. Two gaps are noted concerning the limited ability to connect MKT and student learning. Firstly, few studies draw on real classroom practice (Johns & Burks, 2023; Speer et al., 2013). Secondly, none of these studies reviewed include how MKT translates into classroom impact or student learning data. Future research needs to include classroom transcripts, student work, and evidence of how students respond to certain MKT domains in instruction.

The poster will present all the patterns with gaps and future steps. I look forward to discussions with conference attendees about more results mentioned in the poster.

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