

link; <https://jme.ejournal.unsri.ac.id/index.php/jme/article/view/3958>

Bridging a framework for mathematical abilities: How set theory becomes the ultimate problem-solving algorithm

Ma'rup

Department of Mathematics Education, Muhammadiyah University of Makassar, Makassar, Indonesia

<https://orcid.org/0009-0003-4149-4123>

Ahmad Talib

ahmadtalibunm@gmail.com (Primary Contact)

Department of Mathematics, Makassar State University, Makassar, Indonesia

<https://orcid.org/0009-0009-4260-6717>

Suradi Tahmir

Department of Mathematics, Makassar State University, Makassar, Indonesia

<https://orcid.org/0009-0004-7225-3565>

Rusdin

3Department of Primary Islamic School Teacher Education, Institut Agama Islam

Abstract

Set theory functions as a foundational structure in mathematics, underpinning logical reasoning and the interpretation of relationships across diverse mathematical contexts. Nevertheless, research in mathematics education indicates that students often experience difficulty transferring abstract set-theoretic concepts into effective strategies for solving contextual problems. This challenge reflects a critical pedagogical gap: the lack of a systematic instructional framework that explicitly links the logical structure of set theory to students' problem-solving processes. To address this gap, the present study proposes a novel pedagogical construct, termed the Bridge Model of the Set Theory Framework, which is designed to mediate between conceptual understanding and applied problem-solving competence. The primary aim of this study is to develop and explicate the Bridge Model and to examine how students employ it to operationalize set-theoretic concepts when engaging with contextual mathematical problems. A qualitative research design using a case study methodology was adopted. Data were collected through classroom observations, semi-structured interviews with mathematics teachers and purposively selected students, and analysis of students' written solutions. Participants were selected based on their demonstrated engagement with set concepts. Data analysis was conducted inductively using narrative and grounded theory approaches to identify patterns in students' cognitive and representational practices. The findings reveal recurrent difficulties in students' translation of contextual information into formal mathematical representations and result in a three-phase Bridge Model, namely problem decontextualization, symbolic mapping of sets, and logical solution validation. Theoretically, this study contributes to mathematics education literature by articulating a structured mechanism that connects abstract set theory with mathematical reasoning in context. Practically, the model offers a principled instructional guide for teaching set theory as a core logical tool, supporting students' analytical reasoning and systematic problem-solving abilities.