APPARATUS-BASED MATHEMATICS PROBLEMS: CONCEPTUALIZATION AND EARLY EVIDENCE

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ABSTRACT

Based on the observation that problems involving concrete objects have received insufficient attention and that the role of manipulatives in mathematical problem solving has been studied only to a very limited extent, [6] introduced a new type of problem: "Apparatus-Based Mathematics Problems (AbMP)". AbMP is the name given to each problem in a series defined on an apparatus (a group of objects). In other words, AbMP serves both as the name for each individual example within a problem family and as the umbrella term for the family itself. The primary goal of AbMPs is to support the development of mathematical thinking through problem-solving and problem-posing, thereby fostering hand-eye-mind coordination. This study aims to introduce the concept of AbMPs and provide an in-depth overview of graduate theses and conference papers on this topic. Designed as qualitative document analysis, the study employed descriptive content analysis [3] of studies on AbMPs. Within this scope, documents from 5 master's theses, 3 conference papers, and 3 ongoing doctoral dissertations were analyzed. The studies were examined under the headings "research objective," "participant characteristics," "research method," "data collection tools," "types of AbMPs used," and "findings." The study aims to offer insight into research trends and preliminary findings regarding AbMPs. In the graduate theses examined, the AbMPs were used to investigate the problem-solving and problem-posing processes of mathematically gifted students [1], to identify the analytical thinking and reasoning processes of preservice mathematics teacher [5], in the assessment of collaborative problemsolving skills among high school students and preservice teachers [2, 7], and in the analysis of problem-posing experiences of architecture students [4]. It was found that mathematically gifted middle and high school students were able to demonstrate most of the criteria for mathematical giftedness in their AbMP-solving and problem-posing processes and expressed positive views of these problems; that "analytical thinking" patterns were predominant in preservice mathematics teachers' AbMP-solving processes; in terms of reasoning, participants demonstrated logical, advanced visuospatial, and advanced mathematical reasoning; that AbMPs were effective and useful tools in examining preservice teachers' "collaborative problem-solving" skills; the findings showed that architecture students' experiences and products in the processes of solving and designing AbMPs were evaluated as challenging yet distinctive and beneficial, and that functional frameworks for AbMPs could be developed. In conclusion, the findings of the reviewed studies indicate that AbMPs are not merely an alternative problem type across diverse participant groups; rather, they can also serve as valuable research tools that provide insight into problem-solving, problem-posing, reasoning, and higher-order mathematical thinking.

***K*eywords** Apparatus based mathematics problems · Problem solving · Document analysis · Regular solid spherical harmonics

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