PRE-SERVICE ELEMENTARY EDUCATION TEACHERS' SOLUTIONS FOR WORD PROBLEMS: USING STRIP DIAGRAM VS. ALGEBRAIC APPROACH

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Creating, connecting, and translating multiple representation are "important cognitive processes that lead students to develop robust mathematical understandings" (Huntley, Marcus, Kahan, & Miller, 2007, p. 117). These cognitive processes are also considered to be crucial elements of preservice teachers' (PSTs') pedagogical content knowledge (Dreher, Kuntze, & Lerman, 2016).

In order to investigate PSTs' cognitive processes regarding multiple representations, we collected data from 73 PSTs, who enrolled in a mathematics content course for elementary education majors in Spring 2019. We analyzed PSTs' solutions to an assessment task following seven weeks of instruction related to the use of strip diagrams, double number lines, and algebraic equations to solve problems involving ratio and proportional relationships and word problems (Beckmann, 2014). The PSTs were asked to determine the total number of cookies Bonnie baked when given information about the cookie types (e.g., 1/3 of the cookies were chocolate chip, 1/6 were peanut butter, 1/6 were oatmeal raisin, and 24 were cinnamon) in two ways: using a strip diagram and writing and solving an algebraic equation. We used an error analysis technique (Radatz, 1979) to sort and interpret the responses based on fluency with strip diagram and algebraic solutions. The PSTs who exhibited complete reasoning were able to use both representations and the PSTs who exhibited incomplete reasoning were unable to use at least one of the representations. The preliminary analysis of solutions revealed the following themes in the PSTs' strategies (Table 1).

Table 1: PSTs' Strategies for Solving the Cookie Problem

	Complete Reasoning	Incomplete Reasoning
Strip Diagram	Partitioned a single bar based and labeled parts based on cookie type and fractional amount or quantity	-Drew multiple bars to represent each fractional amount -Did not consider fractional amounts as parts of the same unit -Misinterpreted the unit of fraction
Algebraic Solution	Defined variable as total amount of cookies wrote expressions based on type of cookie in terms of the fraction of the whole	Assumed sum of given amounts equaled the number stated in the problem Considered fractional amounts as numbers rather than representing parts of the unit

Students' identification of the unit of a fraction is related to unitizing mental process (Lamon, 2012). The findings of our analysis indicate that PSTs' unitizing mental processes is a determining factor in their use of representations to solve word problems. No matter which representation the PSTs used, the way they considered the unit or sub-unit amount was the foundational step in their solutions. These results suggest that further studies investigating PSTs' understanding of unitizing related processes within representations can help us prepare instruction that aligns with their understanding path for the mathematical concepts.

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