Flexibility in Partitioning Strategies of Fourth Graders

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Introduction

The partitioning process includes dividing an object or objects into nonoverlapping and exhaustive parts. Concerning fractions, another stipulation is added: These parts should be of the same size (Lamon, 1999). The ability to use, internalize and reason about partitioning is present in children at an early age (Pitkethly & Hunting, 1996), and partitioning tasks are a good starting point to begin fraction instruction. Therefore, some previous studies, such as those by Pothier and Sawada (1983) and Lamon (1996), gave point to partitioning strategies of students. Moreover, Charles and Nason (2000) identified new strategies and classified all strategies based on their potential to facilitate the abstraction of fractions from the activity of partitioning. More recently, the book written by Steffe and Olive (2010) provided an overall picture of children's partitioning schemes.

Mathematics educators have long since highlighted the importance of developing and encouraging flexibility in children's strategies (Verschaffel, Torbeyns, De Smedt, Luwel, & Van Dooren, 2007). In this context, strategy flexibility can be described as a combination of using multiple strategies, choosing the most appropriate strategy for a given problem, and switching between strategies (Star & Rittle-Johnson, 2008; Star & Seifert, 2006). Although they are related to the domain of non-routine problem solving, two types of strategy flexibility defined by Elia, van den Heuvel-Panhuizen, and Kolovou (2009) are worth mentioning here: inter-task flexibility (changing strategies across problems) and intra-task flexibility (changing strategies within problems).

Despite the abundance of studies on children's partitioning strategies and on flexibility, none of these researches deal with these two domains in conjunction. Hence, distinctively from the above-mentioned studies, this study intends to elaborate on fourth graders' strategy flexibility that they exhibit while working on partitioning tasks.

Method

Seven fourth graders participated in the study. They came from three different fourth grade classes at an elementary school in Bursa/Turkey. These students were purposefully selected by their teachers as they were more self-confident in expressing themselves. Since partitioning is not stated as a learning goal in the Turkish math curriculum at the elementary school level, participants of this study had not met with these kinds of activities in their textbooks or their learning environment before. Also, mixed and improper numbers had not been taught them when the current study was carried out.

The researcher had a semi-structured interview with each student in a separate room. During interviews, all students confronted with three partitioning tasks represented in a context. The first task was about sharing three pizzas between four peoples, while the sharing of six pizzas between nine people was required in the second one. The third task was related to sharing five construction papers between three people. Interviews lasted between 26 and 45 minutes, and all of them were audio-recorded. Each task was presented to students one-by-one on separate papers. When a student completed the first solution for a task, the researcher asked whether there was any other way to share. The next task was presented after the student completed all the options for the task he/she was working on. All papers were collected, and all answers were evaluated and classified based on the strategies defined by Charles and Nason (2000).

Results and Implications

Students produced 48 solutions in total. On average, each student came up with almost 7 solutions for three tasks. The number of solutions produced by a student varied between six and nine. Students referred mainly to five partitioning strategies: *People by objects (1), half to each person then a quarter to each person (5), whole to each person then two-third to each person (6), partitive quotient foundational (9), regrouping (27).* In 18 solutions, each share was correctly quantified as fractions by the student.

In their answers, all students demonstrated signs of inter-task and intra-task flexibility. In the scope of inter-task flexibility, the researcher observed that students could easily change their ways of sharing based on task characteristics. For example, almost all students were able to apply to a completely new strategy (*whole to each person then two-third to each person)* to tackle the third task, since it was the only task in which each share was more than a whole. On the other hand, one of the indicators of intra-task flexibility was the variety of strategies employed in one task. For example, a student employed three different partitioning strategies (*partitive quotient foundational, whole to each person then two-third to each person, and regrouping*) for the third task (see Figure 1). Besides, some students changed the sharing procedure when it did not work for the solution, which was another important indicator of intra-task flexibility.

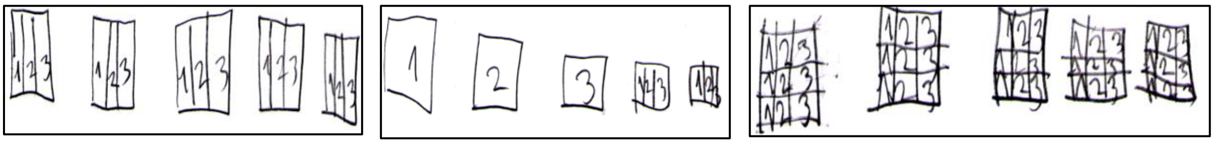

Figure 1: Different partitioning strategies employed by a student for the third task

Students' solutions for the second task showed that if numbers of objects and sharers have common factors more than one, the *regrouping* strategy can be used in different ways. This flexibility can be used as a transition to the concept of equivalent fractions. Additionally, students were able to generate strategies for the third task by using their informal knowledge even though they had not learned mixed and improper numbers yet. Two students stated that each person gets a whole and two-third at the end of the sharing, indicating that they were ready to encounter with the formal notation of mixed numbers.

The findings of this study indicate that fourth graders have potential flexibility in solving partitioning tasks, and this flexibility may be utilized to introduce new concepts such as equivalence of fractions, or mixed numbers. However, some questions are left open for future studies: Can flexibility in partitioning strategies be developed through instruction? Is there any relationship between flexibility in partitioning strategies and achievement in fractions?

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