

# Teaching Recursion in Computer Science to Elementary-School Students

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Recursion is an important idea in computer science (CS). It is an abstract idea that is relevant in various contexts, such as algorithmic design and definitions of discrete structures. The learning of recursion by novice CS students has been widely studied. According to these studies, the difficulties of undergraduate and high-school students in learning recursion were affected, among other things, by: 1) The learning phase in which recursion is introduced to the students. 2) Difficulties in separating between the specific objectives of using recursion and the implementation of recursion. 3) Mental models of recursion that are created by the students.

In this research recursion is viewed as a CS fundamental idea (Schwill, 1994). As a fundamental idea, recursion should be taught in a spiral manner (Bruner, 1960). Spiral teaching allows teaching fundamental ideas from an early age, such as elementary school, as long as the teaching and its underlying approach are adjusted to the students' cognitive level. In this study, recursion was taught to 5<sup>th</sup>- and 6<sup>th</sup>-grade students (age 10-12), outside the context of algorithmics or programming and using tangible aids. The goal of this research was to assess the effect of this teaching strategy on students' tendency to use recursion. Students' solutions were analyzed using a set of five constituents that characterize the use of recursion. The findings indicate some development of a recursive approach in students' solutions. This was depicted by the presence of recursive solutions or solutions that used a reversed perspective – that is, working from the biggest problem downward, rather than from the smallest problem upward. Although there were a few differences between the 5<sup>th</sup>-graders and the 6<sup>th</sup>-graders, there was no conclusive evidence pointing at a cognitive gap between the age groups, concerning the learning of recursion. This research is preliminary, yet it has a promise for a path of teaching an abstract concept such as recursion at a young age level.