

## Pattern-oriented instruction, its practical application, and the connection to various manifestations of abstraction in computer science

Pattern-oriented instruction (POI) is an instructional computer science (CS) approach that relies on algorithmic patterns (APs). APs are abstractions of solutions to common algorithmic problems, for example, finding the maximal value in a given sequence of values. In POI, APs are used as an organizing factor of learning, as well as a problem-solving strategy. Solving a problem using APs requires finding the relevant patterns, adjusting them to the problem at hand, and (when necessary) combining several patterns into one solution. Teaching through POI has been shown to help students acknowledge APs and incorporate them into their solutions, as well as increase their abstraction skills, analogical reasoning, and problem decomposition skills.

Abstraction is a fundamental idea in CS. It is a cognitive means for thinking about an idea, a concept, a situation, or any object of thought at different levels of details, from high levels of abstraction by ignoring details and focusing on the "big picture", to low levels of abstraction by going into the details of the object of thought.

In this work, I look into the connection between POI and abstraction in a wider context. In particular, I examine the connections between three main factors: the teaching approaches of teachers in the context of POI, the teaching approaches of teachers in the context of employing and emphasizing abstraction in teaching, and the students' abstraction abilities. For this purpose, I developed methods for diagnosing the teachers' teaching approaches regarding POI and abstraction and an operational definition of CS abstraction, to measure students' abstraction performance.

I compared the abstraction performance of the students by their teachers' POI-related teaching approaches. According the outcomes of this comparison, and unlike the results of previous studies, the connection between POI and students' abstraction performance are limited at best.

Conjecturing that students' abstraction abilities may also be related to the way their teachers emphasize and demonstrate abstraction in their teaching, regardless of their POI approach, I also compared the abstraction performance of the students by their teachers' abstraction-related teaching approaches. I examined the teachers' perception of their teaching approach in the context of abstraction. I found that students of teachers who perceived themselves as

promoting abstraction, exhibited better abstraction skills in relation to several abstraction indicators. I also examined the teachers teaching approaches in practice, with respect to abstraction. The findings, in this case, indicate lower performance of the students who were taught by teachers who promoted abstraction, in relation to several abstraction indicators.

In addition, I examined the relationship between the tendency of teachers to use POI, and their tendency to employ and emphasize abstraction in their teaching, and found some level of compatibility. According to the findings, teachers who used POI, whether in a full or partial manner, tended to emphasize abstraction in a full or partial manner, respectively. The teachers who did not use POI, varied regarding the extent to which they emphasized abstraction.