

Abstract: Algorithmic Problem Solving in Unplugged Computer Science Outreach Activities

Today's children come into contact with topics related to technology and computer science from early childhood. Therefore, computer science content is covered in many school curricula from the beginning. It is crucial to develop young learners' problem-solving strategies early and to encourage them to address computing problems. Especially in lower secondary school, where computer science topics usually start finding their way into the curriculum, it is worth investigating how children intuitively solve algorithmic problems and how these strategies can serve as a basis for later formal concepts.

The goal of this dissertation is to identify intuitive strategies of young learners aged between 10 and 14 when solving a computational problem, to examine how they can transfer what they have learned to similar problems, and to explore what this means for computer science education.

This thesis focuses on three different aspects of intuitive algorithmic problem solving: (1) the perception of the term algorithm, (2) intuitive problem-solving strategies during a collaborative sorting task, and (3) the transfer of strategies to similar sorting problems.

The first study uses a qualitative content analysis of children's answers to the question of what they think an algorithm is. The second and third studies use qualitative analysis of video recordings of students aged 10--14 solving a collaborative sorting task without prior formal instruction. In these, we observe their algorithmic strategies and connect them to known algorithmic concepts and sorting algorithms. The results show that all children followed a three-step approach to intuitively solve the sorting problem: preparing the input, stepwise sorting of the elements, and creating a visible sorted output. Their strategies often resembled well-known sorting algorithms such as selection sort.

Furthermore, our analysis shows that intuitive strategies can be used as an entry point to the topic, and that a targeted CS unplugged intervention can help learners transfer their newly acquired sorting skills to similar problems. The children were able to apply more non-intuitive sorting algorithms such as merge sort and bucket sort and thereby adapt their previous intuitive strategies.

This doctoral thesis contributes to a better understanding of the early development of algorithmic thinking in the context of computer science education. It offers a basis and orientation for creating age-appropriate, student-centred learning in future computing education and demonstrates how students' first intuitions can be leveraged for more complex concepts.