Computational thinking and Mathematics viewed as transdisciplinary configurations

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There is a general push in the direction that young people should be taught programming and computational thinking in compulsory school (Bocconi et al. 2022). In some countries, this ambition is addressed through mathematics teaching (Tamborg et al. 2022). This makes it interesting to view the interplay between technology education and mathematics education as a case of transdisciplinarity, where, in the best of all cases, there can be a mutual fertilization between disciplinary and pedagogical traditions. From a historical point of view, in the interplay between mathematics and technology education in compulsory schools, we observe a movement from an early (starting around 1980) interest in children programming to improve their mathematical capabilities and provide new ways of working with mathematics, to a period with a lesser focus on the interplay between programming and mathematics (roughly 1990 - 2010). We now find ourselves in the middle of what can be characterized as a "second wave" of the interplay between programming and mathematics education. A little before 2010, people from computer science and industry stated that children need to learn about computing - or "computational thinking" (Wing, 2006). In the following years, some countries began to take up this challenge and implemented computer science and programming in compulsory school.

This abstract explores the question: *How can the interplay between mathematics and computational thinking as scientific disciplines be viewed on the level of national curriculum standards, in resources and in educational practices?*

The main purpose for addressing this question is to create an "orienting framework" for the navigation of resources to support the teaching of programming and computational thinking and mathematics. The question is addressed by a critical case methodology viewing examples of practices, resources and political documents from the three countries Denmark, Sweden and England. These three countries all work with implementing computational thinking programming, digital competence, and technology in their curricula.

In England, for example, the main reason for focusing on computational thinking is to support the industry. The structure resembles the scientific discipline. In a sense, it is a kids' version of computer science which has been implemented in the educational system since 2013 under the topic of "computing" (Misfeldt et al., 2020). In Sweden, the work with programming and computational thinking has been much closer related to the subject of mathematics. In 2018 it was decided that all Swedish pupils should work with programming in relation to their mathematics classes, from grade 1 through grade 12. At compulsory school level, programming was integrated in close connection to algebra and in upper secondary level mainly to problem solving. Furthermore, this initiative was motivated by equity, and especially by an aim to avoid a new type of digital divide between people who can create value with technology and people who increasingly become consumers and spectators to life, through technology (Heintz et al., 2017). Denmark, however, has been experimenting with a new topic of "technology comprehension" in a number of schools for the past four years. Technology comprehension has been tested both as a subject in its own right and as a part of other existing school topics, e.g., first language (L1), mathematics, science, and social science. In both cases, the motivation has mainly been citizenship and democratic empowerment. The focus for technology comprehension encompasses design competencies, computational thinking, citizenship and technical skills.

We view these three choices on incorporating computational thinking through the lens of interdisciplinary configurations. Jensen and Jankvist (2018) distinguish three kinds of interdisciplinarity addressing different types of needs. (1) Interdisciplinarity as *integration of disciplines on the border of two existing disciplines.* Examples are mathematical economics, bioinformatics and geophysics as examples. This kind of interdisciplinarity is *driven by a demand for specialization*. (2) Interdisciplinarity as the *integration of disciplines*. Examples are business studies, which integrates economics, sociology, law, etc.; medical science, which integrates chemistry, physiology, psychology, etc.; engineering, which integrates mathematics, physics, geology, etc. This type of interdisciplinarity is driven by a demand to integrate elements from basic disciplines to create an applied discipline. (3) Interdisciplinarity as *understanding and overview across disciplines*, or as a kind of "allgemeinbildung", a type of interdisciplinarity that is a response to negative and unfortunate consequences of disciplinary specialization. This involves creating the need for bridge-building and the ability to see problems through different disciplinary lenses.

At the presentation we will display document data to describe the interdisciplinary configurations in the three countries on the policy level, the resource level and the level of pedagogical practice, and discuss configurations that can enhance productive interplay between computational thinking and mathematics.

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