

Computational Thinking Skills in Dutch Secondary Education

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Computational thinking - a new concept



Curry, J., Snyder, L., & Wing, J. M. (2010). Demystifying computational thinking for non-computer scientists.

"Computational thinking is the thought processes involved in formulating problems and their solutions so that the solutions are represented in a form that can be effectively carried out by an information-processing agent."

"Computational thinking is a problem-solving process that includes (but is not limited to) the following characteristics:

- Formulating problems in a way that enables us to use a computer and other tools to help solve them
- Logically organizing and analyzing data
- Representing data through abstractions, such as models and simulations
- Automating solutions through algorithmic thinking (a series of ordered steps)
- Identifying, analyzing, and implementing possible solutions with the goal of achieving the most efficient and effective combination of steps and resources
- Generalizing and transferring this problem-solving process to a wide variety of problems"



A typical CS assignment in secondary education

Make a model / simulation / program for:

Traffic lights for a busy traffic crossing



Elevator in an apartment building



Some CT aspects can be recognized in current CS teaching practice. How can we ensure systematic teaching of CT in the CS curriculum?

We shall study the following issues:

1. What is an operational definition of Computational Thinking, tailored to the specific situation and needs of secondary education in the Netherlands?
2. How can students' CT problem solving skills be assessed?
3. What is a suitable pedagogical approach to teach students and stimulate their learning of CT problem solving skills?

The first phase of the research is focused on CT aspects in the existing teaching practice. We ask:

- i. Which aspects of CT can be recognized in Dutch CS teaching materials, curriculum specifications and policy documents?



We started with CSTA/ISTE characterization of the nine essential CT aspects (in the left column of the table). Using the CSTA examples of learning experiences and samples of existing teaching materials, we iteratively constructed a refinement of the CT characterization (the right column of the table).

- ii. How can the CT pedagogical content knowledge of CS teachers in Dutch secondary education be characterized?

Category	Subcategory
Data Collection	Collecting data Selecting relevant data
Data Analysis	Drawing conclusions Finding patterns Making sense of data
Data Representation	Arrange data for analysis Organize/represent data
Problem decomposition	Breaking down tasks Merging subtasks
Abstraction	Finding characteristics Creating models
Algorithms & procedures	Making sequential steps in a specific order Understanding and changing algorithms Making decisions in algorithms Implementing algorithms
Automation	Recognizing different forms of automation Recognizing the advantages of automation
Simulation	Creating pseudo-code Creating models of processes Experimenting
Parallelization	Combine/merge activities

With this draft definition we shall establish CS teachers' PCK on CT through structured interviews (CoRe).

Result of the first phase: final operational definition of CT tailored to the needs of CS course in Dutch secondary education.

An instrument to assess students' CT will be developed in the **second phase**. A pedagogical approach will be developed in the **third phase**. The effects of the curriculum intervention will be assessed in the **fourth phase**.

