Computational Thinking in Dutch Secondary Education

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Computational Thinking in Dutch Secondary Education: Teachers' Perspective

Extended abstract

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In 2006, J.M. Wing introduced the term Computational Thinking (CT) [Wi06] indicating a set of analytical skills needed to employ IT techniques and tools effectively. As a part of the first phase of a larger research project where we investigate how to incorporate teaching CT into informatics course in the upper grades of secondary education in the Netherlands [Gr13], we conduct a study aimed at characterizing the present teaching practice around CT, including the pedagogical content knowledge (PCK) [Sh86] of informatics teachers together with their perceptions, beliefs and hindrances.

As a first step towards exploring these perceptions, beliefs and hindrances we analyze the data acquired in an questionnaire on informatics education. In November 2013, the Netherlands Institute for Curriculum development[1] held an online survey among informatics teachers, aimed at determining their enacted informatics curriculum and exploring their ideas about desired changes of it. Upon our request, a question on CT was added to the survey. We asked, "Do you think that CT gets enough attention in your current teaching practice, as far as it concerns the thought process and as far as it concerns the skills? If you answer in no, then what in your opinion causes the lack of it in your teaching practice?" We supplied a short description of CT: "Computational Thinking is a thought process in which one recognizes situations where data

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[1] www.slo.nl

organization, data processing and data analysis can be employed effectively and at the same time posses the skills to formulate problems using IT concepts and solve these problems using IT techniques and tools." 178 teachers out of an estimated population of about 300 filled in the survey. Out of these 178 teachers, 79 answered 'no' to this question and proceeded to describe their reasons.

We made a qualitative analysis of their answers through several iterations. Originally we set out with four categories Magnusson uses to describe teachers' PCK about a particular topic to be taught: (1) goals and objectives, (2) students' understanding, (3) instructional strategy; and (4) assessment [MKB99]. In subsequent iterations we added new categories concerning external circumstances and conditions, curriculum aspects, policy, recommendations, teachers themselves and to our surprise, a rather large category indicating an alternative understanding of what CT is in the eyes of the teachers.

Our findings indicate that among the teachers who do not believe they pay enough attention to CT in their teaching practice, many believe the causes lie in the curriculum which does not prescribe teaching CT explicitly, inadequate teaching materials or their own inability to teach it effectively. The most interesting findings, however, are those indicating teachers' understanding of CT is not in line with the ideas of CSTA which suggest that CT can be taught to all students in K-12 at an appropriate level when embedded in an appropriate context [CSTA11]. Some of the teachers, for example, find CT to be too abstract and theoretical for 15-year old students, that there is not enough time during informatics lessons to teach CT, that there is no need to teach CT or that it is difficult to teach it because the IT policy of the school does not emphasize it.

After this first explorative pilot study, the next step in our research will be to interview a number of teachers to establish their PCK about CT problem solving skills through semi-structured interviews based on the Loughran's Content Representation (CoRe) [LMB04]. Since a number of teachers hold alternative views on the meaning of the notion of CT, we intend to supply them with an interpretation of CT based on the nine categories described by CSTA [CSTA11] and a refinement into 21 subcategories derived by Barendsen and Stoker through a preliminary analysis of teaching materials, see Table 1 [BS13].

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

Table 1: Categories and subcategories of Computational Thinking

We intend to focus only on those (sub)categories which are directly related to problem solving. This study will yield a characterization of PCK of informatics teachers in Dutch secondary education concerning CT problem solving skills.

References

[BS13] Barendsen, E., & Stoker, I. (2013). Computational thinking in CS teaching materials: A pilot study. *Proceedings of the 13th Koli Calling International Conference on Computing Education Research*, pp. 199-200.

[CSTA11]Computational Thinking Task Force. (2011). *Computational thinking teachers resources second edition*. Retrieved 10/16, 2013, from http://csta.acm.org/Curriculum/sub/CurrFiles/472.11CTTeacherResources_2ed-SP-vF.pdf

[Gr13] Grgurina, N. (2013). Computational thinking in dutch secondary education. *Informatics in Schools: Local Proceedings of the 6th International Conference ISSEP 2013–Selected Papers*, pp. 119.

[LMB04]Loughran, J., Mulhall, P., & Berry, A. (2004). In search of pedagogical content knowledge in science: Developing ways of articulating and documenting professional practice. *Journal of Research in Science Teaching*, *41*(4), 370-391.

[MKB99]Magnusson, S., Krajcik, J., & Borko, H. (1999). Nature, sources, and development of pedagogical content knowledge for science teaching. In J. Gess-Newsome, & N. G. Lederman (Eds.), *Examining pedagogical content knowledge* (pp. 95-132) Kluwer.

[Sh86] Shulman, L. S. (1986). Those who understand: Knowledge growth in teaching. *Educational Researcher*, *15*(2), 4-14.

[Wi06] Wing, J. M. (2006). Computational thinking. *Communications of the ACM, 49*(3), 33-35.