Positioning Computer Science in Flemish K-12 Education: a Reflection

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ABSTRACT
The current state of computing and computer science in Flemish K-12 education is discussed, compared to recent developments abroad, and found to leave much to be desired. Next, i22n is presented: a recently founded "Forum for Computer Science" aiming at remedying this situation.

Categories and Subject Descriptors
K.3.2 [**Computer and Information Science Education**]: Computer science education, Curriculum, Literacy.

General Terms
Human Factors.

Keywords
K-12, computer science education, curriculum, educational policy, digital fluency, STEM education.

1. INTRODUCTION
Currently, in Flemish K-12 education, like in many other countries or regions, efforts are being made to increase the level of Digital Competency, as well as the quantity and quality of education in Science, Technology, Engineering and Mathematics (STEM). In both of these contexts, Computer Science has an important role to play, but this is currently not recognised by most educational policy makers. To help remedy this, computer scientists and teacher educators from the five Flemish universities recently founded i22n, Forum for Computer Science [1].
We first recapitulate the main concepts involved as well as their interrelationships. Next, we outline the current state of CS in Flemish K-12 education, and situate it in an international context. Finally, we present i22n, discuss its goals and plans, some preliminary results, and hopes for the future.

2. CLARIFYING THE CONCEPTS
First, we clarify some of the terminology we use in this paper. In accordance with e.g. [2], "Computer Science (CS)" refers to the science behind "Information Technology (IT)". Typical topics include algorithmics and programming, data representation and communication, as well as some societal issues, and also more generic aspects such as computational thinking: "solving problems in a way that can be implemented with a computer" [2].
Next, we use "Digital Competency (DC)" to refer to a person´s competence level in using IT. Important components of DC are "Digital Literacy (DL)", the ability to work with today's IT, and "Digital Fluency (DF)", which focusses on the ability to adapt to changes in (the use of) IT [3]. Finally, our use of the term "computing (education)" refers to all or any of this.
The basic concepts, skills and capabilities in Computer Science, including computational thinking, are of central importance to Digital Competency, and especially Digital Fluency ([2],[4]).
Finally, Information Technology and Computer Science are clearly part of STEM, but especially CS is not easily classified as either science, technology, engineering or mathematics, since it has elements in common with all four.

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3. COMPUTING AND COMPUTER SCIENCE IN CURRENT FLEMISH K-12 EDUCATION
Currently, the only binding standards related to Flemish K-12 computing education outline in broad terms ten areas in which students should achieve competence by the end of grade 8. These include such statements as: "students use IT safely, responsibly and effectively", and "students can use IT to present information to others" [10]. Schools are advised to integrate teaching these standards throughout their curriculum in grades 5-6 and 7-8, rather than devoting special purpose classes to them. Many schools nevertheless opt to also do the latter, mainly focusing on topics in text processing, presentation making, web searching, etc. All in all, the goals as well as the efforts in this context are nearly exclusively limited to (basic) DL. With some exceptions, inspired by enlightened teachers, CS is nowhere to be seen.

Beyond the second year of secondary school (grade 8), Flemish education currently lacks any legally binding educational standards pertaining to computing. However, in the late 80's, the major Flemish school networks introduced computing as a separate subject, of only 1 hour a week, in most study profiles in grades 9-10. The course plans for these subjects currently feature DL (e.g. more text processing and working with a spreadsheet) and also some CS (introductions to hardware, data management, networking, programming, and some societal issues). However, many teachers teaching this course are not educated in CS. As a result, the CS parts of the course plan often get a shallow treatment or are skipped entirely. Inspired by the grades 7-8 example, educational policy makers at the school networks level recently proposed to integrate computing in the other subjects in grades 9-10, and suppress separate computing courses in most study profiles. This move threatens to reduce computing in grades 9-10 to DL and IT, effectively eliminating what little CS there currently is from the curriculum altogether.

In grades 11-12, Flemish education currently offers its students two study profiles featuring a significant amount of CS: IT & Networking, and Accountancy & IT. Both profiles, however, are

situated within the professional field of Economics and Administration. This entails that CS is mainly taught as a practical tool to help get the job done, and not as a scientific and/or engineering discipline in its own right at the abstraction level of other sciences and mathematics. As a result, a recent Flemish government survey of STEM study profiles in secondary school classifies both profiles mentioned above as non-STEM [11]!

4. MEANWHILE AT THE NEIGHBOURS

In some countries, the importance of CS in the K-12 curriculum, in the context of DC and/or STEM, has already been clearly recognized. One of the leading countries in that respect is Israel, where already in 1991 a secondary school computing curriculum was adopted which emphasizes the foundations of algorithmic thinking (see e.g. [5]). One of the most important lessons learned from that effort is the crucial importance of teacher support, from the development of course materials to intensive in-service teacher training. Since then, also some other countries or regions, including e.g. many German "Länder", adopted a more or less extensive K-12 CS curriculum.

In the UK, the Computing at School Working Group [6] unites educational and industrial partners since 2008/9. Their continued effort to promote CS as an important educational topic contributed to a thorough makeover of British computing education. Other recent contributions were made, among others, by the American CSTA [2], The Dutch [7] and French [8] National Academies of Sciences, and ACM Europe [9].

Most of these proposals and efforts share the following concerns: CS education should start as early as possible and broaden its scope and increase its abstraction level throughout K-12. It should include mandatory courses for all students, mostly aimed at laying the foundations for DF, as well as some advanced optional ones for students with a STEM profile, aiming at a more profound understanding of CS.

5. I22N: PAVING THE ROAD AHEAD

Faced with the situation as described in section 3 above, and inspired by successes and initiatives like the ones mentioned in section 4, professors in computer science and CS teacher training from all five Flemish universities in May/June 2013 jointly founded i22n, Forum for Computer Science [1]. Its main strategic objective lies in helping to bring about a correct treatment of CS at all levels of Flemish education. At the moment of writing, about one month after its foundation, it has already received some specialised press coverage, attracted acclaim from industry, and gained more than 200 registered members. A "live" kick-off event is planned for October 2013.

The main objectives for the next few months and years fit into one or more of four categories. First, i22n wants to unite individuals and groups who share its strategic objective. The target groups include CS teachers, teacher educators and students, but also IT & CS professionals, in academia, industry and elsewhere, scientists and engineers from neighbouring fields, concerned parents, etc. For "united we stand, divided we fall".

Second, i22n wants to be a platform for production, promotion and exchange of CS education course plans, materials and methods at a wide range of levels. A collection of pointers to existing initiatives and materials in many contexts and countries (including our own) has been started and is growing steadily.

Third, i22n wants to gain sufficient strategic weight to help steer Flemish educational policy toward better CS standards and course plans. This should incorporate "CS for all" in a proper DC/DF setting, as well as (more advanced) CS for specialised STEM profiles. In both contexts, it will be important as well as interesting to strike a correct balance between scheduling separate CS classes and courses on the one hand, and integrating CS with other topics on the other. Throughout this effort, providing (for) proper teacher education should be a concern from the very beginning.

And last, but by no means least, i22n hopes to establish alliances with organisations promoting DC and STEM in K-12 education. After all, as argued above, CS has much to offer to them, and they share many of our concerns, albeit that some of them don´t yet know they do.

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