

recognize that the programs they write have the same nature as the “apps” they use on their mobile phones. Similarly, unplugged activities aimed at developing computational thinking skills might be perceived as disconnected from the use of digital devices and programs in everyday life [8, 12]. To overcome these limited perspectives, teachers need to be aware of what NoP is, and use this knowledge to inform their teaching practice.

Programs, programming, and computational thinking. The centrality of programming in CS is reflected in most computing education initiatives¹, which indeed often include some type of programming activity, mainly under the term ‘coding’. One can even argue that, for many teachers, CS is just a synonym for coding [15].

Another fundamental component of computing education revolves around the idea of *Computational Thinking* (CT) [18]. Even if there is no its ultimate definition, this idea concerns the ability to address “problems in a way that enables us to use a computer and other tools to help solve them” [6]. CT encompasses a variety of creative cognitive processes and activities, like modeling real-life situations, representing information in digital form, organizing data, analyzing and generalizing computational solutions, assessing their social impact, etc. In other terms, CT goes far beyond coding and tries to represent and value the greater richness of computing. Since the above mentioned activities play a fundamental role also in the process of designing programs, our WG approach shares a similar scope as CT. A fundamental difference is that CT-based frameworks mostly focus on CT practical and cognitive skills, while here we chose to reflect about the underlying *knowledge* about the NoP, that CT activities should both promote and stem from.

Historical and philosophical perspective. As one can expect, the NoP has had a relevant role in the broader discussion about the nature of CS. Some very significant contributions on the issue appeared in the ’80–90s [3, 11, 17], including the triggering question “Is CS a science?”. CS and its impact on society has greatly evolved since, see e.g. [4, 5, 10] for more recent contributions on the nature of CS, and [13] for an articulate presentations of a historical perspective. Such a discussion, however, has been conducted by and for CS, philosophy, and history matter experts, and has rarely reached a wider audience. Notable exceptions are [1, 4, 14].

Focusing on programs, the ongoing project “PROGRAMme” starts with the premises that the seemingly simple question “What is a computer program?” has no simple answer today². It thus aims at developing “a coherent analysis and pluralistic understanding of ‘computer program’ and its implications to theory and practice”, by taking a historical and philosophical approach. The project plans to consider the various characterizations of programs that derive from different viewpoints and pertain to different historical phases of the development of the discipline (either in academia or industry).

Considering “PROGRAMme” and the mentioned references on the nature of CS, we take a different approach. Instead of analyzing and contrasting the different points of view about the NoP, we want to identify the fundamental tenets that bring together different views. Specifically we target the educational arena with a goal to

develop a NoP framework that teachers and educational policy makers can use in framing CS teaching practice and curricula.

The Nature of Programs and the Nature of Science. The expression “Nature of Programs” draws inspiration from “Nature of Science” (NoS), an expression from the ’70s that refers to the fundamental characteristics of science knowledge and scientific inquiry, as derived from how it is produced: a necessary knowledge to make informed decisions with respect to the ever-increasing scientifically-based personal and societal issues [9]. NoS is a significant component of scientific literacy and it is argued that NoS cannot be learned simply by studying science concepts or attending science labs, but it must be addressed explicitly with active reflective practice and discussions among students in their learning contexts [7]. This also implies that teachers should have a “shared accurate view of NoS” and agree that NoS needs to be taught and assessed explicitly [9].

CS education would benefit as well from a similar approach, in order to boost its contribution in creating a CS-literate society that is able to make informed decisions on CS-related issues. This working group proposes a first step in this direction, focusing on the Nature of Programs (including the way that they are created and built), due to the role that programs play in CS and all society.

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¹Cf. CS4ALL (<https://www.csforall.org/>) and Informatics for All Coalition (<https://www.informaticsforall.org>).

²See the project website <https://programme.hypotheses.org>