In favour for the genetic principle

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In Favour for the Genetic Principle

Martin Wagenschein (1896-1988, Germany) was one of the most prominent researchers in the field of didactics of science.[1] He is well known for his three-fold attutude to learning and teaching which he condensed in the principles of the genetic, the socratic, and the exemplary.

The Genetic Principle could be understood as the opposite of a PowerPoint-presentation. It relies on that students find an issue that is really moving them, find the questions that lead to answers themselves. The questions and the answers are supposed to be generated by the students. The teacher provides for material, gives hints, intervenes, disturbs.

The younger the students are, the more the entry points will be historical, since there lie the simple questions and the simple solutions.

Since for computer science the historic evolution of techniques and methodologies straightly follows a path from the simple to the complex, a genetic approach quite naturally is identical to a historical one. In contrast to structure the material to be handled by students in a top-down fashion, it will be much easier to follow a historical path and to iterate the suite of problems and solutions mankind itself had to struggle through.

But, since the genetic is almost everytime also the exemplary, the touching phenomenon, the initial topic could be a very recent one. Say, the computer games of nowadays. There, almost certainly, the question will arise: what distinguishes the player from his counterpart, the artificial character? The answer could more likely be found in the constitution of the Turing Machine than an the architecture of a recent computer system, since the differences between the human and the computable are much more clear cut when investigating Turing's historical invention than computers you can buy in a store today.

It certainly would be fruitful to design a curriculum for computer science for beginners by following the historical pathways from the simple and early to the complex and recent, even by starting at phenomena that arise from everyday experience of the students.

So I would recommend to start programming with the Turing Machine, begin to discuss hardware with very early computers, show Zuse's machines and the ferrite rings first and integrated circuits last.

More precisely, the Turing Machine could lead to algorithmic elements, to codes, to the loop, to structured programming, to

[1] See, e. g. Martin Wagenschein: Verstehen lehren. Weinheim und Basel: Beltz 1975. Erstauflage 1968. One of the very few english sources is Light and Objects, http://www.natureinstitute.org/pub/ic/ic16/light.htm

compilers (the Universal Turing Machine), languages, and, very importantly, to the limits of computation.

Even when treating the social context of computing, the first Hollerith machines and their role in the american census easily leads to the use of RFIDs and to data mining in today's society. Even the origins of computing in the military sector is easily understood looking at Bletchley Park first and later on arriving at the strategic defense initiative[2] and the problems of the take-over of early warning systems over human judgement.

The genetic principle asks, where the phenomena and the knowledge, the questions and the answers come from. A historic perpective promises helping insights to that.

But, since this is a presentation of some minutes length only which as well could have been give using PowerPoint, it contradicts its own pupose and statement. When did we last find out what is really interesting for students? What really moves them? If we take any curriculum as the only one, and be it a one that is oriented versus a historical perspective, all is lost already.

We have to ask, have to have time, and have the patience to receive the answers from the students to tell us which way is best.

[2] David Lorge Parnas: Software Aspects of Strategic Defense Systems. Communications of the ACM, 28(12), 1326-1335 (1985). American Scientist, Vol. 73, No. 5. pp. 432-440.