Teaching informatics for fun and profit

Carlo Bellettini Violetta Lonati Dario Malchiodi
Mattia Monga Anna Morpurgo
Mauro Torelli
Dip. di Informatica, Università degli Studi di Milano, Italy

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Informatics has little to do with the skilled use of a bunch of specific applications: in fact, being fluent in using a given computer application is largely independent from the knowledge one may have in the discipline. In other words: to be able to read a clock one needs virtually no knowledge about the laws of pendulum.

An interesting remark about the various interpretations of the term informatics is due to Claudio Mirolo [6], one of the promoters of the Task Force for the Research on Teaching of Informatics at the University of Udine, who identifies at least three possible acceptations, corresponding to different cultural approaches:

- *informatics as a science,* providing its own peculiar key to interpret reality and its specific approach to problem solving;
- *informatics as a technology,* concerning the characteristics, structure and working principles of the now ubiquitous hardware and software devices;
- *informatics as an instrument,* providing practical tools to manage information in many different contexts.

Informatics in Italian secondary schools

The secondary school system in Italy was reformed by several national laws in the years 2004–2010 and it is organized in two levels[1].

Lower secondary education In the lower secondary education informatics is not a subject taught by itself, but pupils attend 6–9 hours per week of "Maths and Science" and 2 hours of "Technology" in which informatic topics should be introduced.

[1]For a survey of computer science education in Italy before the reform see [4].

Upper secondary education The upper level, generally planned on 5 years, is rather diversified and dozens of different schools exist. In the Lyceum (aimed at a general education typically refined with further tertiary studies) Informatics is planned only in a special Scientific curriculum focused on Applied Sciences. However, for all the Lyceum schools in the first two years Mathematics should include also "Elements of informatics". Technical and professional schools provide vocational education. The technical curriculum focused on Informatics presents most of the aspects of the discipline. For the other curricula, instead, the focus is mainly on the instrumental role of informatics. Even the technological side is somewhat neglected by textbooks and teachers, although the new national recommendations are rather explicit on the importance of acquiring technological and scientific competencies.

Teacher qualification At the lower secondary level teachers with a formal education in informatics are rare, since this is not required, and the exposure of pupils to informatics in most cases is minimal or limited to the basic use of common tools aimed at office productivity.

Teachers must hold a Master degree in order to teach in any upper secondary school. In Italy in order to obtain a permanent public job, candidates have to participate to a competitive exam. This evaluation is organized with respect to the discipline to be taught, and there exists a specific section for Informatics, open to people with a degree in Informatics, Physics, Mathematics, Information Engineering, Electronic Engineering, Telecommunication Engineering, Industrial Engineering, Aerospatial Engineering, Nautical Sciences. The law has also reformed the way the teaching profession is accessed. The planned idea is to have teachers with a bachelor degree in the discipline and a two-year master in discipline teaching, "Teaching of Informatics" for our discipline. Such courses have not been activated yet, however. Currently, a transitional regime started, during which people who hold a master degree may attend a one-year qualification course, called "Tirocinio Formativo Attivo" (TFA). The first edition of this teaching qualification program started in 2012 and our team is actively involved in it.

Summing up, the new organization of secondary education has introduced several learning objectives clearly linked to the scientific and technological sides of informatics. However, the current state of the teaching is still predominantly focused on applications. This is the symptom of a general misperception: whereas everybody feels it is important to have a basic knowledge about word-processors and web browsers, an understanding of computing is often considered a special domain knowledge to be acquired only by experts of the field, since it is believed to have no immediate interest or usefulness in the real world. This opinion is supported also by many educated people, as shown by the fact that the conceptual contribution of the science of computing to other disciplines (such as cognitive science, economics, mathematics, physics, and linguistics) is seldom acknowledged. However, some peculiar aspects of computing are sufficiently basic to be taught as a fundamental formative subject. For instance, consider:

- the focus on the precise description of objects, processes, and protocols;
- the management of complexity through encapsulation and reuse;

- the synthetic power introduced by the constructs of formal languages;
- the flexible use of abstractions, that can be dynamically coerced to what is more useful in.

This is just a short list: informatics has certainly more to provide to general education [5, 1]. However, the common misperception of informatics as a bunch of applications has negative impacts on ol the discipline: brilliant students tend to be attracted by other sciences because they are not familiar with the challenges of our discipline, freshmen in computing courses sometimes have distorted expectations, public funding of basic computing research is hard to raise, etc. What can be done to change this matter of fact?

Our proposal

In order to show the broader impact informatics may have on secondary education, we started designing and implementing special teaching activities to introduce pupils to selected topics: specifically, information representation and programming. We developed the following workshops.

- *Wikipasta.* On the role of formatting and on how to represent the meta-information it conveys. In this workshop pupils are posed the problem of describing the typographic aspect of a text. By playing with pieces of pasta and other small objects, they are led through a game to the discovery of mark-up languages and then introduced to a lightweight "wiki" syntax. The final activity on the computer is about editing Wikipedia-like pages.
- *Human pixels.* On the digital representation of images. After being shown a video of animations made in stadiums by coordinated soccer teams supporters (so called "human LCD"), pupils are asked to discuss how to set up a very simplified version of such animations. They eventually discover grids, sampling, resolution, compression and complete the activity by using a multi-view editor showing a picture along with different representations as a matrix of numbers.
- *Mazes.* On algorithms. In this workshop pupils are faced with the problem of guiding someone through a simple maze. Pupils first focus on the task of verbally guiding a *human robot* (a blindfolded mate) through a simple path. Initially they are allowed to freely interact with the robot, then they are requested to propose a very limited set of primitives and to compose them into a program to be executed by the robot, with the possibility of exploiting three basic control structures (if, repeat-until, repeat-n-times). After this, pupils are provided with a visual programming language (a simplified version of MIT Scratch) and are asked to write programs guiding a sprite through mazes of increasing complexity.

We had the opportunity to test such workshops in a lower-level and in an upper-level secondary school [2, 3]. As a result, we could refine the design of these activities, and

prepared a set of two-hours workshops which we proposed to classes of 20–25 pupils. A total of 26 classes attended each one of the workshops. Our intention was twofold:

1. propose a methodological approach to informatics teachers, and
2. present some core aspects of informatics to both pupils and teachers.

From a broader perspective, we aim at conveying a view of informatics as a scientific discipline, as opposed to the current perception of this field. We also paid attention in designing workshops requiring resources that are commonly available or easy to prepare (pasta, colored sheets, ...), and the software used is downloadable for free and runs on standard PCs.

References

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