What you see is what you have in mind: constructing mental models for formatted text processing

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Motivation

- Within the context of non-vocational education, computing is often (mis)introduced through teaching the use of specific applications.

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- e.g., Italian schools typically limit the subject programmes to the use of office automation and communication tools...
- ...although the assimilation of selected foundational concepts of “true” informatics is considered, at least potentially, a desirable formative asset for students
Solving the dilemma

- Matching the students’ expectations about CS, with clear links between learning about computing and using computers
- Explaining computing as an *abstract* activity
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Matching the students’ expectations about CS, with clear links between learning about computing and using computers

Explaining computing as an *abstract* activity

Solution: exploit students’ expectation in order to suggest how to explore computational concepts

- teaching the models underneath a particular application (say, a WP), instead of relying on trial-and-error...
- ...leads to proficient use of software (*any* WP),
- but also introduces abstract concepts (e.g., information representation).
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Background: allosteric learning
▶ direct transmission of knowledge kept to a minimum
▶ letting pupils rework their conceptions so as to autonomously discover concepts
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- 8 hours in 4 non-consecutive days
- 25 pupils (9th–10th grade)
- extra-curricular activity
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Letting the pupils...
▶ discover how to encode formatted texts
▶ realize that they need unambiguous descriptions
▶ think about the optimization of a code

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Activity #1 – Basic text formatting

Ask students (in groups of 2 pupils) to

- conceive a formatted text (e.g. a poster or a flyer)
- realize it using a WYSIWYG word processor
- answer (in written form) to some questions: “Which type of formatting did you use?”, “Why did you use it?”, “Did you use more than one formatting for a same text passage?”
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Results: reflection about

▶ æsthetic value of formatting
▶ formatting conveys information
▶ meaning = text + formatting
Activity #2 – Recording of meta-information

Propose students (in group of 6 pupils) to play a game:

**Target** reproduce a formatting, e.g.

Guardando il colore della sua crema i vecchi riuscivano a trarre le previsioni del tempo.
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**Tools**

- textual representation (without formatting) written on big sheets on the gym floor
- objects available in the gym (spoons, beakers, ropes)
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- Students were also asked to produce a written description of the rules they adopted in order to reproduce the formatting.
- The (object-based) formatting and the rules of each group were then checked by another group.
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Results

- Rules often turned out to be ambiguous.
- Objects used in order to “mimic” the visual formatting.
Activity #3 – Discovering meta-language tricks

In order to promote the discovery of symbolic encodings, we proposed another game to groups of 4 pupils, still asking to reproduce a formatting (now using A4 sheets on the class desks)
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**Target** produce a valid formatting minimizing the cumulative cost of used objects
Activity #3 – Discovering meta-language tricks

In order to promote the discovery of symbolic encodings, we proposed the reproduction of a formatting (now using A4 sheets on the class desks) using various kinds of pasta, each associated to a cost proportional to the propensity that that kind of object could be used to mimic a given formatting (e.g. using spaghetti in order to underline a word). The target was to produce a valid formatting minimizing the cumulative cost of used objects.

Results

- autonomous discovery of markup techniques based on tags
- cost optimization related to the frequency of formatting styles
- use of positioning in order to maximize the exploitation of cheapest objects
- minimizing the relative cost of used objects
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Activity #3 – Discovering meta-language tricks

As a final experiment, we proposed a second round of this formatting game, now using exclusively cards carrying letters and keyboard symbols:

- symbols and unused letters (j, k, w, x, y, not in the Italian alphabet) to convey meta-information
- suitable positioning in order to give a special meaning (e.g., ✅ to denote a bold text)
Activity #4 – Rediscovering formatting tools

In a computer lab, students were asked to use a software tool developed by us which allowed to visualize and edit a formatted text simultaneously updating three views:

- standard representation à la WYSIWYG
- wiki syntax
- HTML-like syntax

The goal was to obtain a given result on the WYSIWYG view by updating the remaining two views.

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Constructing mental models for formatted text processing
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Results

Students had no difficulties in adopting these (formal) syntaxes. They immediately noticed the analogy between the wiki syntax and the rules they had discovered in previous activities.

The goal was to obtain a given result on the WYSIWYG view by updating the remaining two views.
Evaluation

Pros
▶ At the end of the experience, students accepted as rather natural (even obvious) the idea of using the same alphabet in order to encode a language and a meta-language
▶ The link with technology was clear. We were also able to show that the same concepts are behind the scenes in other contexts, for instance when editing Wikipedia entries.
▶ In general, students declared to have learnt something while having fun.

Cons
▶ The gym was not an ideal setting for the second activity (disastrous acoustic, location too dispersive), and indeed several participants considered this activity boring
▶ Some participants said that tasks were sometimes even too easy to perform.
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Conclusions

▶ A set of activities for conveying abstract computing concepts to pupils of secondary schools

▶ The same activity was subsequently carried out autonomously by a math teacher in another school, but with younger students (6th grade), with good results.

▶ We are currently studying videos and reports of this new experiment with the help of colleagues working in the field of educational sciences

▶ This experience fostered the creation of 2-hours workshops specially conceived for 7-10th graders which are achieving a good success.