Exploring the processing of formatted texts by a kynesthetic approach*

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1. MOTIVATION

One of the first experiences most pupils have with computing is through a *word-processor* and *formatted texts*. Indeed, computer literacy is frequently focused on acquiring dexterity with office automation tools, whereas the underlying conceptual challenge of automatic processing of information is largely ignored [5, 4]. In fact, mastering the use of a word processor may increase one's knowledge about typography or even the way one should organize ideas and discourse, but it gives very little insight about computing sciences without a specific emphasis on that topic.

Recently, we started several activities [2, 3] aimed at introducing computing concepts to pupils, both striving to make boys and girls at ease with the intrinsic abstract nature of informatics and trying not to disappoint them with something not linked with the technology they are used to. In this paper we describe our experiments with a kind of kinesthetic/tactile learning activity [1] we called *algomotricity.* In algomotricity the abstract symbolic manipulation is (partially) replaced by physical activities, which should help the pupils in developing their mental representation [6]. We tried to choose activities clearly linked to the acquaintance of students with computers and applications. In the following we report on a teaching activity about word-processors we proposed to a group of 25 pupils in 9th and 10th grades of an Italian secondary school. The pupils had some familiarity with word-processor operations. The learning objective we had in mind was the understanding of the challenges posed by the automatic elaboration of formatted text and we mainly focused on information representation techniques.

2. DESCRIPTION OF THE EXPERIENCE

The overall activity (8 hours in 4 non-consecutive days) was organized in four phases:

1. A first approach to text formatting with a word processor;
2. A *dramatization* of the process through the use of tangible objects;
3. A game designed to force pupils to restructure their mental models and discover the power of symbolic meta-languages;
4. A final use of special software tools for formatting texts, also able to show the data structure used to record the meta-information.

We started and ended in a computer lab, in order to partially match pupils' expectations about informatics. The risk we wanted to avoid was that of being perceived as unrealistic or fruitlessly "academic". Thus, we designed the activity around two main ideas: (a) computers and software tools should be of secondary importance, but the conceptual link with them should be clear; (b) the approach should be mostly *allosteric* [7]: the direct transmission of knowledge should be kept to a minimum, and pupils should be forced to reconsider their mental models about text formatting by discovering themselves useful techniques. Moreover, the abstract nature of computing should be conveyed by concrete examples and physical activities. Pupils were requested to work in small groups to foster confrontation and almost every task was proposed together with an accompanying metacognitive reflection. In particular we often asked pupils to imagine how what they described would be understood by someone who ignored the context.

Formatting transfers information.

We started in a computer lab and the first objective was to convince pupils that *formatting is not just an aesthetic issue,* but it has also an important role in transferring information: indeed the *meaning* of a text is given by the words and their formatting. Pupils (working in couples) were requested to produce a formatted text of their choice. Then they had to answer some questions about their work: Which type of formatting did you use? Why did you choose it? Did you use more than one formatting for the same piece of text? The activity took more than we thought and we were not able to introduce the second part, in which pupils would have been requested to produce a formatted version of a text read aloud by the conductor, where changes in voice tones

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and emphasis should be rendered by italics, bold, colors, etc. Then students would have been divided into groups for reflecting on the reproducibility of this process by comparing results produced by different teams.

How to record meta-information.

The second phase was carried out in the gymnasium of the school. Retrospectively this was a bad idea, since the big hall was rather chaotic and groups were too dispersed to foster a fruitful discussion. The proposed task was the reproduction of a formatted text on a big copy of the text put on the floor. The copy contained the same words, but no formatting (also the alignment was slightly different). Formatting had to be *codified* by using the objects available in the gym. Every group of pupils (6 persons) was requested to write down the rules they used in the *codification.* Another team had to interpret these rules in order to decode the text formatted through physical objects and get back to the original formatted text. Most rules turned out to be ambiguous, especially when more than one kind of formatting had to be applied to the text. The objects were used mainly to mimic the formatting in the prototypical text. However, in some cases, pupils discovered a more abstract symbolic use as a means to cope with shortage of objects: for instance, two spoons were used to mark the beginning and the end of the word respectively, since there were not enough spoons to cover the whole word.

Meta-language tricks.

The third phase was carried out in a classroom and was organized around a game. Teams were again requested to reproduce a formatted text with objects and write down codification rules precise enough to be followed by another team. However, the game was made fun by the introduction of a "cost" for the objects. In fact, the more an object could be used to mimic a piece of formatting, the more it costed in order to promote their *symbolic* use, *e.g.,* since spaghetti pasta could be easily associated to the *underlying* meaning, its cost was very high. The winner would be the team able to hand in an unambiguous codification with the lowest cost. The cost incentive was enough to let the pupils discover what is commonplace in *mark-up languages*: the use of tags at the beginning and at the end of (possibly overlapping) regions. A second round of the game was proposed without objects. Instead the pupils had only a multi-set of alphabetic characters on small pieces of paper. Some of the characters (for example, the letters that are not in the Italian alphabet: *j, k, w, x, y*) were not used in the words and could be easily used for weaving meta-information into the text. However, this trick was not suggested by the conductors but discovered by the pupils. Some of them tried to use the characters with a meta-meaning by placing them with a different orientation: a b for example, for meaning *bold.*

Rediscovering formatting tools.

The final phase was carried out again in a computer lab. Pupils were introduced to a special software tool able to show a formatted text according to three different views: formatted and encoded either using a simplified mark-up language or a tree of objects. They were again requested to reproduce formatted texts by working on the other representations: they saw, however, the effect of their (syntactical) manipulation in the formatted view.

3. EVALUATION AND FUTURE WORKS

We think the experience was successful. For example, all the pupils demonstrated to have grasped the idea of a meta-language expressed in the same alphabet of the language itself. This is considered quite an abstract concept, but it was found rather natural (even obvious) by the pupils. The link with word-processor and web technologies known to pupils was recognized. At the final recap we were also able to show that the same concepts are behind the scenes in several slightly different contexts, for example when editing Wikipedia entries. The pupils' feedback was mostly positive: they did have fun and believe to have learned something. However, some of them found that the tasks were sometimes too easy and the part in the gym (see Section 2) was considered boring by several participants.

All in all, the proposed activity turned out to be a good way for conveying abstract computing concepts to pupils of secondary schools. We are now working in refining the activity: as a mid term goal we aim at producing didactic material that should be self-contained enough to be used by independent teachers in their classes. As a first step we re-proposed the activity in an another school, with younger pupils (6th grade) under the conduction of a math teacher who did not participate in the conception. We are now studying reports and videos of the experiences: the first impression is that it worked also in this different context. We found that the *algomotricity* approach can be effective in presenting abstract symbolic manipulations in very concrete ways. By choosing activities clearly connected with the acquaintance of pupils with computers and tools we believe this can be very successful in elaborating a fruitful understanding of informatics concepts.

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