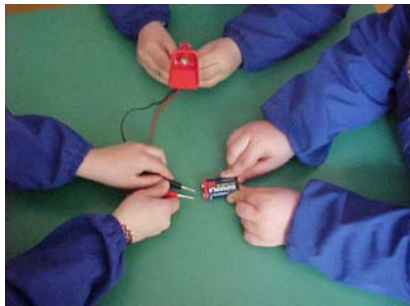


## THE WORDS OF SCIENCE: THE CONSTRUCTION OF SCIENCE KNOWLEDGE USING CONCEPT MAPS IN ITALIAN PRIMARY SCHOOL

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**Abstract** The work is about an experience carried out in an Italian Primary School with children from 6 to 11. It is about the use of concept maps in relation to a Science project entitled “The words of Science”. The laboratory methodology, employed in situations of problem solving, and the concept maps lead children to a significant construction of their knowledge and help them to enhance important abilities: curiosity, inventiveness, criticism, analysis, synthesis and transfer. Concept maps have shown to be highly effective in promoting and organizing the children’s learning and in bringing them to “learn how to learn”.

### 1 Introduction



In 1999 a team of Italian Science teachers joined the project entitled “The Words of Science”, promoted and coordinated by a School Inspector.

Joining the project for the teachers meant reviewing the whole curriculum of science, in particular those concept words which are highly relevant and meaningful because they turn out to be the main organizers of Knowledge. This is to say that the concept words are a powerful means of developing cognitive competences, not only in one specific subject, but in different fields of knowledge as well.

The laboratory methodology, employed in situations of problem solving, and the concept maps lead children to a significant construction of their knowledge and help them to enhance important abilities: curiosity, inventiveness, criticism, analysis, synthesis and transfer.

Concept maps have shown to be highly effective in promoting and organizing the children’s learning and in bringing them to “learn how to learn”



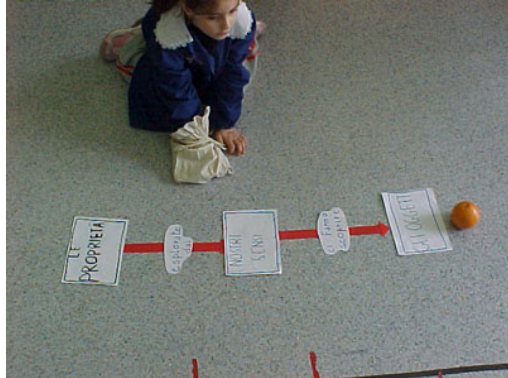
### 2 Approach to maps



A few groups of children have approached and used concept maps since their first year of Primary School (6 years) and have gradually learnt to apply them in new other fields of knowledge and experience.

Even the map with its rules becomes object of learning. Children are gradually able to give meaning to the space and to the elements inside it: words, arrows, and links.

Games, objects, the act of making and building improve the child's awareness of his thought processes. After acting the space of the classroom on the floor, children pass to experience the space on a sheet of paper. Therefore they first place objects and then words labelling concepts. The teacher's questions and indications help them to establish relationships between objects and, eventually, words.



Other groups of children have learnt to use maps since their third year of Primary School (8 years). Teachers have adopted the approach indicated by J. Novak in the appendix of his work "Learning, creating, and using knowledge: concept maps as facilitative tools in schools and corporations".



### 3 A school experience

After a number of experiences carried out in a science lab, small groups of children are invited to think over what they have learnt about the development and vital cycle of plants

Each group is asked to read carefully what it noted down during the lab experience, then turns to point out the words which are supposed to be meaningful and, eventually, has to write each word on a single sheet of paper (We call it Post-it).

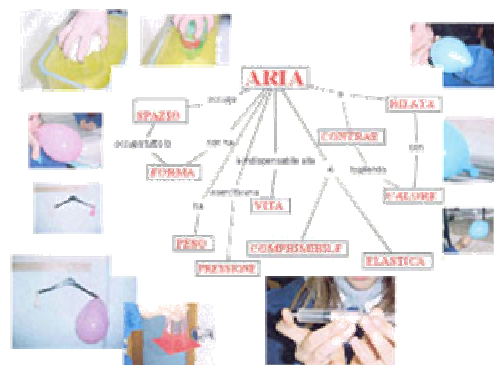
In the end, children try to place the concept-words on the Post-its in the space of a larger sheet of paper, so as to be able to establish relationships between the concept-words

Children use the map:

- As a tool of knowledge: recognition of concepts and their linking phrases
- As a tool of organization and synthesis of knowledge: the map
- As an object of learning: syntax and rules of the map.

The variety of maps constructed by each group and the possibility to change the position of the elements inside a map show the children that the map is a dynamic process of thought, a personal representation, and a tool of becoming aware of what they have actually learnt.

With the Cmap software children are allowed to try fully a type of dynamic construction which involves transfers, changes and deletions according to their thought processes. The systematic and generalized use of maps leads the children to develop successful operative and learning strategies, which enhance their self-regard, motivation, awareness and a systematic way of working. Maps can be built individually, in small groups, in large groups (class-groups).



#### 4 The personal map

Each child builds his own map about a subject, while consulting his notes or books.

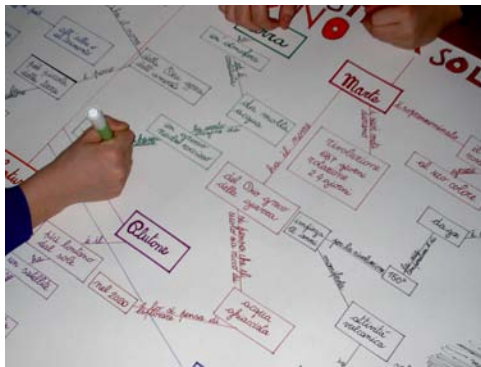
The personal map provides the teacher with information about the child's process of learning and shows his possible weaknesses and misconceptions. In this sense, the map helps the teacher to test the child's level of knowledge and to plan new, right experiences of learning.

#### 5 The Group Map

It is very useful to argue about every single map and compare them within a small or large group. Children can socialize their learning strategies, their thought processes and their knowledge when they are asked to build a new map, in which all the single maps are synthesized and organized.

The discussion gives the child the chance to widen his knowledge, to clarify his doubts and go into a topic.

#### 6 The map as a tool of study

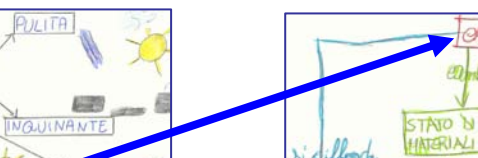
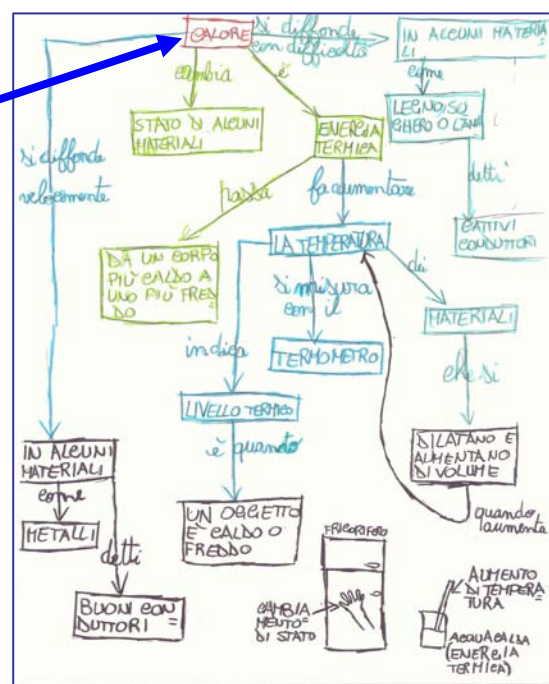
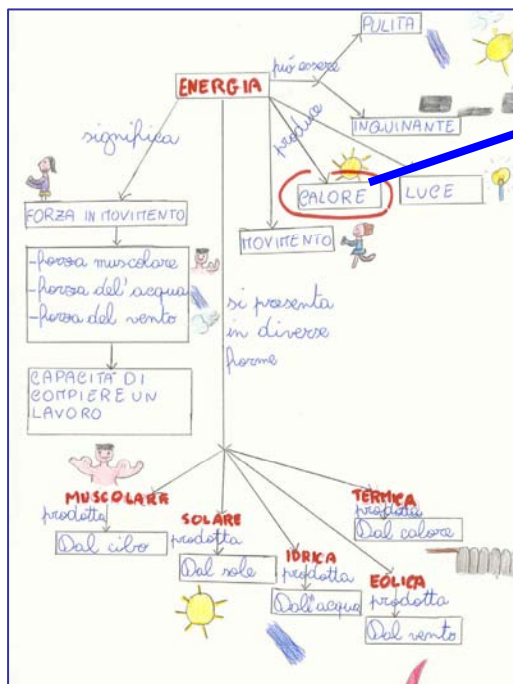


In the last years of Primary School the map is used as a tool to catch and organize contents and information present in a text of every nature: historical, geographical, scientific, narrative.... Once the map is built, it becomes a scheme to argue about an object of learning.

At the final exam of Primary School, all the children who have used the maps as a tool of organization and synthesis of their knowledge for three consecutive years show to be able to tell about a topic by using maps rich with links. Their ability to tell about a map successfully actually depends on their solid knowledge and on the competences acquired in their process of learning.

#### 7 Hyper textual map

Children can see that the use of maps is a very effective means of linking different subjects in a hypertext; this happens whenever a concept word of a map is explained in another different map which, in its turn, is linked to other maps.





## 8 What do children say about maps?

Children at the fourth and fifth year (9 – 10 years old) of Primary School have been asked the following questions:

What's a map?

What do you do when building a map?

What's its use for?

<p>What's a map?</p>	<p>It's a scheme where I study a topic and think about it.          It's a useful scheme to study in a logical way.          It's a synthetic scheme organized like our thought, where every topic is linked to another.          It's a logical method of studying following a scheme, so that I can speak fluently about a topic.          It's a scheme showing functions and detail of... something.          It's a little scheme where I put the main things about a topic.          It's like a diagram explaining a key word.          It's the summary of a page of a book.          It's a scheme where I write the most important points.          It's a written and well arranged scheme.          It's a scheme which I can consult to see the main things.</p>
<p>What do you do when building a map?</p>	<p>I look for words and information.          I give a meaning, a word, to each point.          I put words in order.          What do you mean by "putting in order"?:  <ul style="list-style-type: none"> <li>• I put them in their right place.</li> <li>• I classify them.</li> <li>• I put at the top the most important.</li> </ul>         I build my map with my pencil or with my post-it.          I put the words in relationship with arrows and linking phrases.          I change the position of words by rearranging arrows and linking phrases.</p>
<p>What's its use for?</p>	<p>It helps me to remember what I have studied: The scheme fixes in my mind.          It helps me to understand better a concept and to tell a topic.          It helps me to study, to think, to understand.          It helps me to have a well arranged, logical visual scheme.          It helps me to study better and quickly.          It helps me to review what I do not remember and to link different topics.          It helps me to know a lot of things simply by reading summaries.</p>

The answers above show that the children, by the systematic use of maps, can develop not only cognitive competences, but even the metacognitive competences in thinking about thinking, taking awareness of their learning processes, and testing their degree of knowledge.

Cognitive and metacognitive competences, acquired in meaningful and motivating contexts of learning, are the starting point for the development of the most important competence of all, that is to say "learning how to learn"

