Concept Mapping: Connecting Educators
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BUILDING CONCEPTS AND CONCEPT MAPS

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Abstract. A group of teachers decided to create an Interdisciplinary Working Group stimulated by the students' curiosity and love for new experimentations. Their idea was that the student must be the actor of his/her personal learning process. It is a problem solving project that includes three steps: investigation, invention and discovery. Considering the childrens'inquiries on orienting and compass and their poor knowledge of these topics, teachers decided to study magnetism through experiments suitable for 9-10 years old students. Such a process gives the children an opportunity to make hypothesis, set up experimentations and verify them. Furthermore, they focus on basic concepts of this scientific topic and acquire its specific language. Assessment is of particular interest and importance for the implementation of this Interdisciplinary Working Group: it is continuous during experimentations, when doubts and questions arise, with continuous feedback among students and teacher, while students undergo evaluation tests at the end of the project. Thanks to concept maps and group learning, each student can follow his/her peculiar characteristics, has the opportunity to show acquired knowledge, and also explain the learned topics, thus highlighting his/her mental processes.

1 Overview

Teaching experience starts from the very beginning of the project: teachers of the scientific area (including mathematics, science, geography, physical education and information sciences) create an Interdisciplinary Working Group (IWG) for students attending the 5th grade primary school (10 years old). The IWG follows the guidelines given by the Members of the Teaching Panel of the School District they belong to.

2 Our experiences: learning process implementation – experimentation through investigation, invention and discovery

2.1 Experience magnetism: from Geography to Science

During orientation lessons the students asked: "How do we build a compass"? The experiment begins following the instructions of the science book used in the classroom and the story told by a student who saw a similar experiment on TV:

MATERIAL: a small basin with water, a cork stopper, adhesive tape, *needle*
After the failure of the experiment because of a needle that was not magnetized, students are induced to consider the meaning of the word *magnetic* and during the discussion we understand what is their knowledge of the *magnet*; starting from the question/hint *:''what are the strange forces of magnet ?*"students begin to study thoroughly this topic.

2.1.1 Experience magnetic attraction: "what is attracted to magnets?"

Let's try to bring close to a magnet a few different items and record the results.

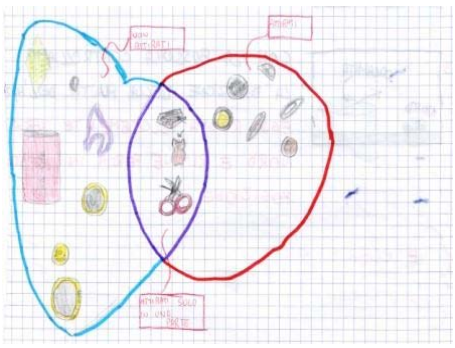


Figure 1. This picture shows different kind of magnets brought to school by students. With these magnets they tried to attract different items and then showed the results of the experiment through a Venn diagram.

2.1.2 Identify induced magnetism:“ Can an iron item become magnetic?”

After their investigations the students verify that iron can be magnetized by rubbing it or through contact, thus becoming a magnet itself. At this step of the experiment we introduce the specific term for this phenomenon: *induced magnetism*.

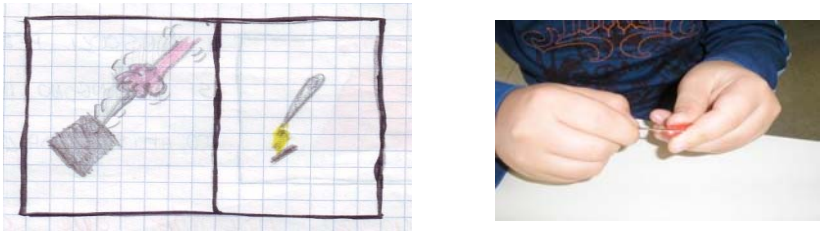


Figure 2. Students run the experiment and record it on their notebook.

2.1.3 History of magnetism

In order to learn more on this topic, the teacher together with the students starts this study from an easy text, records comments on the blackboard, creates a summary map of concepts following these main steps:

- reading comprehension;
- identify key concepts in each paragraph
- list key concepts paying attention to their order (write on the blackboard)
- find the most suitable linking words: the structure of the map appears once concepts are connected
- look for other possible connections among concepts
- students read the map, all the students must recognize their contribution
- log in the notebook and study.

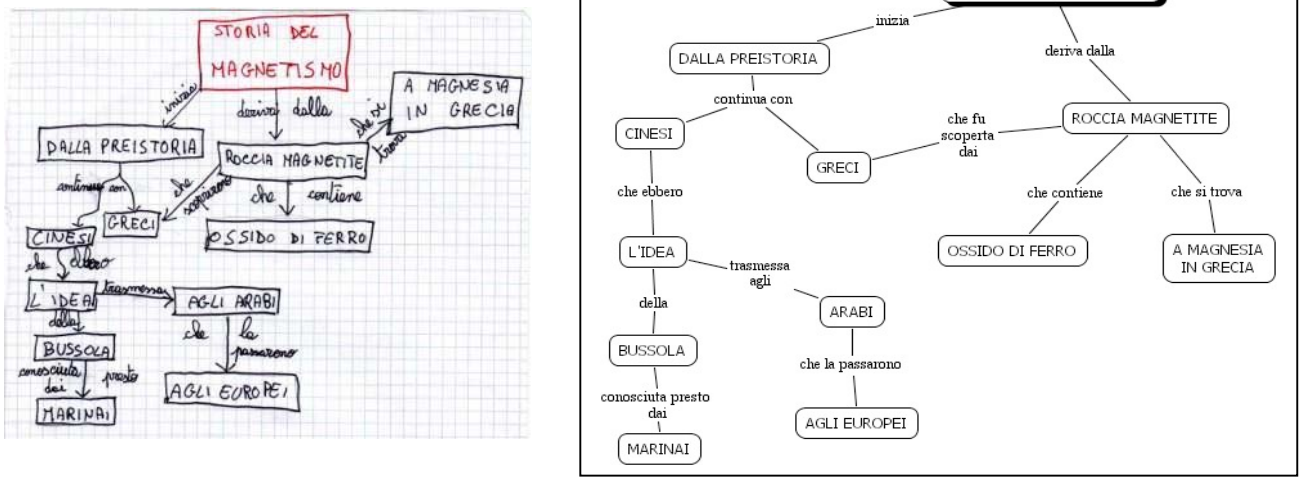


Figure 3. Building a summary map of concepts

2.2 Assessment

As described in the preliminary phase of the science IWG, the assessment is made on an experiment. Students will group in two and create a compass inducing magnetism, a new concept for them:

- magnetize the needle by rubbing it;
- fix the magnetized needle to the cork stopper;
- place the compass in a small basin with water, no matter what the position of the needle is, **we can see that the compass points towards north and comes to a rest.**

Figure 4. Building a rudimentary compass

All compasses are placed in water to verify if they work. Children are surprised because the compasses move in a row and are attracted one to the other!

Figure 5. Here are 10 compasses!

3 Concept Map: a tool to organize new concepts

The study of the geography IWG led to the learning experience described above. Concept map was used in order to bring to light new assumptions and above all to understand mental processes caused by the experiment itself.

First of all, the teacher starts brainstorming the whole class on key concepts as orientation and magnetism and continues by introducing scientific concepts, such as “interaction” and “system”. Students learned these concepts in the previous years following the guidelines of the “The words of science” project. Concepts are written on the backboard at random, all students participate, repetitions are not accepted, links among concepts are highlighted, science and geography concepts are on the same plan, they are: Earth, Force, Magnetic Field, Lines of force, Iron Oxide, Magnetic poles, Cardinal points, Intermediate, Magnetite, Induced magnetism, Magnetized needle, Chinese/Arabs/Europeans/Greeks, Objects, Orientation, Sun position;
CONCEPTS FROM “THE WORDS OF SCIENCE”: Interaction– System

Students are grouped in two, following the guidelines of cooperative learning: each student is responsible for part of the concepts, has to decide where on the map to write a concept and the words to link, sharing and verifying his/her logical choice with his/her classmate. The group/class is divided in nine pairs and one group in three (which includes a disabled student and two girls with learning problems, working with the help of the special education teacher). Each station will receive a sheet of paper with these instructions:

- elaborate a concept map summarizing knowledge and acquired concepts on *compass*, using all concepts on the board and adding new ones;
- elaborate a concept map summarizing knowledge and acquired concepts on *magnetism*, using all concepts on the board and adding new ones.

Students will be seated one in front of the other, will be given a pencil, an A3 sheet and can use their own notebook. When they are sure that their map is finished, it can be copied by both students. This step of the process lasts a few hours, not always in the same day. The teacher acts as a facilitator in case of different opinions between the students, but his/her role is crucial when one of the students does not participate and all the work is done by the other member of the group. Furthermore, the teacher reads the map with each couple so that students “may listen” if “it works”, thus stimulating changes and verifying that all concepts have been included. When the map is finished the students choose the colour of the concepts that are grouped in themes; arrows and linking words will be written in black to be more clear.

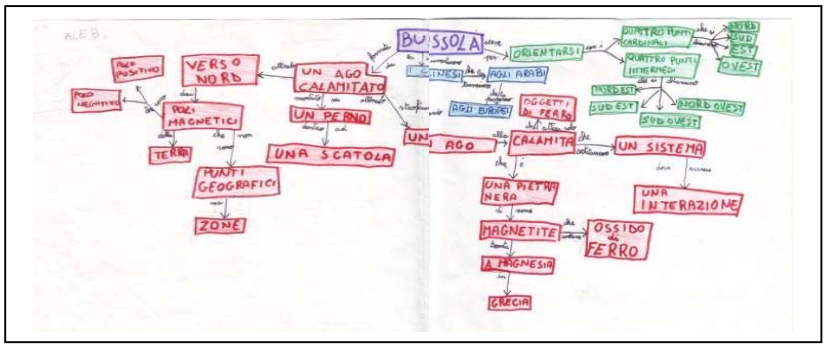
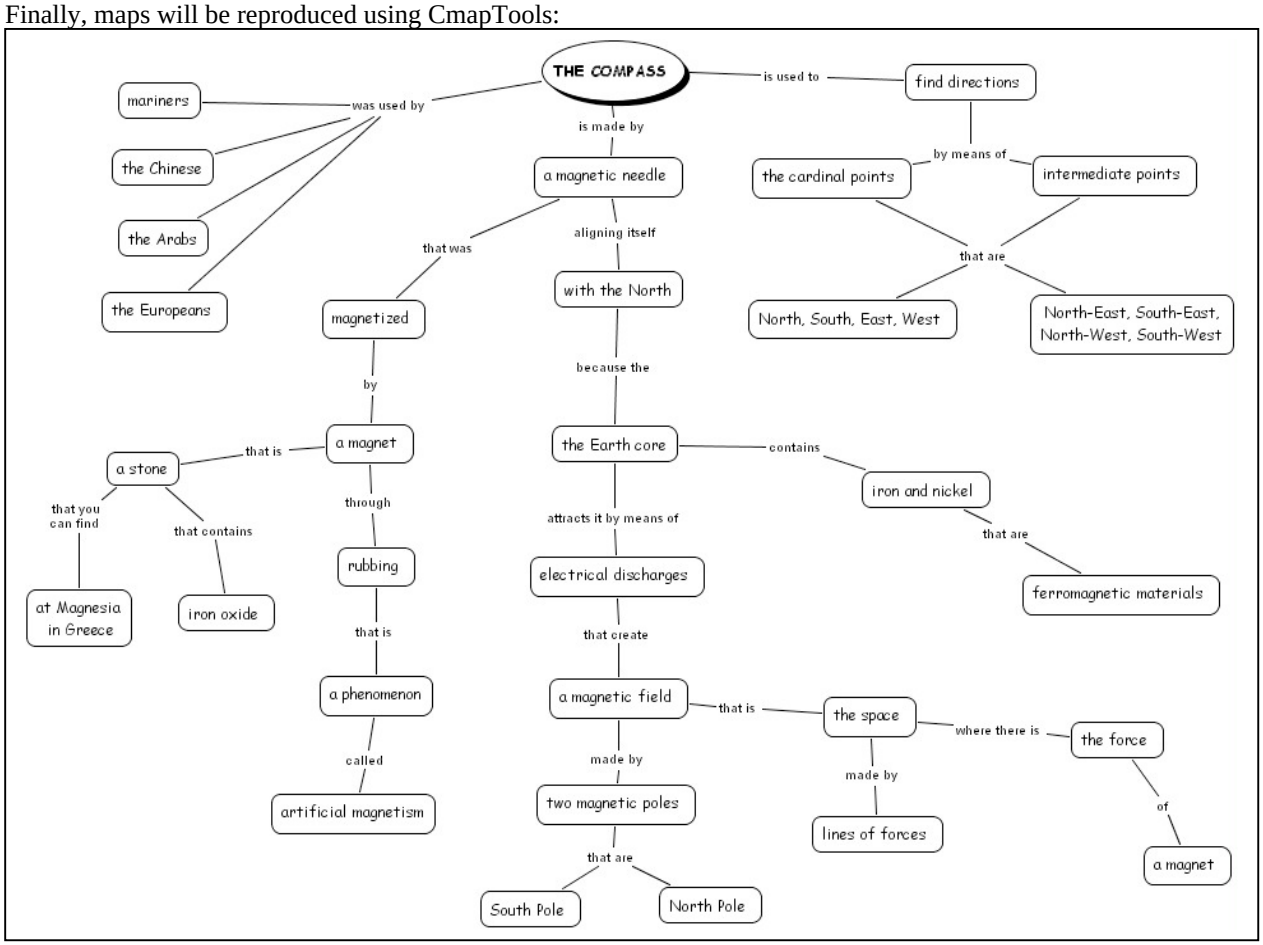


Figure 6. Example of a coloured map realized by a couple of students.

Finally, maps will be reproduced using CmapTools:



The final explanation and discussion take place at the end of the process. Each station presents its map. The students and the teacher discuss the importance of experimentation, research, study, debates and brainstorming in the process of learning and teaching. During this phase the specific language that till now was only used during experiments becomes the expression of everybody's thoughts. Every student applies the newly acquired abilities and skills, enriches his/her classmate, corrects his/her poor knowledge, strengthens his/her learning strategies.

The differences among the maps allow the teacher to understand if the project accomplished responds to the needs of the students and at what extent the process objectives have been met.

4 Summary.

For the first time, the teachers have carried out an interdisciplinary project based on problem solving, concept maps and cooperative learning. The project has been completed in different grades and the maps were introduced in 3rd grade classes (8 years old students). Thanks to “The words of science” students and teachers learned how to build a map in a different learning environment, above all acquiring a method of study (through text summaries, schemes, etc.) and a model of summary, at the end of an IWG in different areas (such as geometry, geography, etc... It was an enriching and stimulant interdisciplinary experience for students. They became the actors of their own learning process and, most of all, were aware of their knowledge made of concepts acquired in the past and of new ones (metacognitive awareness). The concept map shows the way each student progresses and gives everyone the opportunity to say something; it joins and links notions that are too often set apart in traditional school organization.

5 References

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