Concept Mapping: Connecting Educators
Proc. of the Third Int. Conference on Concept Mapping
Tallinn, Estonia & Helsinki, Finland 2008

BUILDING MEANINGFUL LEARNING THROUGH A WEB SEARCH AND CONCEPT MAPS

Gabriella Guaglione
Istituto Comprensivo Falconara Centro - Italia
Progetto Pilota MPI "Le Parole della Scienza" Università degli Studi di Urbino

Abstract. What is the situation in which a teacher has to operate every day?

- Our students highlight a great tension because of relationship problems;
- It's more and more difficult to motivate students as for Science is concerned;
- Students "learn" what teachers teach them, but they are not able to transfer their learning into a real life context;
- The research OCSE, PISA 2003 and 2006, about both scientific areas and problem solving, points out a deficiency in Italian students' base abilities and their low motivation for scientific studies.

"Paradoxically bad marks in Science, wrote the French professor Andrè Giordan (University of Geneve), are not the worst data of the PISA survey. What must worry us is something that the PISA did not measure: the feeling of boredom and the lack of interest in Science, which students show while talking about it. These subjects, as they are taught nowadays, discourage, and sometimes disgust most of the young people. They are said to be disgusting, difficult and boring, unbearable."
It's obvious that the traditional school, which offers severe curricula and only teachers the repository of knowledge transmission, is not able to form open minded European citizens, able to give their own contribution to the society in our immediate future. The following proposal of teaching innovation, based on webquest and a daily use of concept maps in classroom, makes the pupil indipendent, the master and protagonist of his/ her learning and supports motivations.

1 Introduction

The experience that is going to be explained is the result of a research made by a group of teachers who share a project of teaching innovation in the experimental science field, called "The Words of Science". In such a project particular curricula are experimented, from the Infant School to the Secondary School, by teachers who share teaching strategies based on the problem solving method, cooperative learning, the use of concept maps and laboratory teaching.

The will of changing and the desire of innovation come from the necessity of "motivating" our students, who seem to have lost their interest in Science. The web search and the concept mapping are teaching strategies which can motivate our pupils and give them the opportunity to learn, understand and reorganize the information received in class and in their everyday life. The final purpose is to make them more and more independent in facing new situations.
A webquest on "Water, common wealth of mankind" was done in the first year of a Secondary School, where the students are 12 years old. The choice to build a webquest just on water had different reasons:

- It's a topic in which everybody has a direct experience, so it is possible to build new learning, starting from what students have already learned in the primary school;
- It allows then refresh the concepts, explained trough the particle model of substance, about the water cycle transformations;
- It permits us make problems from different points of view: from the closest (one's territory) to the far off (other realities), from the individual (myself) to the social (the others);
- It stimulates the individual and group awareness through the acquisition of the "limited resource" concept and of the necessity to educate in responsible consumption..

The class takes part in a project promoted by the Museum System Association of the Province of Ancona, with the aim to strengthen the link between school-museum. It considers the conception of a teaching lab in the Museum of Natural Science "Paolucci" in Offagna, elaborated by a class for a class of younger pupils. The following webquest has been thought as an answer to this proposal.

2 WebQuest and concept mapping to encourage metacognition

The webquest created by Bernie Dodge, from San Diego State University, is a constructivist environment of learning, based on the extensive use of the Net and other off-line resources, which can promote the pupils' autonomy in the whole learning process through cooperative learning and problem solving strategies.

2.1 A WebQuest's qualifying aspects:

- Collective learning in which there are experimented all the relational abilities: negotiation, cooperation and motivation.

- Meaningfulness of teaching/learning ties, which are linked to the context of a precise experience. It permits us to find some of the characteristics of informal learning in formal school learning. The students are invited to solve real problems.
- The construction of concept maps, at the end of the learning course, which reinforces the metacognitive aspects related to the realization of the webquest.
- The valuation is authentic, because it is based on self assessment processes.

2.2 The method

The steps for the building of a good webquest are:

1. *Brief introduction* (starting from a question or a problem to solve).
2. *Task* to assign to working groups.
3. *Method* (a card to fill in and 3-4 Net sites to surf, which are chosen by the students and teacher).
4. *Evaluation* (with inter-group exchange, negotiation and self-assessment of the cards).
5. *Conclusion* (communication of the results, also with a concept map). it is the time of metacognition, during which the students analize the strong points and limits of their own knowledge and strategies, and build concept maps. They are stimulated to test the same experience in other contexts.

2.3 The metacognitive aspects develop creating webquest and concept maps

Concept mapping helps students to discover key-concepts and to organize them. First, the pupils formulate individual concept maps, then they share them with the other group mates. In the end, they negotiate the group concept maps. We can see how important and meaningful this phase is, because the students must compare and negotiate a new map, which takes into account the knowledge and the cognitive styles of the group. The verbal communication has a fundamental role. The language gets refined, the pupils build up well structured specific languages, which take roots in meaningful learning processes. The students themselves became aware of what they have learned and how. Sharing their ideas, they understand the value of diversity, and become aware of the points of strength and of the limits of their knowledge and learning strategies.

Concept mapping enhances the metacognitive aspects connected with the webquest creation.

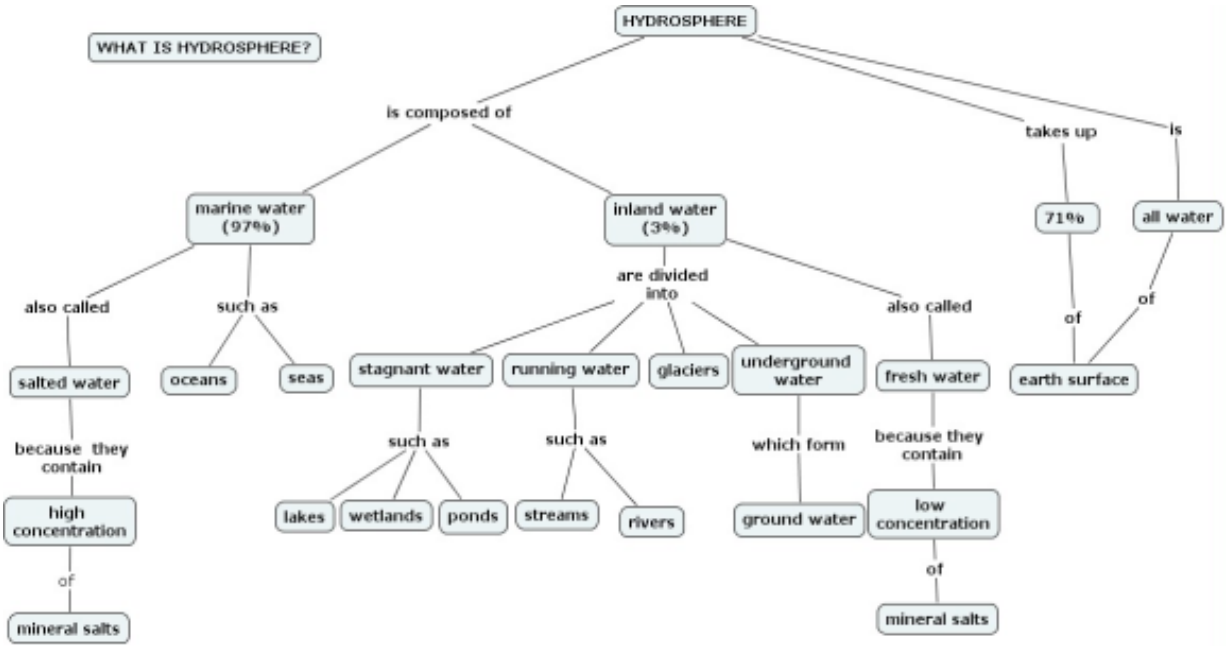

Figure 1. Concept map about the distribution of water on planet earth made in group

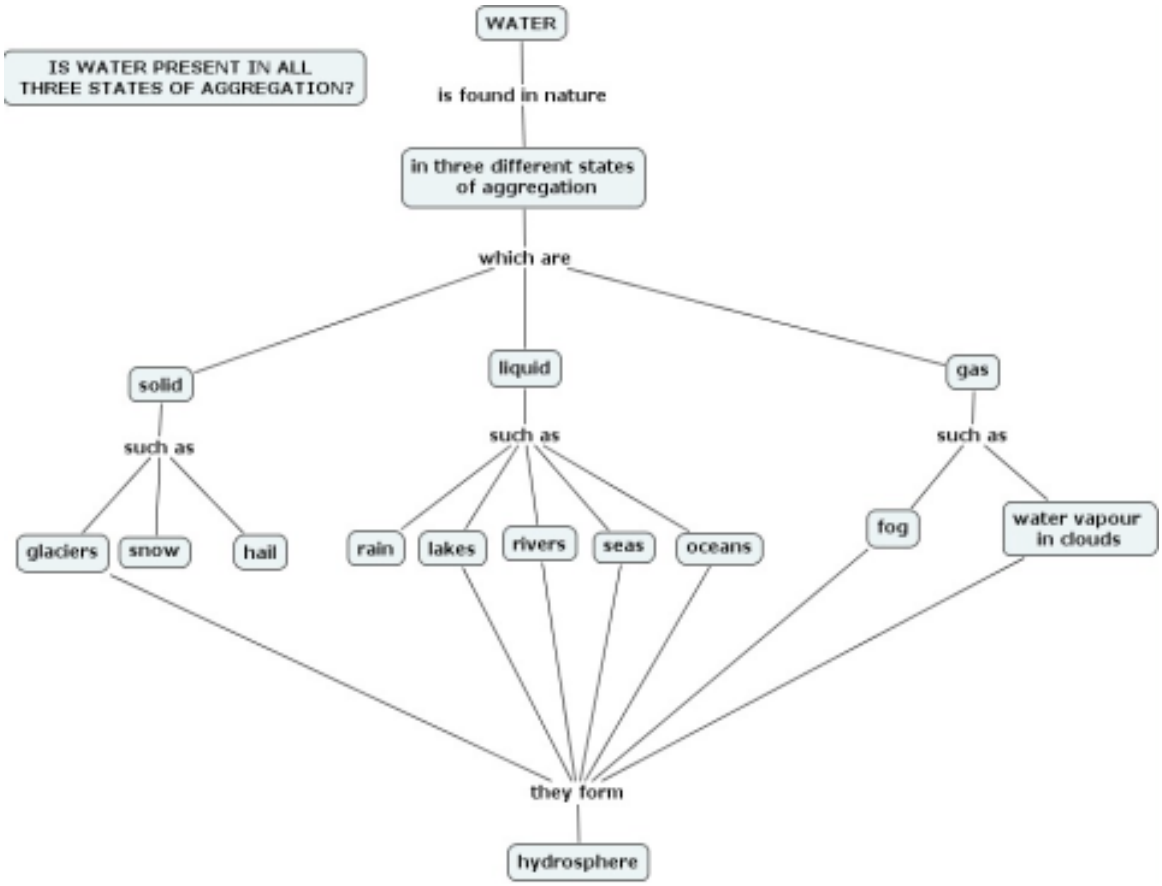

Figure 2. Concept map about the states of water aggregation made in group

2.4 An example of webquest : "Water, the common richness of Humanity"

2.4.1 Introduction

The presence of water in its different aggregation states makes the Planet Earth unique in the Solar System. Such uniqueness is to be found in the physical and chemical properties of this precious compound; so it will be appropriate to examine knowledge through a series of investigations. Water is a vital resource to be protected and defended. Taking care of water is a duty and a responsibility: water emergency is a theme of global interest and every action which involves water consumption must be studied with the aim of saving it.

2.4.2 The task

The Natural Science Museum "Paolucci" in Offagna wants the class (12 year old students) to project a teaching lab about water, which is to be developed by the children of the fourth year of elementary school (9 year old students).
The classmates are divided into six groups, each of them will do the following task:

1. to prepare the introduction to explain the distribution of the water resource on the Planet;
2. to prepare a brief report about water in the different states of aggregation, drawing pictures of the various passages of each state;
3. to plan the experiments which permit the reproduction of what happens in nature in the lab; all the experiments are to be repeated in class and video recorded;
4. to prepare simple experiments about the other properties of water, such as diffusion, capillarity, superficial tension and solubility;
5. to write a story beginning with "If I were a water molecule…";

6. to analyze the different behaviours towards the use of drinkable water, and project the most suitable way to communicate the responsible use of water to children.

Every group will have to build up individual and group concept maps at the end of the investigation to consolidate the metacognitive aspects of the same investigation.

2.4.3 The resources

A list of three, maximum four, websites is given to each group, with the indication of what to look for and where to look.

2.4.4 The course-process

Cards with the indication about the experiments to do and with guide questions are given to the groups to elaborate the results of the experiments The students are invited to build up individual and group concept maps, which aim at organizing and relating the different concepts.

2.4.5 The evaluation

All groups are given:

- An questionnaire of self evaluation of each pupil and of the group;
- An index book for the assessment, where the abilities to check are described by the following indicators:
  1. organization and group work;
  2. participation and involvement;
  3. research of information;
  4. elaboration and drawing up of the final report.

  To each criteria are given 4 levels with a score from 1 to 4, with its corresponding evaluation grid.

2.4.6 The conclusion

Each group fully describes the ways of presentations of the investigations about water to the younger pupils (ages 5 to 9).

Figure 3. The class is divided into groups. These girls are experimenting the phenomenon of capillarity.

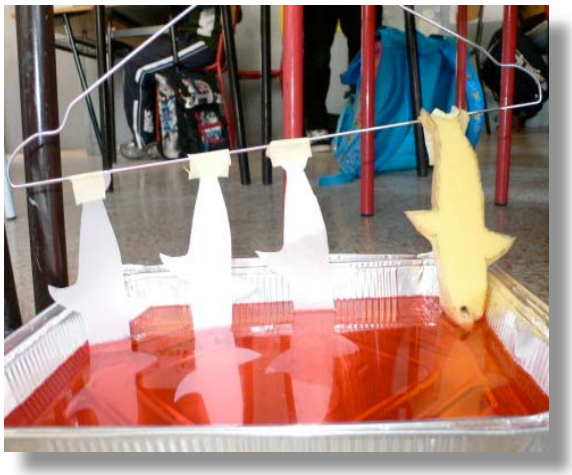

Figure 4. Each fish is made of different stuff. In this experiment it is possible to observe how different materials behave differently in water.

2.5 The scientific laboratory

The experimental activity, above all if led in cooperative groups, can have a very important role for the students, because it allows the learning of knowledge and abilities, at the same time it teaches them to be protagonists. In the Science lab, the students must be able to move and use resources of the lab freely and responsibly, after having made an educative pact with the teacher. The pupils are given complete autonomy and responsibility during the development of the experimental activities so that they can have the opportunity to develop other metacognitive abilities: to interpret the data and to communicate the experiments' results in a correct language.

Figure 5. The pupils are checking the solubility of some substances in water, the concept of homogeneous mixture (solution) and of heterogeneous mixture is introduced.

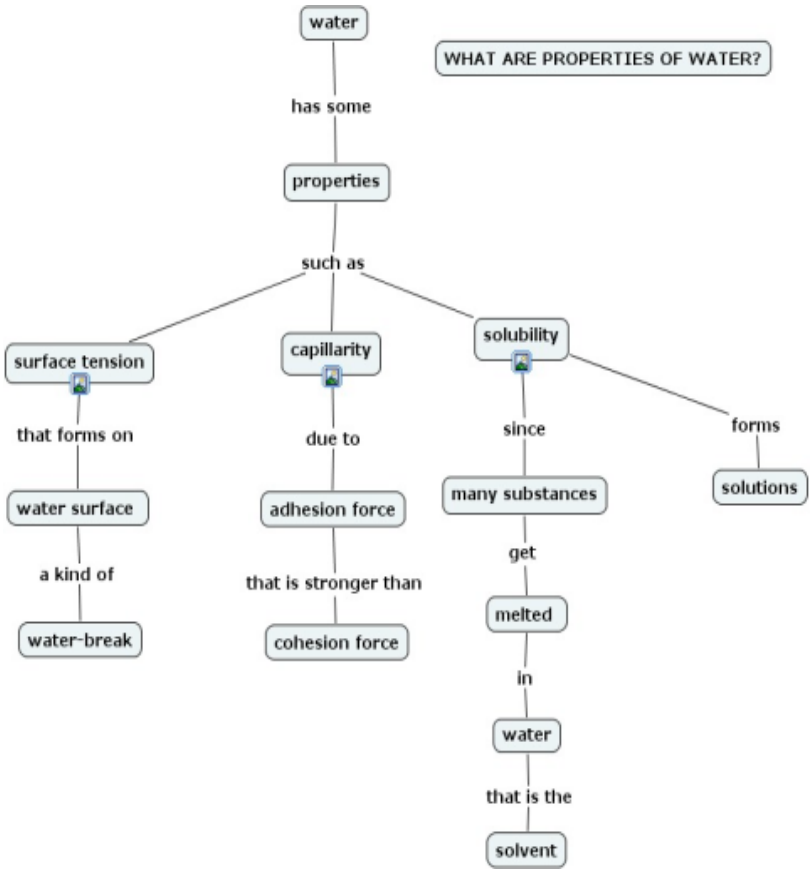

Figure 6. During the lab phase, the students conduct the experiments and elaborate maps to conceptualize what was learned during the experimental and manipulative phase. The maps are individual and from comparison and mutual listening, the pupils build up matacognitive thoughts and the group maps.

2.6 The teacher's role

The teacher has the role of an adviser and assistant of the cognitive process, to make the pupil a real protagonist of his/her own learning. The teacher, watching the students' behaviours, during the planning and experimental resolution of the problem can better estimate the mastery of individual abilities. At the end of the work the teacher:

- elaborates the questionnaires;
- assesses each group according to the index book of evaluation;
- stimulates his/ her pupils to think about the work carried out, the acquired knowledge and the way which they have really collaborated.

2.7 "If I were a water molecule…." An example of authentic composition

The students are asked to identify themselves with a water molecule and to describe one of the passages of state or one of the water characteristics, as a story, a tale, or a comic strip.

The stories, the tales, and the strips are socialized with the rest of the classmates that give their opinion both about the originality of the story and about the scientific rigour through which the author was able to tell it. In this phase the mistakes emerge, on which the class will discuss. In picture number 7 we can see the ice fusion, which was reported like this: "I'm a molecule and I've got many sisters. They are very cold, so, to be warmer, they stay very close to each other. Suddenly, I and my little sisters felt a little warm, so we started to move away

and, being free, we started to slide on one another." That performance is an example of how formal and informal understanding can interact. To build their stories, pupils used both their imagination and their scientific knowledge.

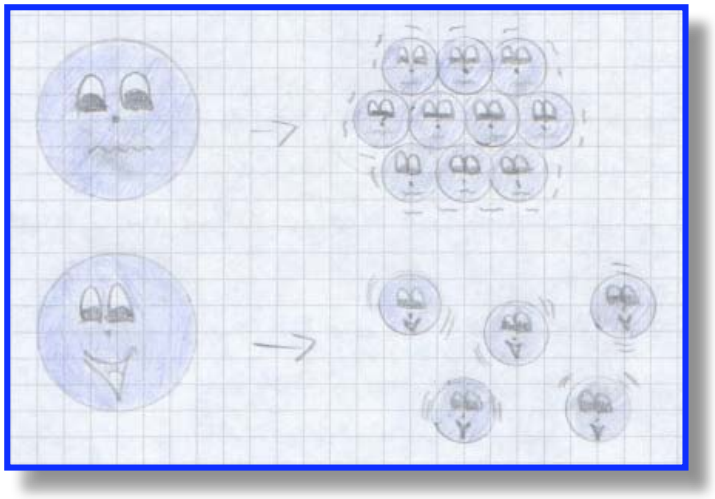

Figure 7. The students of a group have talked about the fusion of the ice from the molecular point of view and represented it in this picture. In picture 6 there is the concept map of fusion. An example of formal and informal learning interaction.

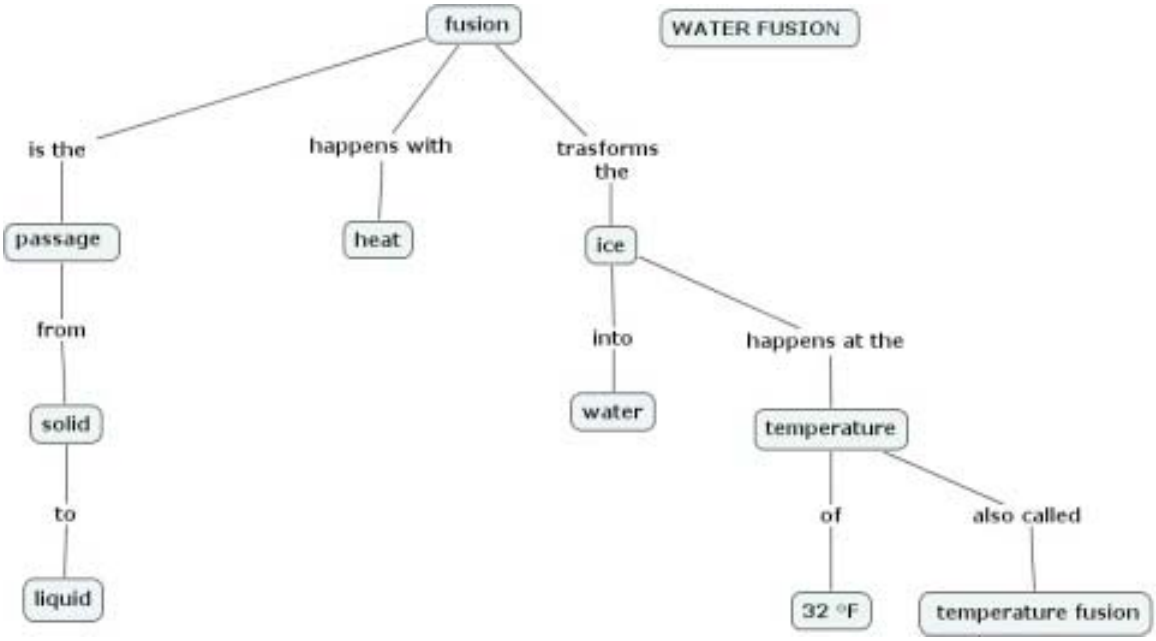

Figure 8. The concept map of fusion.

Figure 9. The diffusion of a liquid in water is explained and drawn with the comic strip technique. The story tells of the first difficulty of the molecules of the red liquid to mix with the water molecules which resist. At the end of various fights and reconciliations the molecules of the two liquids mix (diffusion process), being able to mediate a conflict situation, living in peace! In this case pupils have transferred in the scientific area what they have learned in an educational lab to peace and living together..

2.8 Authentic evaluation

Carrying out a webquest means suggesting a significant learning, because it implies the execution of a true task. During the process the student uses all his abilities in coordination. The obtained evaluation is authentic, because it is also based on the contribution of the pupils' self assessment. Evaluation acquires significance as it encourages the pupil to self-knowledge and to motivation.

2.8.1. Analysis of evaluation of the webquest on "Water, the common richness of humanity"

Individual self-assessment

At the end of the assessment process, the following data were gathered:

- 85% of pupils preferred doing activities in group, 15% in pairs: they did not like to work individually;
- at the end of activity all the students were satisfied; 65% were greatly satisfied;
- the more easily respected social abilities were collaboration, listening and taking a decision together;
- the most difficult social abilities to be respected were speaking one at a time and controlling voice volume

Group self-assessment

- most of the pupils found the task interesting but demanding;
- the pupils judged the available materials good and the time sufficient;
- not every body respected the social abilities ;
- taking decisions and collaboration were the easiest social abilities to respect;
- respecting friends' opinions, speaking in turns and controlling the voice volume were the most difficult abilities to respect

2.8.2 Assessment through an evaluation index book

Excellent: [(16-14)/16 points] the group were able to organize according to operative criteria and activated effective strategies in the research of materials. The work is complete and correct and well presented in each part. The pupils respected all social abilities and roles.
Good: [(13-11)/16 points] the group were not able to organize all the phases of the work effectively and not all the pupils showed the same level of involvement, even if, on the whole, they were motivated. The work is not completely finished and corrected but it is well presented. Almost all the social abilities and roles were respected.
Fair: [(10-8)/16 points] the group needed the teacher's help to organize some steps of the work. The division in tasks caused conflicts. They acquired information about some points. The involvement and participation were very little. Half of the work was done correctly. They were respectful of two social abilities at least.
Fail: [score under 8/16] the group could not organize, the conflicts were not settled. They did not obtain any information, as they could not do an adequate research. The group could not become active for the final result. One social ability was respected.

3 Summary

The webquest and the concept mapping have all the necessary characteristics for our pupils' formative success. The most pertinent elements are as follows:

1. they work in a cooperative learning environment and teach students to be respectful of the social abilities, to the comparison, the dialogue and listening, as it is necessary in a more and more open minded and multicultural society;
2. students are motivated because they are asked to put in practice their creative abilities, the abilities of critical and metacognitive thought, and to solve real problems;
3. the pupil is made aware of what he/she knows and needs to learn other concepts and, above all, why and how he/she learns;
4. the pupil learns to self behave in the learning process, to learn for the need and the interest of knowledge, not as a burden.

4 References

Costa, A. L., Garmston, R. J. (2002). *Cognitive Coaching: A Foundation for Renaissance Schools.* Christopher-Gordon Pub**.**

Wagenschein, M. (2000). *Teaching to understand: on the concept of the exemplary in teaching.* In Teaching as a reflective practice – The German didaktik tradition, Lawrence Erlbaum Associates, Publishers.

Livingston, J. A. (1997). *Metacognition: An Overview.* State University of New York at Buffalo.

Swartz, R. J., Parks S. (1995). *Developing critical thinking through science*, Critical Thinking Books.

Exline, J., et al. (2002). *Earth's Changing Surface*, Prentice Hall, New Jersey

Mintzes J. J., Wandersee J. H., Novak J. D. (eds.) (2000). *Assessing science understanding*, Academic Press, San Diego.

Pankratz R. S., Petrosko J. M. (2000). *All children can learn*, Jossey-Bass, San Francisco.