THE CONCEPTS OF CENTRIPETAL FORCE AND HARD/SOFT WATER SCIENTIFIC THINKING STUDY USING THE THEORY OF CONTRAINTS (TOC) TOOLS

Background: Natural Science personnel, like other professionals, developed the language of symbols and formulas. The languages were formed from the need to use a shortened language, one that crosses borders and languages as well as from the wish to safeguard the trade secrets from laymen. Describing an experience, observation or a natural phenomenon requires sometimes a lot of verbiage. It was crucial to mathematicians, chemists, physicists and scientists in many other areas to find a uniform language that will enable understanding without using so many words.
Today when the know how and the methods of using it are well known by many, a situation has been created where the professional languages rich in symbols and formulas, constitute a deterrent factor to science students. Who is going to learn a profession, as interesting as it may be where the main obstacle facing him is the language? Another thing creating antagonism towards certain professions are the control processes--the many examinations. Studying became virtual--the student is not experiencing personally!
The examinations become more and more virtual and do not necessarily prove knowledge and qualifications other than the ability of memorizing and learning by heart.
As initiators in the field of Scientific studies, who emphasize the direct personal experiences of the students, we face a number of problems.

The main one of them being the need to find an effective way to explain to children in a simple language understood by anyone the complex phenomenon which happens right in front of their eyes. We are used to say- "a picture worth a thousand words, an experience worth a thousand pictures". A simple multiplication will show us that in order to transcript an experience we need millions of words.
The various TOC tools enable us to word a lot of knowledge in a condensed form and simultaneously make it possible for the children to describe in a very clear way the experience they have just conducted. The conflict cloud presents and focuses the need for the scientific phenomenon we are describing. The logic contexts used in building branches enable them to describe activities and complex experiences.
During the last two years we have developed a program integrating practical scientific activity and scientific thinking with the TOC thinking tools.

THE STRUCTURE OF THE LESSON:

A certain dilemma is presented through a story. The dilemma is not necessarily a scientific one. It can be moral, logic, social etc.
We work together the cloud.
The children raise suggestions for solutions (injections).
We examine the existence of positive and negative implications in every suggestion.
The tutor presents the subject of the lesson as one of the possible solutions.
We check the solution by experience.
The tutor presents the scientific explanation with the aid of a logic branch.

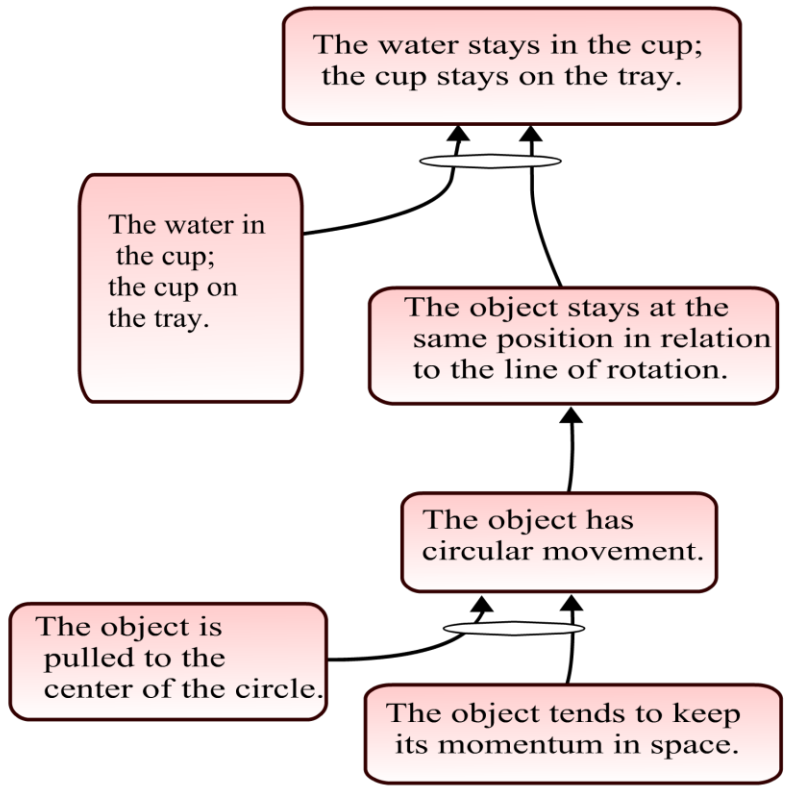
The use of those tools has two advantages:

1. The connection between the problem and its scientific solution is clear and assists in understanding the studied process.
2. The scientific phenomenon presented before them is worded in if-then contexts.

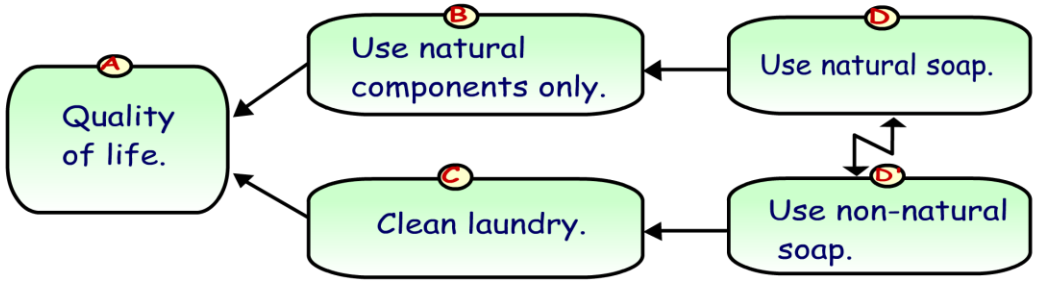
The wording is clear and summarized.
In each and every lesson emphasis is put on practical experience of each one of the children. The product received is a possible solution to the problem presented in the cloud or a product of the process presented in the logic branch.
Samples of contents studied in this manner.
Lesson subject: The centripetal force.
Product: preparing a "flying tray"
Background story: A veteran waiter in a small restaurant is getting old and his hands begin to shake. Consequently he spills the liquid dishes he serves and customers keep complaining. The owner is debating whether to fire him or not.

Injections suggested by the children:	
IDEA	***NEGATIVE IMPLICATIONS***
Glue glasses to the tray.	How will he serve glasses to customers? Does not prevent trembling & spilling.
Cover glasses with a lid.	Existing glasses have no lids. Buying new ones requires financial expense.
Freeze the drink and warm again at the customer's table.	No suitable equipment. Customers may not appreciate this service
Put an absorbing pad under the glass and squeeze liquids back into the glass.	Not esthetic. May drive customers away.
Make the manager give him another job in the restaurant.	Waiter is experienced and may be a flop in another job.
Install a small train with glasses to travel between the tables.	Change the restaurant character. The waiter will be fired anyway.
Add another waiter for serving drinks. The trembling waiter will only serve solids.	Adding another waiter means extra wages.

The first three ideas relate to the way where the drinks can be "retained" in the glasses whilst the water moves around. The solution suggested by the teacher also enables movement without spilling the liquids.
Explanation: why the water does not spill.



Lesson subject: Hard and soft water.
Product: preparing tub salt.
Background story: My sister insists on maintaining a natural life style. She eats natural food, when she is sick she prefers natural medicines and her hand laundry she does with a natural washing soap.
During a certain period of her life she lived in an area where the water was hard (containing a high percentage of heavy metals). When she washed her laundry with a natural soap, not only the simple stains remained on the clothes but they were coming out with a thin layer of dirt. The explanation father the chemist supplied was that the fatty acids in the natural soap are getting tied to the heavy metals in the water and creating precipitate.
Detergent (a non-natural soap) is not getting tied to these metals
and so if she will wash her clothes that way the problem will be avoided.



Injections suggested by the children:	
IDEA	***NEGATIVE IMPLICATIONS***
Take the heavy metal out of the water (use purified water).	My sister does not have the resources to buy or make purified water.
Add natural soap to the water, create precipitate and clean the water. Then use soap again.	Using a lot of soap.

The solution suggested by the teacher, using sodium bicarbonate, parallels in its logic to the kids suggestions: to neutralize the heavy metals in the water.

Presenting the solution in a logic branch: