

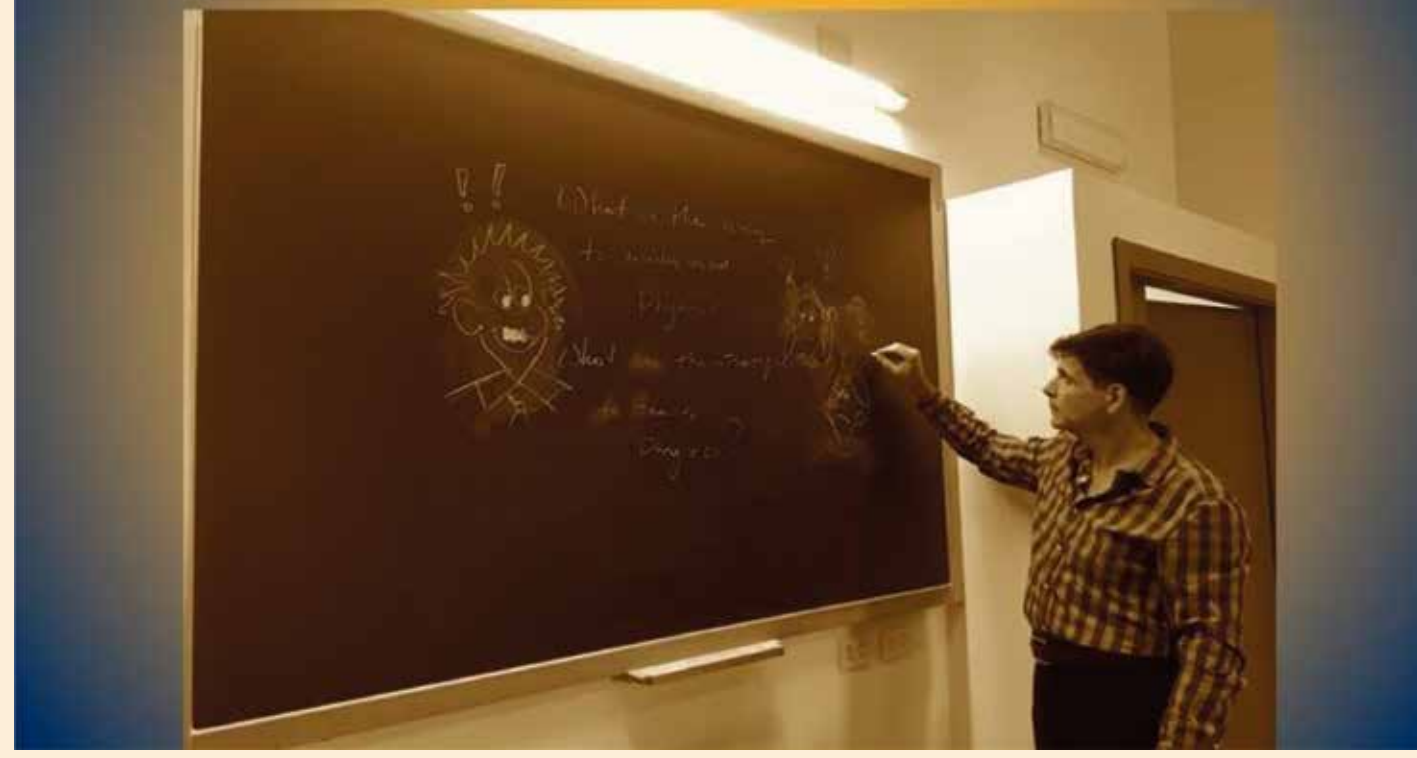
DECODING AND CODING IN PHYSICS

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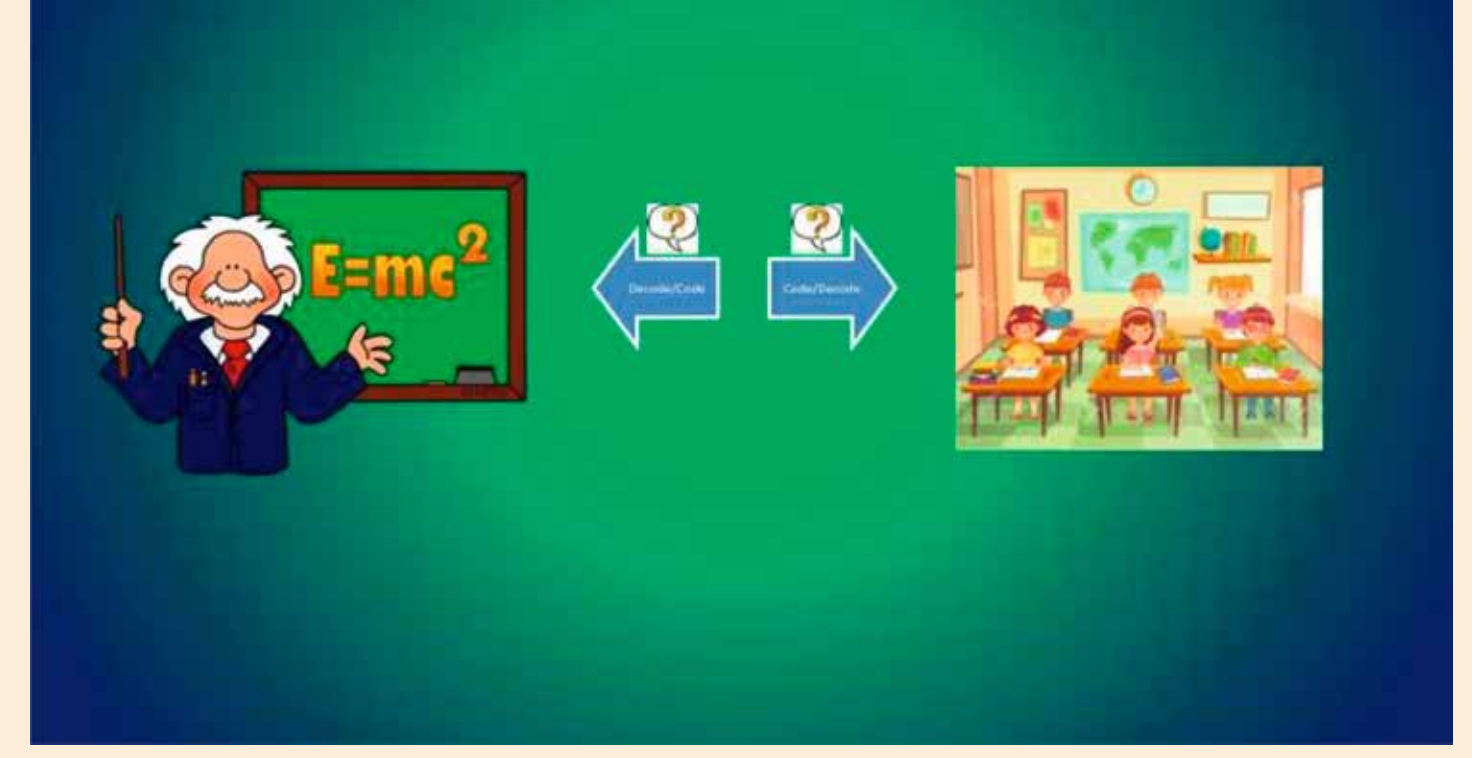
Decoding and coding in physics

The problem of communicating a concept is present in each discipline but in the Sciences there is something more. In addition to the language we use there is also the logical structure that characterizes Science and the particular subject. In Physics there are also symbols that are sometimes important because with their correct use we, not only succeed in communicating a concept, but we can also understand what we want to say from the most intimate point of view of the subject. Sometimes those symbols contain additional information and are not just an alternative way to represent what we could say in words. The necessity to use this multi-level language is a bottleneck in encoding and decoding Physics. In this work the importance to communicate Science in a correct way is discussed so as to better understand it. Coding a physical concept through words, logical structures and symbols is a way for students to understand and therefore decode what the teacher says. The majority of the data in this work comes from lessons in High School and University and from interviews with a sample of high school students.

Often there is confusion in teaching and understanding Physics



CODING AND DECODING PROCESS



Why Physics is difficult for students? Bottlenecks

Answers	%
Discipline too complex	19
Discipline too simple	1
Too many formulas	11
Not enough formulas	7
Too much Mathematics	8
Not enough Mathematics	4
Language never simplified	18
Language never simplified	1
Too little laboratory	19
Too distant from concrete	12

Answers of a statistical sample of 500 students from a High School and University to the question: What are the difficulties that you find in studying Physics?

Why Physics is difficult to teach? Bottlenecks

- Difficulty in understanding cultural and social framework of student
- Difficulty to transmit the message that what we hardly arrive to know of the Universe is not a conquest but a gift of Nature
- Difficulty to use the specific language adact to that particular student
- Difficulty to use the adequate symbols in a context where the symbol is fundamental
- Difficulty to have the sufficient umilty to accept that teacher doesn't know all, but only a grain of the mystery of the World
- Difficulty to understand that before the knowledge there is the love for the know and the teacher must transmit it by empathy
- Difficulty to code and decode abstract concepts in an easy way

Is there a solution?

- Yes, there is.
- Teachers must think of each topic in a new way, trying to individuate the difficulties that the student could have, but not forgetting the fundamental structure of the discipline because that structure is fundamental for the education and the formation of a correct scientific thought. They have to code again what they want to say, thinking how to transfer the concept in the best way, considering above all the students' particular cultural situation, but not only.

Conclusions

- This work is only a short presentation of a very large problem present in the education of Physics. When we say Decoding the Disciplines we want to analyze this fundamental real problem. It is surely not new in the history of culture but now it has an increasingly more important role for expanding the borders of knowledge and for a complex structure of our society that places the Professor and the student in a multilayer world where the cultural problems are mixed with psychological ones. Didactic in the Physics is in this situation, so it is necessary to analyze new ways to "do" education. This status creates a divergence between Professor and student. We must now find new models in coding and decoding Science. A single model does not exist, rather there are many models of communication based on the same concept of Culture.
- We have to adapt the education to the context. In Physics the elements that stand out are:
 - 1) Language by words;
 - 2) Language logical structures of discipline;
 - 3) Symbols and Mathematics;
 - 4) Emotional sphere (psychological, social, empathic).
- The future of Education in Physics is in being able to find better and better ways of Coding and Decoding the Disciplines, in an active and continuous improvement of this framework.

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DECODING THE DISCIPLINES - Maths for teachers

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SEVEN STEPS



Introduction

Here is a report about the experience of an attempt to run the Decoding Method in a class of primary school prospective teachers, at The University of Roma Tre. The entire project lasted during 3 years, hereby we focus on one class of *Elementary Mathematics for primary school teachers*, annual course for freshmen, of a 5 years' academic degree. By law, lessons are not compulsory. 10 Credits, written examinations.

Looking for bottlenecks

An exploratory questionnaire has been posed to the students, to understand their personal knowledge of basic mathematics, their feelings and expectations on the subject. A discussion followed. The awareness of the difficulties and in some case of a personal prejudice and closure towards the Maths has emerged. Moodle platform and email was the environment where the interaction of the teaching and learning process was visible. Three Types of Bottlenecks:

- procedural obstacles in which students have not mastered the steps that are necessary for successfully completing the tasks required in a course;
- epistemological bottlenecks in which students fail to understand the basic nature of knowledge construction in a discipline;
- emotional bottlenecks in which students affective reaction to the nature of the discipline or of the subject matter hinders learning.

Mental Operations

- Focusing attention on the identification of hypothesis and thesis;
- Focusing attention on deductive mathematical process;
- Operation of comparison of mathematical objects;
- Operation of classification of mathematical objects;
- Operation of representation of mathematical objects .

Modelling and Praticing

The practice of the mental operations has been based on the axioms of Euclidean geometry, and some theorems, such as Pythagoras Theorem. In particular: Making research of materials on web, solving some problems with different strategies, disproving some statement, thinking about questions and hypothesis, and presenting the work to the rest of the class. Verbalization among peers has been a central operation, as well as written homework delivered to the teacher by the Moodle platform.

Feedbacks

Feedback questionnaires have been give to the students, brainstorming has been praticated in the classroom in order to vulate the process Interactions of the students went from passivity to activity and the final feedback reached satisfactory level.

Motivating students

The increasing awareness of the students of their own abilities, the awereness of the esthetical historical and philosophical aspects of Mathematics have been the key to motivate students in approaching a hard work.

Evaluating

Written open questions with a prescribed time. Questions were mainly on processes, only very few computations were usually asked. Some question could ask to "invent a problem", or to find the optimal solution to a problem, rather than to give a numerical output.

Conclusion

Istructor awareness and self-valuation also come in, a renewed interest in teaching is a great by-product!

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