

Weight vs Mass

A case of teaching STEM

experimented during the year
2014/15 in a first class (students
aged 14-15) of our school ITT
Buonarroti



Experimentation supported by

Iprase and Fondazione Cassa di Risparmio di Trento e Rovereto



Directly involved subjects

Physics, Mathematics, Italian Language
(mothertongue), Information Technologies

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Main didactic goals

PHYSICS	MATHEMATICS	ITALIAN LANGUAGE	INFORMATION TECHNOLOGIES
distinguish MASS and WEIGHT	handle correctly with algebric calculation	distinguish and produce different kinds of written texts	
	translate mathematical symbols and equations in natural language (and vice versa)		
understand physical phenomena by experimenting			
analize physical phenomena	handle with direct and inverse proportionality fuctions	be able to write a scientific report	use dedicated software to graph a function
	analize a statistic and its statistical quantities		use software to graph different kinds of diagrams

Most important lessons in PHYSICS to achieve the goals



- Error calculation (theory and related experiments)
- Movie about Galileo Galilei, the founder of the experimental method
- Experiment: add masses to a dynamometer and measure its elongation (and therefore the force necessary to elongate it)
- Production of a scientific report including a graph (elongation vs mass) and a chart (mass/elongation/weight force)

Example of experiment's result

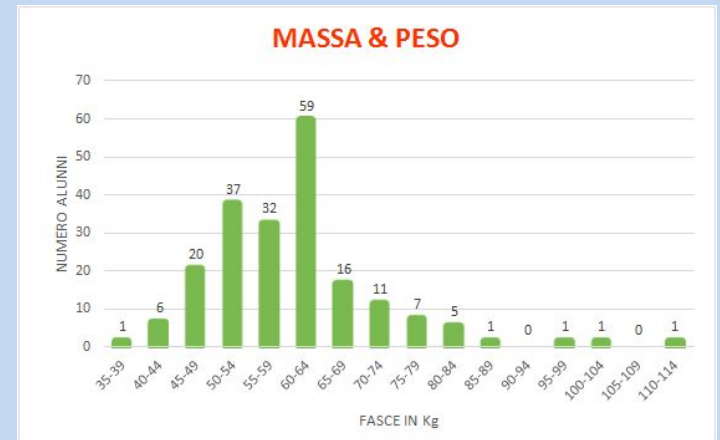
PROCEDIMENTO: utilizzando il dinamometro pesiamo le varie masse (10g, 20g, 30g, ..., 100g) e riportiamo il valore che ci indica il dinamometro in una tabella

	m (g) ±1%	m (kg) ±1%	Fp (N) ±0,01N	$K = \frac{F}{m}$	K media	Errore discrepanza
A	0	0	0	0	9,98	±1,8%
B	10	0,01	0,10	10	9,98	±1,8%
C	20	0,02	0,20	10	9,98	±1,8%
D	30	0,03	0,30	10	9,98	±1,8%
E	40	0,04	0,40	10	9,98	±1,8%
F	50	0,05	0,50	10	9,98	±1,8%
G	60	0,06	0,60	10	9,98	±1,8%
H	70	0,07	0,70	10	9,98	±1,8%
I	80	0,08	0,80	10	9,98	±1,8%
J	90	0,09	0,89	9,9	9,98	±1,8%
K	100	0,10	0,99	9,9	9,98	±1,8%

GRAFICO:
rappresenta la relazione tra massa e peso



Most important lessons in MATHEMATICS to achieve the goals



- Algebraic calculation necessary to solve first degree equations
- Cartesian diagrams and representation of straight lines
- STATISTICS: preparation, submission and statistical analysis of a questionnaire (submitted to all the students of the first class of our school – about 320 students)

Example of lesson

PREPARATION OF A QUESTIONNAIRE:

- How much do you weight?
- Would your weight be equal, more or less if you were on the moon?
- Is there any difference between mass and weight? ...

ANALYSIS OF THE QUESTIONNAIRE:

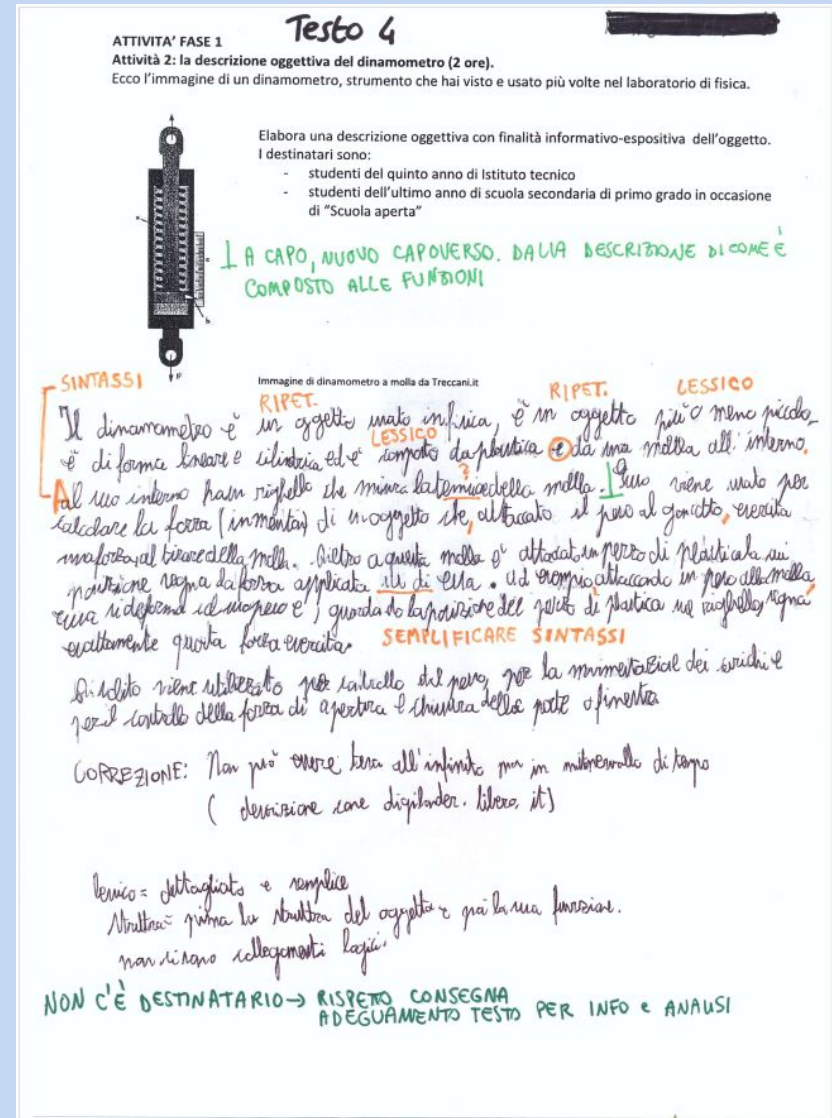
- Different analysis and graphs for open questions and closed questions
- What do you do with 'strange' answers? (ex: 'I do not know how much I weight')
- Is the average value of the weight of the school's students the same as the average value of the classes' weight averages? (more than 300 students in 13 classes) – average and weighted average ...

Most important lessons in ITALIAN LANGUAGE to achieve the goals



- Presentation and descriptions with exercises related to different kinds of written texts
- Objective description of the dynamometer
- Objective description of the procedure of the experiment 'mass vs weight'
- Verbal description of a graph and a chart

- respect of the assignement
- correctness and richness of the content
- ability of details' description and synthesis ability
- syntax correctness
- use of specific language



Most important lessons in INFORMATION TECHNOLOGIES to achieve the goals

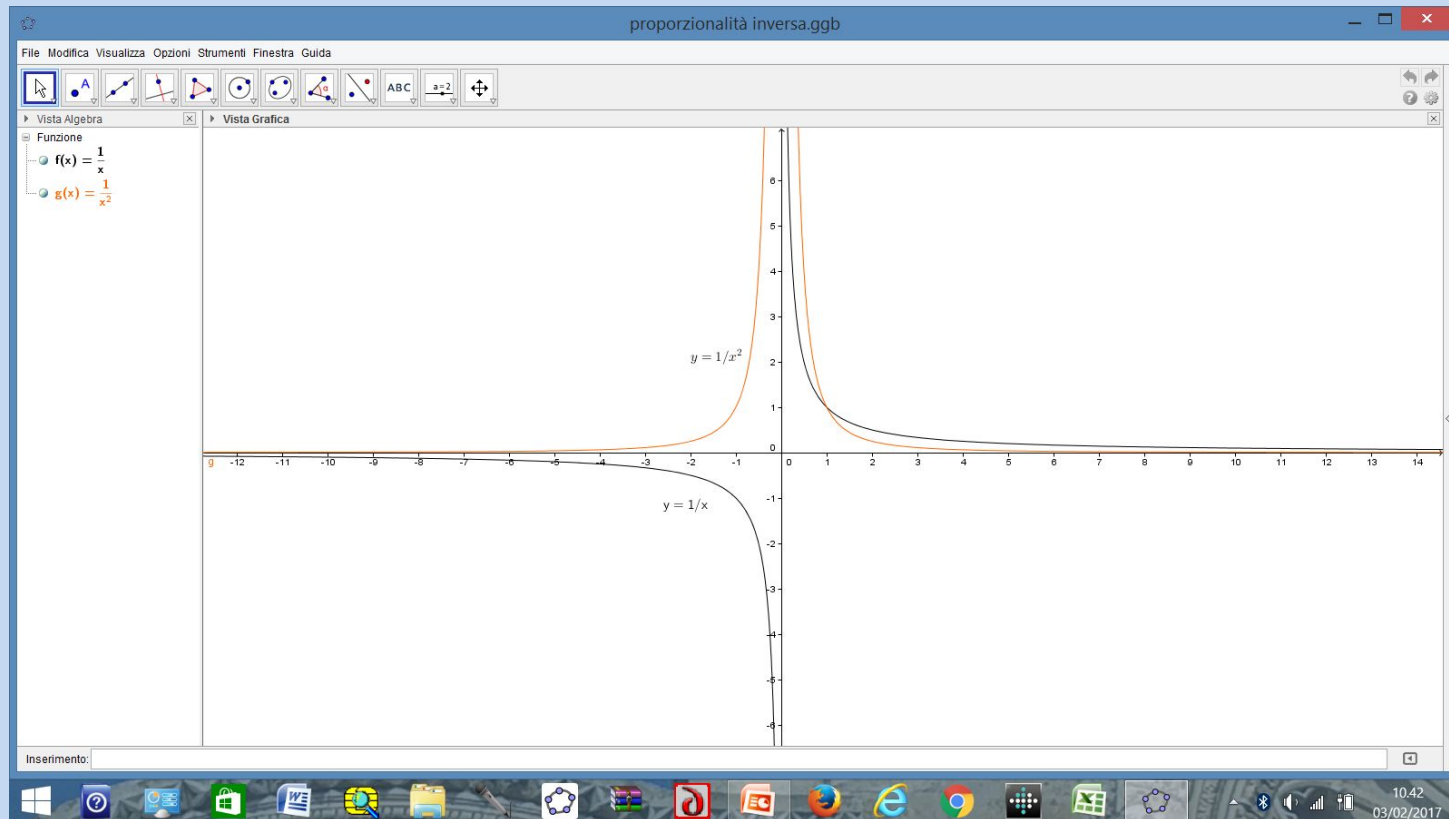


Support for the graphic part of the job

- Statistical functions in Excel
- Diagrams in Excel
- Charts in Word
- Function graphs in Geogebra

example

graph functions with specific programs



Final test and evaluation

OBJECT

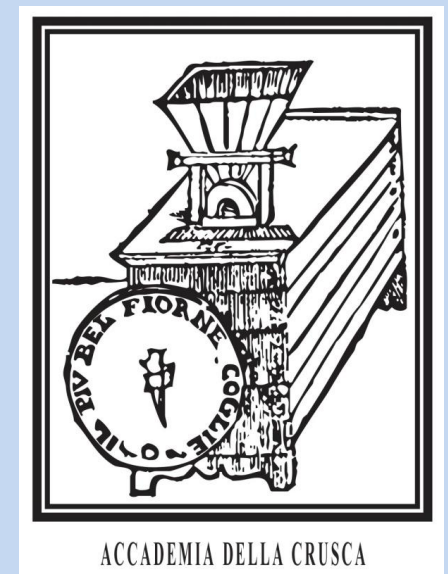
- Perform a different experiment and report about it (evaluation of the force to apply at the end of a pole to maintain it balanced)
- Analysis of an histogram

EVALUATION CRITERIA

- Correctness of contents, presentation form, graphics and diagrams
- Ability to use specific language and informatic programs
- Ability to work in groups (communicate, participate, follow specific rules, be responsible of a specific task)
- ...

How we projected

- Common initial choose of the subject
- Common initial project and periodic evaluation among the teachers
- Periodic validation and supervision by University of Trento - Departments of mathematics and physics and Accademia della Crusca
- Separate lessons in the same class



How we worked in class

- Experimentation in class during the school year
- Students worked mostly in groups
- We both paid attention to group dynamics and content learning
- Evaluation in progress and final evaluation

Possible developments

Involvement of other subjects such as:

- English/German (questionnaires and reports in foreign languages)
- Science (correct nutrition, human biology)
- Physical education (movement and muscle/fat mass)
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THANK YOU

FOR YOUR
ATTENTION

