DARK GRAINS OF SAND: A GEOLOGICAL STORYTELLING

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Introduction

In the secondary Italian school the Earth science learning begins at first year (students 14 years old), in synergy with other natural sciences such as Astronomy, Chemistry and Biology.
Italian teachers have to focus on the landscape geomorphological aspects even Earth processes are difficult to display since they are related to certain phenomena happened during the past and often far from the involved countries.

Objective

The aim of this work is to show how a learning process can be developed on the geological and geomorphological occurence, totally free of school books, starting from a touristic trip and based on an inverted sequence experience-theory, so far from the canonical paths. Exploring before teaching allows a longlife learning, focusing on phenomena observation and data analisys, useful for developing scientific skills on young guys more similar to the Galilei approach to the natural sciences.

Methods

According to the **IBSE**[1] (Inquiry Based Science Education) approach, a learning unit has been implemented, starting from a walking along the light carbonate beaches of the Adriatic sea: a smart look to the sands strokes the students fantasy pushing them to explore some strange black grains on the sands.

Dirty sands on our beaches?

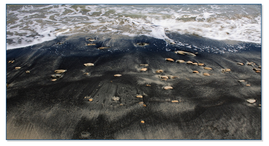
THE TEACHING CHALLENGE.
Due to the youngest age, a third level guided inquiry has to be adopted, so the teacher is the "guide of inquiry" encouraging the students using the research question ("Why is the sand dark?", "Do all sands look the same?") and driving the them around their investigation plans ("How can I measure grain size?"). A brainstorming about questions opens each lesson followed by a discussion on some hypothesis to investigate. The explanation follows the exploring step.
This approach matches the "BSCS 5E Instructional Model"[2] consisting in five phases: 1) the **Engagement** helps the students become engaged in a new concept through the use of short activities promoting curiosity; 2) the **Exploration** experiences provide students with a common base of activities within which current concepts (i.e., misconceptions), processes; 3) the **Explanation** focuses students' attention on a particular aspect of their engagement and exploration experiences; 4) the **Elaboration** where teachers challenge and extend students' conceptual understanding and skills; 5) the **Evaluation** encourages students to assess their understanding and abilities.

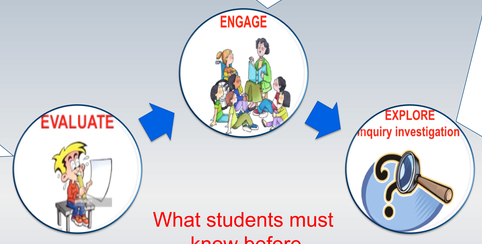
Evaluation procedure isn't so easy because Italian assesment is mainly based on summative than a formative practice, otherwise collaborative practices such as collecting data in a group, planning and conducting investigations, interpreting evidences, drawing conclusions and discussing results with peers has been take into account, as they are at the centre of the IBSE approach. Different rubrics are adopted for the different skills and different performance like partecipation and group work, research report, concept maps.

Competences	Skills
Planning investigations	Decide what you want to do to find out the answer to the question, Decide what materials you need, Decide how to record the information, Decide how to analyse the information, Decide how to report the findings
Developing hypothesis	Defining question to test. Formulating hypothesis. Making comparisons. Formulating research questions
Forming coherent arguments	Analysed, supported evidence, drew conclusions
Working collaboratively	Team work, engaged with peers. Offering ideas. Challenging with respect. Actively listening to others. Turn taking. Communication. Peer assessment
Scientific literacy	Understanding how things relate to real world context. Communicating in creative & clear ways.

In particular the assessment process for the **Teamwork** is composed of two parts: the first is the ***peer evaluation*** where every team member evaluate his peers; indeed the second is performed by the teacher.

"Why is the sand dark?"

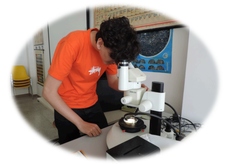




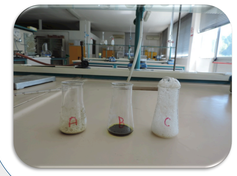
What students must know before

- ✓ Minerals' and rocks' classification
- ✓ Rock cycle
- ✓ Phisical and Chemical weathering

"Let's observe and describe our sand"



Considering particle size we classify as "**Fine sand**" (0,1-0,2mm diameter)



"How many carbonate clasts are there?"

Let's find out our sand has the 50% of carbonate grains*

"Do all sands look the same?"

Sands from different locations (Polinesia, Australia, Arabic desert and coast, Isle of Vulcano and Mykonos)

"Very coarse sand" (1-2mm diameter) from Mykonos (Greece)

"Why do the beaches change during the time?"

In this phase the students use their knowledges to understand a wider context like the different coastal geomorphology of our country or the implications of different flow rate have for river morphology. Moreover they can understand the inferences between these phenomena and the important issues due to coastal erosion.

Fluvial geomorphology

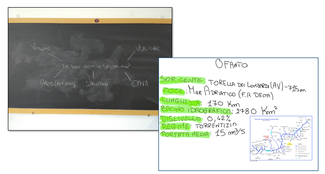
Erosion/ stream load/ deposition

Coastal geomorphology

Marine abrasion/transport/deposition

"Where does it come from?"

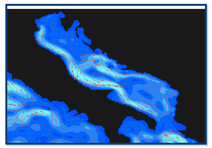
Mount Vulture: an extinct volcano



"How do the grains build up our beaches?"

"Are the grains old the same?"

The main features of Vulture volcano, Ofanto river, Adriatic marine currents and Apulian geological setting have been analized to explain the volcanic and carbonate grain composition of our sand.



Adriatic marine currents

Thematic maps

Ofanto River

***Determination of a acid insoluble residue in sands**

1)Transfer the weighted sample "A"=3,00g to a 100 ml glass beaker and add enough deionized water to cover the sample;
2)Slowly and carefully pour 5 ml of hydrochloric acid (a small amount at a time) over the sample. Stir or agitate sample and acid until all bubbling or effervescence has ceased. Continue to add acid until no reaction is noted. Then add an additional 1ml of acid to be sure that all carbonate is dissolved.;
3)Place it in an oven to remove water;
4)Add deionized water to dissolve the white precipitations of calcium salt;
5)Filter through the filter paper to remove soluble calcium salt;
6)The remaining mass is the mass of volcanic grains.

Websites
(1)http://ec.europa.eu/research/science-society/document_library/pdf_06/report-rocard-onscience-education_en.pdf
(2) https://bscs.org/bscs-5e-instructional-model

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