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Section 4: *Books and companion: critical reviews and suggestions for integrating teaching resources*
Secção 4: *Livros e companhia: recensões críticas e sugestões de integração de recursos didáticos*

SUGGESTION FOR USING THE TEACHING RESOURCE "FROM CLAY BALLS TO THE STRUCTURE OF THE EARTH"

SUGESTÃO PARA UTILIZAÇÃO DO RECURSO EDUCATIVO "DE BOLAS DE PLASTICINA À ESTRUTURA DA TERRA"

SUGERENCIAS PARA UTILIZAR EL RECURSO DIDÁCTICO "DE LAS BOLAS DE ARCILLA A LA ESTRUCTURA DE LA TIERRA"

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1. CONTEXTUALIZATION OF THE EDUCATIONAL RESOURCE

This resource is taken from the Earthlearningidea website (https://www.earthlearningidea.com), an open-access repository of geosciences teaching resources, originally developed by the Earth Science Education Unit (ESEU) at Keele University - UK, for teachers' professional development (King & Thomas 2012), and – since 2008 – published on-line ad freely accessible for all.

Figure 1 Plasticine™ balls, images: Giulia Realdon, CC BY-NC; phys.org/news/2015-earth-layers-html, educational use permitted; https://www.earthlearningidea.com/PDF/74_Clay_balls.pdf

This activity, suitable for 14–18-year students working in small groups, requires a limited time (about ½ hour) and a very simple and cheap equipment. The addressed topic is included in any geoscience secondary school curriculum and can be used at an introductory level. The same activity has been presented to science teachers during professional development workshops.

The proposed pedagogical approach, called CASE (Cognitive Acceleration though Science Education) is constructivist (Adey at al. 2003). It provides experiences that challenge students' preconceptions raising a cognitive conflict leading to knowledge reconstruction, accompanied by metacognitive reflection, and followed by "bridging", namely applying this new understanding to new contexts and the real world.

As other *Earthlearningideas*, this resource, available in different languages, includes the materials for a practical lab with instructions and pedagogical guidance for its use in the classroom. Additional related resources are a teaching video presented by the author and a file with the video question script.

2. DESCRIPTION OF THE EDUCATIONAL EXPERIENCE OF APPLYING THE RESOURCE

The activity "*From clay balls to the structure of the Earth*" starts with an inquiry about two similar Plasticine™ balls given to students, asking if they can perceive differences between them with their senses. In facts, apart the similar appearance, one of the balls has a metal bearing inside that makes it distinctly heavier.

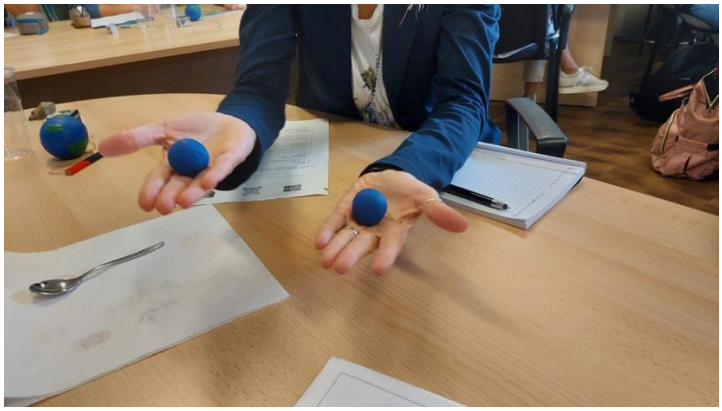

Figure 2 Sensing the difference, image: Giulia Realdon, CC BY-NC

Students, then, are asked to raise hypotheses to explain the different weight of the balls and plan experiments to test these - without destroying the balls – also with the use of technologies. They usually propose to stick a pointy object into the balls, to roll or spin them, to weigh with a scale, to use a magnet (all feasible options in the classroom) or to use echography or X-rays.

When all these proposals are discussed and the feasible ones tested by the students, they are invited to think how the same methodological and technological approaches can be used to explore the interior of the Earth, discussing the feasibility of every option (drilling, measuring mass and rotational inertia, magnetic field, using electromagnetic radiations or mechanical waves

(in this case they are seismic low-frequency waves instead of ultrasound), to bridge their lab findings with the geophysical data.

3. EVALUATION AND SUGGESTIONS

The evaluation of the activity has been performed in different ways defending on the target audiences.

Students have been informally assessed by means of direct observation during the performance of the activity and of *ad hoc* questions (request for "thought aloud") during the metacognitive reflection after the activity. Specifically, students were invited to verbalize their reasoning about the proposed hypotheses and the testing: this offered them an opportunity for strengthening their learning and gave the teachers an insight useful for assessment. Students usually felt engaged by the inquiry approach, keeping a satisfactory attention level, and evidenced good participation both in the practical and in the discussion phases.

Teachers have been assessed by means of a questionnaire. Teachers too evidenced interest, particularly for the hands-on approach and for the ease of performing the activity and expressed their willingness to propose it to their students (Realdon et al. 2020).

In my opinion, the pedagogical constructivist approach and the proposed methodology are inspiring and effective, and I would advocate a wider dissemination of the hands-on approach to science teaching with the use of models and simulations to overcome the traditional transmissive approach.

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