How to teach Nature of Science and change the student’s views about scientists in Science Camps?

Mg © Natália Cândido Vendrasco
David Santibañez Gómez
Joyce Andrea Maturana Ross
Nature of Science (NOS)

Features of scientific knowledge

Tentative
Empirical
Theory-Laden
Imagination and Creativity
Culture and Society
Observation and Inference
Theories and Laws

Lederman (2007)

Abd-El-Khalick et al. (1998)
Lederman et al. (2013)
Now, most researchers agree that explicit and reflective approach is more effective to improve understanding of NOS (Abd-El-Khalick y Lederman, 2000; Cofré et al., 2014; Khishfe y Abd-El-Khalick, 2002; Lederman, 2007; McDonald, 2010)
This stereotypical view are connected to the way that students learn and relate to science, decreasing their motivation to learn.

(Chambers, 1983; Finson, 2002; Narayan et al., 2013)
Non-Formal education as a strategy for scientific literacy, teaching NOS and promoting changes in student’s views about scientists (Feder, Shouse, Lewenstein, y Bell, 2009; Schweingruber y Fenichel, 2010; Shouse, Lewenstein, Feder, y Bell, 2010; Stocklmayer, Rennie, y Gilbert, 2010)
Non-Formal Science Education

Science Camps

- Discussions about science
- Contact with scientists
- Experiments
- Field research

Fields, 2009
Science Camps

- NOS
- Views about Scientists
- Inquiry
- Scientific Literacy

Foster & Shiel-Rolle, 2011; Leblebicioglu et al., 2011a; Leblebicioğlu et al., 2011b; Metin & Leblebicioglu, 2012
Activity 1 – Mystery Bones
Lederman, N.G.

What?
Explicit Instruction
Nonintegrated
Which aspects of NOS can we learn and teach?

How?
Groups 3 - 4
15 bones
Put the dinosaur bones together
Activity 1 – Mystery Bones
Lederman, N.G.
Activity 1 – Mystery Bones

Possible questions to ask students:

1. The skeletons armed by all groups were equal? Why do you think that happened?

2. Do you think scientists also go through similar situations? If you think yes, how do you think they solve it?

3. Why do you put together your skeleton like this? Did you use any prior knowledge?

4. You had to use your creativity and imagination to build this skeleton. Do you think that scientists also have to use their creativity? If you think yes, in what kind of activity?
The reconstructed skeleton of *Scaphognathus crassirostris*
In the last 20 years, the representation of the external morphology of this species has changed according to new findings (feathers!) and new interpretations of paleontologists.
Activity 1 – Mystery Bones

Discussion and Reflection

1. What aspects of Nature of Science can we learn and teach with this activity?

2. Do you think this activity will work the same way in a classroom and in a Science Camp? Which may be the advantages and disadvantages of both environments to this kind of activity?

3. In your experience what would be the difficulties in the development of this activity?

4. How can we improve this activity in a Science Camp?
**Activity 2 – Scientific Inquiry (Field Research)**

**What?**

1. **Explicit Instruction**
2. **Integrated**
3. **Which aspects of NOS can we learn and teach?**

**How?**

1. **Groups 3 - 4**
2. **Student’s research design**
3. **Review, discuss and find opportunities to teach NOS**
Activity 2 – Field Research
Discussion and Reflection

1. After reading your student’s research design, did you see any opportunity to teach NOS and change the student’s views about scientists? Where (design, methodology, discussions, field research, etc)?

2. What aspects of NOS can we teach using the student’s research? What stereotypical character of scientists can we possible change with a field research?

3. Propose an activity to teach NOS and change student’s views of scientists using a field research in your science camp.

4. How would you evaluate if your students improve their comprehension about NOS and changed they views about scientists with this activity?

5. Present your proposal of activity and evaluation

6. Feedback
Activity 2 – Field Research

Abstract:

This study reports the effect of altitudinal gradient and the type of vegetation in the distribution and abundance of arthropods conducted in two sectors of the Elqui Valley at different heights (El Arrayan 280 m and Horcón 1548 m) were selected in each sector two types of vegetation: without human intervention (dry) and with human intervention (agro). Sampling was performed by pitfalls trap, manuals and entomological collections networks. The result was a greater richness and abundance of arthropods at lower elevations. Regarding the type of vegetation, dry (without human intervention) presented a higher abundance and richness than agro ecosystems, the last result is attributed to the use of pesticides to control pests that affect agricultural production.
Activity 2 – Field Research

Effect of altitudinal gradient and the type of vegetation in the distribution and abundance of arthropods

Empirical
Theory-Laden
Observation and Inference
Activity 2 – Field Research

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Activity 2 – Field Research

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Empirical

Theory-Laden

Tentative
Activity 2 – Field Research

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### Instruments to measure learning

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<tr>
<th>Nature of Science (NOS)</th>
<th>Views about scientists</th>
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<td>Pre and post test “Views of Nature of Science Form D” (VNOS–D)</td>
<td>• Pre and post test “Draw a Scientist Test” (DAST)</td>
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<td>• Interview</td>
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Los científicos producen conocimiento científico. ¿Usted cree que este conocimiento puede cambiar en el futuro? Explique su respuesta y de un ejemplo.

“creo que sí porque cada vez más los científicos analizan nuevas cosas o formas de vidas siempre están encontrando nuevos conocimientos y van apareciendo cosas nuevas”
Thank you!

nataliacandidov@gmail.com