PARSEL teaching –learning materials compiled by the consortium
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How do scientists work? (Teachers)

Subject

Reflection on scientist's activity, based on fictional scientific stories about socio-scientific issues, written by the students.

Objectives

This task's main goal is to facilitate the construction of knowledge related to the nature of scientific knowledge. Students are expected to develop a conception of science as an enterprise, which plays deep and complex relations with technology and society, and which aims at explaining natural phenomena that uses multiple methods. Such a conception opposes the idea of a single, universal, algorithmic scientific method. Besides, students are expected to face scientific ideas as transitory, subjective, which result from human creativity and, as such, are influenced by the socio-cultural context. Also students are expected to face scientific ideas as based on the observation of the natural world, experimental evidence, rational arguments and scepticism.

Competences

Construction of knowledge regarding the nature of science
Development of argumentation and communication competencies
Development of collaboration competences
Development of attitudes and values such as responsibility and respect

Rational

Science education involves the construction of knowledge about main scientific themes and some of its contents, its agents, its methods, its uses as well as its misuses. As such, for developing science literacy

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one has to develop teaching strategies where students can discuss critically contemporary science and its different processual, political, economical, social, environmental and ethical issues.

Discussion is considered a main issue within this task, as by compelling students to contact with others students' interpretations and life experiences, discussion can expand individual understanding. Indeed, through interaction students have the opportunity to learn with each other, to become aware of different possibilities, to interiorize theory, to criticize ideas and to become aware of ones' conceptions.

Task description

With this task, students are supposed to write their own fictional scientific stories about the work of a group of scientist over a controversial issue related to a real life situation (e.g. cloning, genetic engineering, pollution, nuclear power plants, research with stem cells), and then to discuss it.

Written fictional scientific stories are a particular interesting source of information, as they can furnish important clues about students' conceptions concerning scientific enterprise and scientists' activity and characteristics[1]. Classroom discussion about such details and clues allows for the identification of students' conceptions concerning scientists' characteristics (cognitive, socio-affective, moral and ethical), concerning scientific activity (goals, places where it develops, methodologies and research tools, relationships among scientists) and concerning the relationship between science, technology and society (the social impact of science and technology; research control made by the society; relationship between science and technology; fear of eventual undesirable secondary effects which result from scientific and technological innovation; others issues). Classroom discussion about each written fictional scientific story may constitute an efficient catalyser for changing wrong or stereotyped ideas about scientific enterprise and for learning about scientific processes and epistemology.

Procedure

Phase 1. Homework

For homework students are supposed to write fictional scientific stories. For that, each student has to imagine a group of scientist who is working over a controversial issue related to a real life situation.

Phase 2: Story plot analysis by the teacher

Teacher has to analyse each student story's plot, in order to plan classroom discussion.

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[1] Reis, P. & Galvão, C. (in press). Reflecting on scientists' activity based on science fiction stories written by secondary students. *International Journal of Science Education*.

Reis, P. (2005). Research in brief: Using science fiction stories to assess students' ideas about the nature of science. *The Science Education Review*, *4*(2), 57-58. Available at http://www.scienceeducationreview.com/

Reis, P. & Galvão, C. (2004). Socio-scientific controversies and students' conceptions about scientists. *International Journal of Science Education*, *26*(13), 1621-1633.

Stories' plots are a combination of different elements, namely: a) students' ideas and feelings about science; b) students' values; c) students' images constructed from media, movies and fictional science books; d) social representations of scientist and scientific activity and e) a collection of elements that students consider as making up a good fictional science story. As a result, stories' plot doesn't represent a portrait of students' conceptions about scientific enterprise and scientists characteristics; it only gives some clues that should be clarified, deepen and discussed inside the classroom. In his/her analyses, the teacher should pay particular attention to the following points:

- Scientists' characteristics (cognitive, socio-affective, moral and ethical);
- Scientific activity (goals, places where it develops, methodologies and research tools, relationships among scientists);
- Science, technology and society interaction (the social impact of science and technology; research control made by the society; relationship between science and technology; fear of eventual undesirable secondary effects which result from scientific and technological innovation; others issues).

Based of his/her analyses, teacher should select some stories with an interesting and diversified picture for subsequent classroom discussion and analyses.

Phase 3: Group discussion about the selected stories

Each group of four to five students will analyse and discuss one selected story, concerning the following issues:

- Scientists' characteristics (cognitive, socio-affective, moral and ethical);
- Scientific activity (goals, places where it develops, methodologies and research tools, relationships among scientists);
- Science, technology and society interaction (the social impact of science and technology; research control made by the society; relationship between science and technology; fear of eventual undesirable secondary effects which result from scientific and technological innovation; others issues).

Each group should identify and justify which issues it considers more interesting, to which it agrees with and to which it disagrees with.

Phase 4: Classroom story reading and classroom discussion

Each group has to read its story to the class, to present the issues that it considers more interesting and those with which the group agrees or disagrees. At the end of each presentation, teacher should stimulate and manage a small discussion (open to all the class) about the presented issues.

Phase 5: Joint written composition of a synthesis text (for students aged 8 to 15 years old)

After discussion, all the class should participate in the composition (on the blackboard) of a text, which answers the following questions:

- What are the relationships between science and society? Is scientific activity influenced by the society? Is society influenced by science?
- What are scientists' characteristics? What are their motivations?
- How is scientists' work organized? What does it involve? Where does it develop? What are the methodologies used?
- What is a theory? Is it possible to prove a theory?

Population

10th -12th grades

Curriculum context

Integrated Sciences and Science for Public Understanding

Kind of activity

Written activity + discussion activity

Anticipated time

1 hour at home + 3 lessons at school (40 to 50 minutes each)

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