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SSIBL: A theory-informed instructional framework for enhancing students' understanding and action on socio-scientific issues through an inquiry approach

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Abstract

This project aims at science teachers' professional development (TPD). The TPD is based on four pillars, described in the Socio-Scientific Inquiry Based Learning (SSIBL) framework (Levinson & The PARRISE consortium, in progress). It focuses on pre- and in-service science teachers at the elementary and secondary school levels, and is implemented in 11 European countries. The SSIBL pedagogy integrates four important pillars for promoting young students' scientific literacy: responsible research and innovation, citizenship education, socio-scientific issues and inquiry-based science education. The SSIBL approach is a novel approach to scientific literacy; at this roundtable we invite conference delegates to explore the feasibility of the SSIBL pedagogy from their point of view and identify pedagogical, epistemological or pragmatic challenges relating to the implementation of SSIBL curricula in science classrooms across Europe.

WHAT IS SSIBL

The four pillars which comprise the SSIBL framework, and which guide the PARRISE approach to learning and teaching of science are as follows:

Responsible Research and Innovation (RRI)

Developments in science and technology can facilitate human progress. Any such progress should take into account societal needs and priorities, be ethical, democratic, and responsible.

Citizenship Education (CE)

Democratic deliberation is a crucial characteristic of SSIBL. Students are called to critically engage in dialogic scientific reasoning, respecting and trying to understand each other's view point. Through this pillar students are expected to inquire about individual and collective rights and responsibilities that accompany decision making around a socio-scientific issue.

Socio-scientific issues (SSI)

As part of the SSIBL approach students engage with controversial socio-scientific issues, with no clear answers. Resolving these issues will require taking into account conflicting view points, prioritizing values and critically examining evidence. Such an approach will provide opportunities for rich discussions that will illustrate the complexity of modern decision-making in socio-scientific debates.

Inquiry-Based Science Education (IBSE)

Inquiry teaching and learning is the pedagogy adapted in SSIBL. IBSE actively involves students in pursuing authentic problem-solving, which involves them in core scientific practices such as developing and testing hypotheses, collecting and interpreting data and building evidence-based explanations.

A representation of the main aspects of the Socio-Scientific Inquiry Based Learning Framework (SSIBL)

TEACHERS' PROFESSIONAL DEVELOPMENT

The teaching of science in schools has traditionally and intentionally separated science content from societal values and ethical dilemmas, with the focus being on the former. SSIBL seeks to re-integrate the social and personal into the scientific, and as a result, approaches the teaching and learning of science much more broadly and encompassing.

Examples of SSIBL CPD activities

PARRISE plans extended professional development programmes in the 11 participating countries. These TPDs can take a variety of forms. A sequence of key activities for a SSIBL TPD could be based on the idea of teachers' guided participation, scaffolding, and legitimate peripheral participation. According to one version of this approach, teachers are first introduced to the four pillars, discuss examples of SSIBL scenaria, contrast these scenaria with non-SSIBL ones, and gradually begin to develop their own scenaria and activities or adapt existing ones. The final step would be for teachers to enact and engage in action research, in order to reflect and revise their approach. We anticipate that teachers will need guidance to move through their own ZPD; this will be provided by their TPD mentors but also through reflection on their own practice.

SCENARIO

You are a member of a scientific board which needs to decide whether your government should allow the growing of genetically modified organisms (GMOs).

There are strong opinions both for and against GMOs. Review scientific data on genetically modified (GM) crops and their effect on three areas: the environment, economy and health.

In your group, examine your data in order to reach an evidence-based answer to the following question: "*Would you allow the growing of GM plants in your country? Why or why not?*"

Finally, your group will participate in a class debate on this topic with your classmates. To prepare for this debate you will need to review your evidence and reach a group decision based on how you prioritize the issues (environment, economy, health).

Teacher notes

Examining the data in each of the three areas (environment, economy, health) will provide different answers for different GM plants and different results for each of the 3 areas. As such, this topic cannot be fully resolved.

How should the decision be reached? In debating this issue, students will need to consider the following issues:

- What are our local priorities as to what is most important?
- What do we value most? (The environment, health, or the economy?)
- What is the best decision for whom and why?

As an extension, students can consider if the decision they have reached is also fair in other contexts: e.g. scientists using GM crops to prevent diseases or famine.

Through group collaboration and whole class discussions students are expected to appreciate the connections between values, understanding of science and of scientific evidence, and public deliberation.

CRITERIA FOR A GOOD SSIBL SCENARIO

SSIBL scenaria revolve around problems that can be solved through research.

The following criteria guide the selection of appropriate scenaria. The problem should:

⇒ Have a genuinely open solution;

⇒ Draw on different funds of knowledge;

⇒ Connect to relevant science knowledge in the curriculum;

⇒ Foster democratic deliberation of different perspectives;

⇒ Allow the liaising with different agencies either within or outside the school setting, i.e. active networks of exchange;

⇒ Should culminate with students taking action based on research.

TAKING ACTION!

SSIBL scenaria culminate with students taking action on things that matter!

Authenticity

Students' engagement with authentic, open-ended inquiry is a gradual process which needs to be scaffolded over time. Depending on where students are, students may initiate inquiries into researchable phenomena or can be guided to do so by the teacher.

Length of lessons

Lessons can be shorter or longer; SSIBL discussions can occur at any stage of teaching and learning, and their length, extend and authenticity will depend on the background of the students, the teacher, and local contexts.

Responsibility

Action is crucial to the approach and should not be omitted. It can take many different and innovative formats (i.e. posters, YouTube videos, presentations, story-telling, etc.). Action-oriented problem solving can help students appreciate the full spectrum of responsible research and innovation.

TEACHERS' PROFESSIONAL DEVELOPMENT

The Teachers' Professional Development Programme includes a variety of activities ranging from presentations, and discussions to curriculum design work relating to:

- The four pillars of SSIBL
- Mapping controversies and setting instructional objectives
- How to develop or adapt appropriate authentic scenaria
- Designing matching activity sequences
- Use of digital media and multimedia to promote engagement and enhance understanding
- Assessment of SSIBL
- Strategies on supporting student dialogue and informed deliberation in open-ended inquiry
- Challenges in implementing SSIBL (local & global)
- Supporting students' understanding of the nature of science in SSIBL investigations
- How to support student action and communication of culminating decisions

Teachers are expected to build confidence over time at which time they can consider enacting a SSIBL informed unit they designed.

In Cyprus, teachers will be asked to enact and bring back videos of their classroom practice for reflective conversations with the group.

THIS ROUNDTABLE DISCUSSION

During this roundtable we would like to receive feedback on the SSIBL framework and TPD approach from teachers and researchers.

Teachers

What are the pedagogical challenges in integrating distinct epistemic domains, e.g. social and political questions with scientific aspects?

What are the epistemological and ontological difficulties in moving from experience of IBSE to SSIBL?

Researchers

How might (a) SSIBL; (b) teacher development for SSIBL, be assessed?

What criteria and competences are appropriate?

What challenges do you see in implementing SSIBL in your classroom?

How might we assess SSIBL and our professional development programme?

ABOUT PARRISE

PARRISE is a four-year programme (2014-2018) funded by the European Commission's FP7 scheme, under grant agreement 612438.

PARRISE aims at introducing the concept of Responsible Research and Innovation in formal and informal science learning settings.

The consortium reflects a multidisciplinary team who will facilitate networking activities among teachers, teacher educators and educational researchers of 18 institutions in 11 countries.

PARRISE is coordinated by the Freudenthal Institute for Science and Mathematics Education (FIsme) at Utrecht University in the Netherlands.

For more information on the PARRISE project visit www.parrise.eu

PARRISE

Promoting Attainment of Responsible Research & Innovation in Science Education