Translated outline & lesson plans

Pre-service biology and chemistry teachers in lower secondary school (15-18 year olds)

These materials are based on the work within the project Promoting Attainment of Responsible Research & Innovation in Science Education (PARRISE).
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Course outline and lesson plans
SSIBL teacher professional development (TPD) sessions

Utrecht University, Freudenthal Institute, The Netherlands

Pre-service biology and chemistry teachers in lower secondary school (15-18 year olds)

Overview course outline

Duration	Two 1.5 hour sessions, with a ±1 hour independent assignment, in the context of the regular 20 weeks pre-service teacher course (one semester).
Short summary	This teacher professional development (TPD) programme adopts an inductive approach in which teachers get acquainted with the SSIBL pedagogy through several experiential activities. First, teachers explore SSIs, after which they collaborate in designing and reflecting on SSIBL learning and teaching activities. This pre-service teacher programme has been implemented with different groups of biology, chemistry and mixed science student teachers. The programme is designed to develop student teachers' understanding of, and skills and competence in, teaching and learning through socio-scientific inquiry-based learning (SSIBL). The goal is to support teachers in designing SSIBL lessons and to contribute to their teaching repertoire, by providing them with the means to foster scientific literacy and reflective citizenship in science education.
Intended learning objectives of the TPD	The student (pre-service teachers) can : - State characteristics and examples of SSIs, in which knowledge of school subjects (biology, chemistry, computer sciences, mathematics or physics) is involved and develop arguments about why SSIs should be integrated in science or mathematics education - Map a controversy / SSI (including different stakeholders' viewpoints and values that are at stake) - Identify learning and teaching activities to introduce and discuss SSIs in classroom settings - Link inquiry-based learning to students' questions (SSIs) - Link SSIBL to the science curriculum (e.g. new science modules, Concept-Context approach) - Develop a SSIBL lesson (or school work plan) for science classrooms drawing both on existing and novel SSIs, and inquiry contexts - Reflect on PSTs' SSIBL lesson designs and be able to identify strong and weak elements

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	• Recognise and be able to name different learning and teaching activities that can be used in classroom practice in the context of SSIBL, as well as their pros and cons • Recognise opportunities for teaching school students about aspects of citizenship in SSIBL

Session no.	Duration	Main Activity /objective	Approach: Inductive
1	1.5 h	• Get acquainted with characteristics of SSIs • Learn how to raise meaningful student questions, a 'need to know' • Scaffolding student's inquiry	Teachers as learners
Homework assignment	±1 h	• Recognise suitable SSIs in the media which can be used in science and mathematics teaching • Design SSIBL lesson plans linked to the science curriculum	Teachers as developers
2	1.5 h	• Present SSIBL lesson plans and discuss • Reflect upon different learning and teaching activities that can be implemented in classrooms in the context of SSIBL, as well as the required teacher skills	Teachers as learners Teachers as developers

Lesson plans

Session 1 (1.5 hours)
Introduction to SSIBL and take home assignment

Learning goals
The student can:
- state the **characteristics** of SSIs (from experience with a number of cases)
- select examples of SSIs in which **knowledge from their own school subjects** plays a role
- make **arguments** for integrating SSIs in mathematics / computer science and science education
- indicate **learning and teaching activities** that enable an SSI to be discussed in the classroom
- state how **inquiry-based learning** can be linked to SSIs.

Enacting an SSI activity: Controversy line [15']
The TPD starts with enacting an SSI activity by introducing a dilemma and asking the student teachers to 'take a position on the line' in the classroom.

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- Statement: 'Everyone in The Netherlands should automatically be registered as an organ donor at birth'. Agree/disagree?
- Students think for a minute about the statement and choose their position on the line (from 'agree' to 'disagree').
- Discuss with neighbours on the line: give arguments for where you are, ask questions of the others; one person per group states these in 1 minute (there is no debate! It is not about winning, but about listening to each other and understanding different points of view).

Option for longer activity
This activity can be replaced by or enhanced with 'Arguments in motion' ('beweegredeneren', Van der Zande, 2011; Van der Zande, 2012; see explanation below, and UU_Handouts).

Other options for the introduction are:
- Refreshing a prior session on IBL (after the blue screen on slide 4 in **Presentations_UU**; slides are based on papers by Kirschner (2006) and a reaction to this paper by Hmelo et al. (2007).
- Connecting to curriculum innovation in The Netherlands (concept-context approach, introducing SSIs as a context)
- Connecting SSIBL to existing curriculum aims.

What and why? [25']

After the introduction, pre-service teachers (PSTs) are **introduced to multiple SSI-cases**, such as genetic testing, nanotechnology, waste plastics, climate change etc. Provide several recent news articles to stimulate thinking. They discuss these controversies in a 'carousel assignment' (worksheet available in **Handouts_UU** 'Resources'' section, example SSIs can be found in the 'SSI cases' document in the Resources, in Dutch), based on questions like:
- What is the case about, what is the controversy?
- Which stakeholders are involved, which societal values are associated with this?
- What content knowledge is relevant?
- Which questions does the issue raise that your students could investigate?

First, pairs of PSTs study all (or most of the) SSI cases. After studying the cases, PSTs sit together in groups of four, consisting of two pairs, and reflect on the cases using the following questions:
- Compare the cases you have studied / discussed on characteristics of SSI and IBL.
- What is similar to the way you filled in the worksheet?
- What are the differences?

Different version of the carousel activity:
You may opt for pre-service teachers bringing their own SSIs to the session. You could give them the assignment to bring a news article related to their subject (from a paper or from online sources) to the session. They can use these articles for the carousel activity.

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What and why? [20']

Based on PSTs' findings during the carousel activity, **reflect upon the SSI cases** in a plenary discussion from a SSIBL perspective (SSI, IBL, CE).

- Identify and discuss characteristics of these controversies and how to address them in classroom settings
- Develop arguments about whether and why SSIs should be included in the science curriculum.

Box 1 lists some answers provided by the UU pre-service teachers to give you an idea of what to expect from these activities.

Box 1 – UU outcomes of the carousel activity

During reflection on SSI articles in the UU TPD sessions, these characteristics were often mentioned by PSTs:
- Dilemma, controversial issue, societal issue
- Linked to science, developments in science
- Usually interdisciplinary in nature
- No simple or clear-cut answer or solution
- Involves making a choice/decision
- Both scientific content knowledge & emotions play a role (different kinds of knowledge)

PSTs often mentioned that incorporating SSIs in science education is important because it:
- Promotes scientific literacy
- Includes citizenship education
- Asks for scientific and moral reasoning concerning authentic problems (societal issues)
- Is present in national curriculum aims of The Netherlands
- Connects their science subject to students' daily life

How? [15']

Examples of ways to inquire are discussed, centred round opinion-forming and argumentation:

- e.g. mapping controversies, scaffolding inquiry, data sources & reliability, social inquiry, experiments.
- Dialogue and decision making: a dialogue tool for teachers is discussed with pre-service teachers and examples like '*beweegredeneren*' (''Arguments in motion'', van der Zande, 2011) are shown and/or practiced (see also **_Handouts_UU_**).
  During 'Arguments in motion', participants (teachers, students, etc) think about a statement, their own opinions and whether these opinions were formed based on their feelings (heart) or thoughts (brain). First, introduce a statement (for example: 'Everyone should automatically be registered as organ donor at birth'). Participants place themselves on a line in the room, showing whether they are 'for' or 'against' this statement.
  Subsequently, the teacher (educator) introduces the 'heart-brain-axis' by placing the heart and brain pictures with captions 'for' and 'against' in the four corners of the classroom. Participants now have to position themselves according to how they reached their opinions, using mostly feelings/emotions (the 'heart') or rational thinking (the 'brain').

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The teacher (educator) is the mediator during the whole activity. They ask the participants questions, illustrating as many different sides and opinions as possible. If participants change their opinions about the statement, they are able to move to a new location in the classroom. Remind them that there are no 'winners' and answers are not 'right' or 'wrong'.

Homework [10']

Teachers receive a **take-home group or individual assignment to design a SSIBL lesson**:

Option 1   Teachers design a SSIBL lesson in small groups or individually, with the help of a worksheet (available in ***Handouts_UU*** in the ''Resources'' section).
The pre-service teachers (PSTs) do not have to trial this lesson in their classroom practice (since training schools do not (always) offer this freedom to PSTs) and the assignment is not graded. However, the PSTs have to present their work during the second session. This assignment helps the PSTs to integrate SSIBL in their future lessons.

Option 2   Research and describe three SSIs that can be linked to the curriculum of the classes and subjects you (the PSTs) currently teach. Provide a short description and upload your assignment on the TPDs' peer support forum/online platform. Carry out small-scale teaching trials during your following lessons. These can be discussed during the second TPD session. Related questions can be:
- What does this offer you?
- What did it ask of you as a teacher?
- What did you do differently?
- Which elements were difficult?

Session 2 (1.5 hours)
Presenting a SSIBL lesson
(Preferably a week or more after the first session)

The **teachers present their designed SSIBL lessons** to the other teachers and teacher educator, and receive feedback. Discuss the lessons and developmental process in a plenary. This session helps teachers to analyse different SSIBL scenarios and to reflect on their own skills. Product and process reflection is standard in all activities during the TPD course.

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