SSIBL SESSION 1
UPPER SECONDARY EDUCATION

Socio-scientific Inquiry-based learning
Development of values in chemistry/biology education

Marie-Christine Knippels & Michiel van Harskamp
The student (pre-service teachers) can:

• Name characteristics and examples of SSIs, in which knowledge of the school subject (chemistry or biology) is involved and develop arguments about why SSIs should be integrated in biology/chemistry education
• Map a controversy/SSI (including different stakeholders’ viewpoints and values)
• Identify learning and teaching activities to introduce and discuss SSIs in classroom settings
• Link inquiry-based learning to student questions about SSIs
• Link SSIBL to the science curriculum (e.g. new science modules, Concept-Context approach)
• Develop a SSIBL-based lesson for science classrooms
• Develop a school work plan in relation to examination requirements, based on SSIBL elements
Do you agree or disagree?

‘We should intervene when animals in the ‘Oostvaardersplassen’ nature reserve are threatened by starvation’

Agree ———— Disagree

Too many grazers in Oostvaardersplassen

The suffering of grazers in the Oostvaardersplassen nature reserve is not acceptable. It is recommended that the heck cattle should be completely removed from the area.

Additionally, a well-executed culling policy can prevent the unnecessary suffering of animals.

This was stated by the KNMvD, the veterinary association of professionals, on Monday. The veterinarians advocate another policy for the so-called big grazers in the Oostvaardersplassen. The area includes hay cattle, conic horses and red deer. In winter, animals often die because there is not enough food for the total population.

According to veterinarians, the meat of shot animals may find its way to the consumer or be used as feed in zoos. In addition to culling, other measures are conceivable, such as relocation to other nature areas.
Short feedback moment on student teachers’ experiences of the learning and teaching activity
EDUCATIONAL PHASES THAT CAN BE DISTINGUISHED IN A LESSON (MODULE)*

1. **Introduction** of dilemma (student’s daily life, interest)
2. Formulate **initial opinions** individually (or in small groups)
3. Raise questions: ‘**Need to know**’
   - Scientific / content-related questions
   - Social
   - Personal
   ➔ Inquiry questions
4. **Dialogue** ➔ value clarification & communication
5. **Decision making** ➔ action (formulate solutions which help to enact change)
6. **Reflection** (e.g. Changes in opinion? Why? Reflection on process)

ASSIGNMENT 1
SSI CAROUSEL (OR DISCUSS YOUR OWN SSI EXAMPLE)

Write down on the worksheet [see Handouts_UU]:

• What is the case about, what is the controversy?
• Which stakeholders are involved, which societal values are associated with this?
• What could you do with it in your lesson?
• What content knowledge is relevant?
• What questions does the issue raise that your students could investigate?

Discuss at least two SSI examples
E.g.:

- Features of an SSI
- What types of argument play a role in opinion-forming?
- What types of questions do they raise, what is the 'need to know'?
What kind of questions can students research about in the IBL phase:

**Subject matter, e.g.**:
- Is this possible?
- How does this solution work?

**Social questions, e.g.**:
- What do you do?
- What is the law?
- What is the current practice?
- What does it cost?
- Who benefits and how are the risks divided?

**NoS questions, e.g.**:
- What do scientists disagree on and what causes that?
- What does this result mean?
- What are the causes of uncertainty in the predictions?

**Ethical questions, e.g.**:
- May we decide for another?
- Do animals have rights?
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   - Social
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   → Inquiry questions
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(Knippels, M.C., & de Bakker, E. (2016), Didactief, 12-13).
Zooming in on phase 3

a. Planning and consultation
   • What information do you need, how do you determine if it is reliable?
   • Which theory is relevant, what are possible variables?
   • Which method do you choose, prepare research protocol, interview schedule etc.

b. What is a possible hypothesis?

c. Data Collection and Interpretation
   Formulating conclusions, answers and solutions

Phase 4 Decision making
Phase 5 Possible actions?
Phase 6 Reflection
Answering students’ questions

**Analyse the controversy (dilemma)**

- Which stakeholders are involved, what are their interests?
- Different points of view?
- Type of argument?
- Research into sources:
  - Scientific sources
  - Societal sources
### Examples of Activities for Social Inquiry

#### Ethical matrix (Mepham, 2000 and 2006)

<table>
<thead>
<tr>
<th>Stakeholders</th>
<th>Wellbeing</th>
<th>Autonomy</th>
<th>Fairness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wildlife</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>State forestry service</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hikers</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Forest rangers</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>...........</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>


1. In the centre, write down the dilemma
2. Name stakeholders and interests
3. List views
4. Identify arguments
5. Identify values

Controversy mapping
1. **Introduction** of dilemma (student’s daily life, interest)
2. Formulate **initial opinions** individually (or in small groups)
3. Raise questions: ‘**Need to know**’
   • Scientific / content-related questions
   • Social
   • Personal
   → Inquiry questions
4. **Dialogue** → value clarification & communication
5. **Decision making** → action (formulate solutions which help to enact change)
6. **Reflection** (e.g. Changes in opinion? Why? Reflection on process)

(Knippels, M.C., & de Bakker, E. (2016), Didactief, 12-13).
Let students determine their opinions individually first (or in small groups) before initiating a classroom dialogue.

Different learning and teaching methods

- Debate
- For and against

More attention on value clarification & communication:

- Socratic dialogue
- Arguments in motion (see next slide)
- ...

Teacher tool for dialogue is available online: http://www.fi.uu.nl/toepassingen/28422/

(For an English version see Handouts_UU in Resources)
ARGUMENTS IN MOTION (P. van der Zande, 2011; 2012)

A possible lay out of the classroom during ‘arguments in motion’.

http://www.ecent.nl/artikel/2599/Beweegredeneren/view.do
Dialogue

• Differs from discussion: there is no ‘winner’
• Teacher takes a specific role

See teacher tool on next slide
## Teacher roles in classroom dialogue

++ is very suitable, + is suitable and – is unsuitable

<table>
<thead>
<tr>
<th>Teacher roles</th>
<th>Role description</th>
<th>Development of values through:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Transmission</td>
</tr>
<tr>
<td>Participant</td>
<td>You are free to express ideas, opinions and emotions, like the pupils. This can be confusing for pupils, since teachers are the professionals.</td>
<td>+</td>
</tr>
<tr>
<td>Dedicated teacher</td>
<td>You disseminate your own opinion about the topic. This can lead to indoctrination.</td>
<td>++</td>
</tr>
<tr>
<td>Observer</td>
<td>You do not interfere in the dialogue.</td>
<td>-</td>
</tr>
<tr>
<td>Instructor</td>
<td>You clarify relevant information, concepts and ideas. You ask questions to assess the level of understanding. And you give positive or negative feedback to input from pupils.</td>
<td>-</td>
</tr>
<tr>
<td>Devil’s advocate</td>
<td>You propose contradictory points of view to stimulate the dialogue.</td>
<td>-</td>
</tr>
<tr>
<td>Advocate</td>
<td>You present all possible points of view and conclude with your own opinion, supported by arguments.</td>
<td>+</td>
</tr>
<tr>
<td>Neutral chair/Neutral facilitator</td>
<td>You encourage pupils to contribute to the dialogue and keep an eye on the rules of the dialogue, but do not give your own opinion or positive/negative feedback on the input of pupils.</td>
<td>-</td>
</tr>
<tr>
<td>Declared stakeholder</td>
<td>At the start of the dialogue you give your own point of view, so that pupils will be able to assess teacher bias later on.</td>
<td>-</td>
</tr>
</tbody>
</table>

See hand-out
Overbeek, M., Knippels, M.C., and Waarlo, A.J. (2014). *Teacher tool for holding a whole-class dialogue*. Freudenthal Institute, Utrecht University
VD1 (= students in the first semester of their teacher training programme)

**Individually:** Make a lesson plan using the principles of the meeting. Use a chemistry module as a source of inspiration. You can use Worksheet 2 as a tool (available in *Handouts_UU*). Submit to the online platform. Next meeting you will present your lesson plan.

VD2 (= students in the second semester of their teacher training programme)

**Duos:** Implement the following national examination requirements (see assignment in *Handouts_UU*) in a schoolwork plan that elaborates on the principles of SSIBL. Combine at least four of the examination requirements. In the school work plan, indicate when the examination requirement is discussed and what learning resources (textbook, modules, etc.) will be used. In addition, the school work plan describes the form of assessment. Submit to the online platform and present your assignment in the next session.
Subdomein A9: Waarderen en oordelen
9. De kandidaat kan in contexten een beargumenteerd oordeel geven over een situatie in de natuur of een technische toepassing, en daarin onderscheid maken tussen wetenschappelijke argumenten, normatieve maatschappelijke overwegingen en persoonlijke opvattingen.

Subdomein A13: Redeneren over systemen, verandering en energie
13. De kandidaat kan chemische processen beschrijven in termen van systemen met kennis van stoffen, deeltjes, reactiviteit en energie.

Subdomein A14: Redeneren in termen van duurzaamheid

Subdomein E3: Duurzaamheid
36. De kandidaat kan met behulp van kennis van chemische processen uitspraken over duurzaamheid waarderen en van commentaar voorzien.

Subdomein F3: Energieomzettingen
41. De kandidaat kan in de context van duurzaamheid beschrijven welke chemische en/of technologische processen worden gebruikt bij energieomzettingen en kan met behulp van kennis van energieproductie deze processen beschrijven, daarbij voorkomende condities aangeven en voorstellen voor aanpassing beoordelen.

Subdomein F5: Duurzame productieprocessen
43. De kandidaat kan met behulp van chemische kennis ten minste in de context van duurzaamheid een oordeel geven over het ontwerp van productieprocessen.

Subdomein G2: Milieu-effectrapportage
45. De kandidaat kan met behulp van kennis van productieprocessen ten minste in de context van gezondheid of duurzaamheid beschrijven welke maatschappelijke condities een rol spelen bij milieu-gerelateerde vraagstukken en voor deze vraagstukken beschrijven welke mogelijke gevolgen er zijn op het gebied van gezondheid en duurzaamheid.

Subdomein G3: Energie en industrie
46. De kandidaat kan met behulp van kennis van productieprocessen ten minste in de context van duurzaamheid energieomzettingen vanuit de verschillende bronnen beschrijven, vergelijkingen maken en een beargumenteerd oordeel geven.

Subdomein G4: Milieueisen
47. De kandidaat kan met behulp van kennis van grootschalige chemische processen beschrijven welke kwaliteiten van water, lucht, bodem en voedsel op welke wijze worden gewaarborgd en kan voorgestelde aanpassingen beoordelen.

Subdomein G5: Bedrijfscriteria
48. De kandidaat kan met behulp van chemische kennis ten minste in de context van duurzaamheid een voorbeeld uit de Nederlandse chemische industrie analyseren en aangeven wat de bijdrage is van het bedrijfscriteria aan lokale en mondiale kwaliteit van leven.
Design a draft lesson (module) in a group of three students according to the SSIBL approach. You can use the worksheet as an aid (available in Handouts_UU).

Points of interest:
- What is the socio-scientific issue (SSI)?
- What has this SSI to do with the curriculum requirements?
- What is the social controversy?
  - Analysis of stakeholders and interests
  - Analysis of types of argument
  - Analysis of relevant values

How do you design the lesson (module) in such a way that students will learn to study?
- Distinguish types of question (e.g. Subject questions, Social questions, Nature of Science questions, Ethical questions)
- Critically consult information sources
- Opportunities for students to take action themselves

How do you organize and evaluate the opinion-forming phase? How do you discuss it?
SSIBL SESSION 2
UPPER SECONDARY EDUCATION

Presentation of student teacher’s SSIBL lesson design

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Materials
www.parrise.eu   www.ecent.nl   http://www.fi.uu.nl/synenergene/

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