Module 9

RELEVANCE OF LANGUAGE IN SCIENCE EDUCATION
This module is based on the work within the project Intercultural learning in mathematics and science initial teacher education (IncluSMe). Coordination: Prof. Dr. Katja Maaß, International Centre for STEM Education (ICSE) at the University of Education Freiburg, Germany. Partners: University of Nicosia, Cyprus; University of Hradec Králové, Czech Republic; University of Jaen, Spain; National and Kapodistrian University of Athens, Greece; Vilnius University, Lithuania; University of Malta, Malta; University of Utrecht, Netherlands; Norwegian University of Science and Technology, Norway; Jönköping University, Sweden; Constantine the Philosopher University, Slovakia.

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General overview and aim

The main aim of this module is to tackle the gap between pupils’ deficient (second) language competencies and their capacities in science. The module focuses on preparing pre-service teachers on how to support pupils, who are at different stages of acquiring a second language, in learning science in this second language – and prepare students in ITE in this respect.

The module will address learning and teaching mechanisms in multicultural classrooms that hinder concept development in science. Pre-service teachers will learn the role of language in science, and become aware of difficulties that students face with language in science. They will work with case scenarios of classrooms with students that either do not speak the language, or have limited knowledge of it and will design lesson plans to work around these issues.

This module is part of:

- Mathematics and Science Education dimension: pedagogical issues, in particular in respect to dealing with diversity in classrooms.
Relevant topics

In this module high emphasis is set on introducing the relevance and role of language in science and how language, and the different cultural background can hinder learning. Pre-service teachers will learn about students’ difficulties with language in science and also about frameworks and activities to support students from different language and cultural background. We will also point to the following exemplary challenges in connection to the topic:

- Different use of language in everyday life and science
- Western science and cultural congruency
- Different framework supporting learners from different backgrounds in science
- US programs aimed at supporting Latin speaking students in science and lessons learned.

Learning Outcomes

Students will acquire:

- An awareness of the role and relevance of language in science (Activity 1.1 and all other activities)
- An understanding of the difficulties that students face with language in science, and ways to support them (Activity 2.1)
- Knowledge about the different types of language in science and how to support students in these (Activity 3.1)
- Experience frameworks used to support students’ difficulties with language in science (Activity 4.1 & Activity 5.1.)
- Pedagogical strategies to help them design lesson plans to teach science to students from culturally diverse backgrounds (Activity 6.1- Homework)
Flowchart and Module plan

This module involves a number of sections, structured in 3 tasks, including 3 face-to-face 40 min sessions and 45 mins of homework. It includes lecture parts, group discussions, student presentations and readings and homework. The structure is as follows:

- Introduction: 15 min
- What is the role of language in science: 25 min
- Different forms of language in science: 30 min
- Difficulties students face with language in science: 30 min
- Instructional strategies: 30 min
- Designing teaching activities for students from diverse backgrounds: 45 min

Introduction
• Activity 1.1: Why is the role of language in science important

Role of language in science
• Activity 2.1: The role of language

Different forms of language in science
• Activity 3.1: Activities to support students

Students’ difficulties with language in science
• Activity 4.1: Case study on identifying difficulties

Instructional Strategies
• Activity 5.1: Examples of using the framework

Designing Teaching Activities
• Activity 6.1: Homework - Design lesson plans
1. Introduction into the topic “Relevance of language in science” (15 mins)

1.1. Why is the role of language important?

Duration: 15 minutes

This is a “warm up” activity. The intention is to get pre-service teachers start thinking about difficulties that students from diverse language or cultural backgrounds might face in a science classroom.

This session contributes to the achievement of the following learning outcomes:
- An awareness of the role and relevance of language in science (Activity 1.1)

II. The role of language in science

2.1. The role of language in science

Duration: 20 minutes

In this session the teacher educator presents a theoretical background on the role of language in science in general (not specifically for students with diverse language or cultural backgrounds) and engages students in a discussion on how they would deal with a classroom with specific characteristics to teach Sound in a science lesson. The pre-service teachers are provided with a scenario that they are asked to discuss.

This session contributes to the achievement of the following learning outcomes:
- An awareness of the role and relevance of language in science (Activity 2.1)

III. Different forms of language in science

3.1. Activities to support students

Duration: 30 minutes

In this session the teacher educator presents the different forms of language in science (oral, written, spoken) and the different types of language and provides examples from
each category. Students are then asked to read the short report from Evagorou (2018) describing activities to support students in each of the categories and share their notes.

This session contributes to the achievement of the following learning outcomes:

- Knowledge about the different types of language in science and how to support students in these (Activity 3.1)

### IV. Students’ difficulties with language in science

#### 4.1. Activities to support students

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<tr>
<th>icon</th>
<th>Duration: 20 minutes</th>
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In this session the teacher educator presents a number of difficulties that students face with language in science by providing specific examples. Pre-service teachers are then asked to work with a scenario from a classroom to think about their own practice in the classroom.

This session contributes to the achievement of the following learning outcomes:

- Knowledge about the different types of language in science and how to support students in these (Activity 4.1)

### V. Instructional strategies

#### 5.1. Examples of using the frameworks

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<th>icon</th>
<th>Duration: 30 minutes</th>
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In this session the teacher educator presents a number instructional strategies and frameworks that people have used to support learners whose language in different from the language of instruction in science.

This session contributes to the achievement of the following learning outcomes:

- Experience frameworks used to support students’ difficulties with language in science (Activity 5.1)
VI. Designing Teaching Activities

6.1. Homework – Design Lesson Plan

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<th>Duration: 30 minutes</th>
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In this session the teacher educator presents a scenario to the pre-service teachers and asks them to prepare a lesson plan to teach science to a class with students who do not speak or understand the language of instruction and apply the framework from the previous lesson to support the students.

This session contributes to the achievement of the following learning outcomes:

- Pedagogical strategies to help them design lesson plans to teach science to students from culturally diverse backgrounds

### Materials and resources

- Presentation 9 (pptx). Teacher Educator. Relevance of Language in Science Education
- Readings and students’ handouts
- Access to computers for internet research and collaborative work

### Granularity

- Skip activity 2.1
- Skip part 6, Activity 6.1


**Further readings**

Assessment

Assessment for this module can be connected to the design and presentation of the lesson/teaching-activity (Activity 6.1). Students can hand in their lesson plan along with the reflection on the process of designing the lesson and activities (see questions in Activity 6.1). You can use this to assess to what extent pre-service teachers understood and used different aspects of the role and relevance of language in science education.
Module 9

RELEVANCE OF LANGUAGE IN SCIENCE EDUCATION

Worksheets
This worksheet is based on the work within the project Intercultural learning in mathematics and science initial teacher education (IncluSMe). Coordination: Prof. Dr. Katja Maaß, International Centre for STEM Education (ICSE) at the University of Education Freiburg, Germany. Partners: University of Nicosia, Cyprus; University of Hradec Králové, Czech Republic; University of Jaen, Spain; National and Kapodistrian University of Athens, Greece; Vilnius University, Lithuania; University of Malta, Malta; Utrecht University, Netherlands; Norwegian University of Science and Technology, Norway; Jönköping University, Sweden; Constantine the Philosopher University, Slovakia.

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I. Introduction into the topic “Relevance of Language in Science Education”

Activity 1.1: Why is the role of language important in science

Work in groups 15 mins

Read the two vignettes presented in the introduction and then in your groups discuss the following.

- Why is the role of language in science important?
- What are the main issues identified in the two vignettes?
- What should a teacher teaching in a linguistically diverse class be doing during her preparation.

Afterwards the groups will present their answers followed by a plenary discussion.
II. The role of language

Activity 2.1: The role of language in science

Work in groups  20 mins

Work in Groups:

Discuss the following scenario in your groups and identify problems and possible solutions.

- You are a first year science teacher at a multicultural school. You have three students who do not speak the local language, and two students who can communicate orally but cannot read or write. On the first day you plan to teach sound and do group work and experiments.”
- Click here for content of the lesson that you will teach.
III. Different forms of language

Activity 3.1: Activities to support students

Work in Groups

20 mins

Work in Groups:

Read the short report by Evagorou (2018) presenting activities to support the different forms of language in science. Note 3 activities that you can use in your classroom to support students.

Afterwards we will briefly discuss your descriptions of the activities.

## IV. Different forms of language in science

<table>
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<tr>
<th>Activity 4.1: Case Study</th>
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<tbody>
<tr>
<td><strong>Work in groups</strong></td>
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</table>

**Work in Groups:**

"You are a first year science teacher at a multicultural school. You have three students who do not speak the local language, and two students who can communicate orally but cannot read or write. On the first day you plan to teach kinematics and do group work and experiments."

[Click here for content of the lesson](#) that you will teach.

In your groups identify difficulties that speakers of the language might have with the topic you are teaching, and the difficulties of the 5 students who are not native speakers might have. Suggest ways support the students.
### V. Instructional Strategies

#### Activity 5.1: Examples of using the frameworks

<table>
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<tr>
<th>Groupwork</th>
<th>30 min</th>
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Find a topic that also allows for discussions about similarities and differences (e.g. DNA) and explore it in the classroom, thinking about the issue of language as well.

You can see an example here:


[https://www.hopkinsmedicine.org/henriettalacks/index.html](https://www.hopkinsmedicine.org/henriettalacks/index.html)

(Click link here for more information)

More specifically, in your groups think about the following questions:
- What are some language issues involved in these stories?
- In which ways could these stories help the students be more aware about their own culturally and linguistically diverse background?
- How could you use these stories as part of your science lesson?
VI. Designing Teaching Strategies

Activity 6.1: Homework: Design a lesson plan

- Based on the scenario from Activity 2.1, and the framework from Activity 5.1, design a lesson plan to teach sound to this specific class:
- Include goals for the students from the linguistically diverse backgrounds
- Describe in detail activities to support students from linguistically diverse backgrounds.
- Explain why this activities are helpful.
- Describe the challenges you are facing as a teacher while designing the lesson.
RELEVANCE OF LANGUAGE IN SCIENCE EDUCATION

*Initial teacher education of prospective mathematics and science teachers*
Aims

• Investigate the role of language in science:
  • Differences between street, school and formal scientific language
  • Difficulties pupils face in the learning of science when teaching (local) language in not their mother tongue
• Develop scaffolding strategies and pedagogical approaches for pupils in language-oriented science lessons.
Structure of the module

I. Introduction: 15 min
II. What is the role of language: 25 min
III. Different forms of language in science: 30 min
IV. Difficulties students face with language in science: 30 min
V. Instructional strategies: 30 min
VI. Designining teaching activities for students from diverse backgrounds: 45 mins
1. Introduction
Activity 1.1: Why is the role of language in science important?

You will read two vignettes as an introduction.

Then, discuss in groups (based on your experiences) and write down your major results

- Why is the role of language in science important?
- What are the main issues identified in the two vignettes?
- What should a teacher teaching in a linguistically diverse class be doing during her preparation.

Afterwards the groups will present their answers followed by a plenary discussion.
Why is the role of language in science important?

Suri is not a native speaker of English but she can communicate in English. During the science lesson last week her teacher asked them to collect leaves from deciduous trees, stick them in their note book, label them and bring them to class with them.

Suri was not familiar with the word deciduous. She asked her parents but they did not know the word either. So she collected leaves from a tree they had in her backyard and brought it to school with her. The teacher told her that she failed the assignment because she did not follow the instructions.
Why is the role of language in science important?

Fabio, Costas, Marianne and Blanca are participating in a science summer school and they are all part of the same group. The lesson is taught in English and none of them is a native speaker. Today they were given a bulb, a wire and a battery and were asked to connect them to make a simple electric circuit. They were also excited and could easily complete the assignment.

Then the teacher asked them to write in English the steps they followed, and explain their answer during a presentation. They all got very frustrated and disappointed as they were trying to use the correct terminology but they could not agree.
2. ROLE OF LANGUAGE

Important concepts and definitions
The role of language in science

- Language is central to **understanding the world around us**, making it in that way central to science, and as Keys (1999) states, ‘language does not merely describe or reflect preexisting conceptual structures; language actively creates those structures’ (p.115).

- Scientific knowledge is the product of thinking and is dependent on language.

The role of language in science

- Language is central in everyday life since it is one of the tools for understanding the world around us, communicating with peers, expressing ideas and developing knowledge.

- Education involves learning some special ways of using language.

- Hence, language can be considered as the principal means of communication in the class, and the cultural tool to share our experiences with other students and teachers (Evagorou & Osborne, 2010).

Activity 2.1: The role of language in science

Work in Groups:
Discuss the following scenario in your groups and identify problems and possible solutions.

• "You are a first year science teacher at a multicultural school. You have three students who do not speak the local language, and two students who can communicate orally but cannot read or write. On the first day you plan to teach sound and do group work and experiments."

• Click here for content of the lesson that you will teach.
3. Different forms of language in science
Different forms of language in the classroom

Forms of language

- Talk (e.g. exchanging ideas, communicating during investigations)
- Writing (e.g. explaining ideas, presenting outcomes of investigations)
- Reading (e.g. understanding instructions, understanding visuals)

Types of language

- Words/letters
- Numbers
- Visuals (graphs, diagrams, pictures, videos of experiments)
Activity 3.1 : Activities to support students

Work in Groups:
Read the short report by Evagorou (2018) presenting activities to support the different forms of language in science. Note 3 activities that you can use in your classroom to support students.

Afterwards we will briefly discuss your descriptions of the activities.

4. Students’ difficulties with language in science
Difficulties students face with language in science

- Everyday language and science language might be different (Evagorou & Osborne, 2010)
  - e.g. turn on the light means close the circuit
  - different examples in different languages?

- Difficult “words” that have no meaning for students (e.g. photosynthesis) (Wellington & Osborne, 2001)


Difficulties students face with language in science

• Difficulty “reading” visuals (Evagorou, Erduran & Mantyla, 2015)
  • Not easy to interpret graphs and other visuals

• Difficulty following instructions (reading) and writing (explaining ideas) (Wellington & Osborne, 2001)


Activity 4.1: Case study

Work in Groups:
” You are a first year science teacher at a multicultural school. You have three students who do not speak the local language, and two students who can communicate orally but cannot read or write. On the first day you plan to teach kinematics and do group work and experiments.”

Click here for content of the lesson that you will teach.

In your groups identify difficulties that speakers of the language might have with the topic you are teaching, and the difficulties of the 5 students who are not native speakers might have. Suggest ways support the students.
5. Instructional Strategies
Instructional Strategies

• Other than the linguistic issues that students might have in science, there are also the cultural challenges to science learning (Meyer & Crawford, 2011).

• Science learning is challenging when the culture in which learning occurs is very different in terms of their own culture (Lee, 2003).


Instructional Strategies

• Therefore, science learning is more accessible to students whose cultural background is western, since science is closer to western ways of knowing, and becomes abstract to students from different cultures (Aikenhead, 1996).

Framework to support learners in science

1. A sharing of scientific authority,
   - Do we all understand the same things with the terms used? If not, then how do we make terms explicit?

2. A diversity of cultural experiences and materials,
   - Does our culture allow us to understand the provided materials? If not, then how do we change them?

3. The use of students’ home languages in classrooms, and
   - Can we help the students by using terms from their languages?

4. The use of linguistic scaffolding to enhance meaning.
   - Can we use visuals to support the students?
• ‘Directed Activities Related to Texts’ (DARTS):
  • Reading and understanding text
  • Reading and understanding graphs
  • Synthesizing information from the text

(Davies & Green, 1984; Wellington & Osborne, 2001)
Example of using the framework

- Find a topic that also allows for discussions about similarities and differences (e.g. DNA) and explore it in the classroom, thinking about the issue of language as well.


- [https://www.hopkinsmedicine.org/henriettalacks/index.html](https://www.hopkinsmedicine.org/henriettalacks/index.html)
  - Immortal Life of Henrietta Lack

*(Click link here for more information)*
Activity 5.1: Examples of using the framework

Find a topic that also allows for discussions about similarities and differences (e.g. DNA) and explore it in the classroom, thinking about the issue of language as well. You can see an example here.


https://www.hopkinsmedicine.org/henriettalacks/index.html

(Click link here for more information)
6. Designing Teaching Activities
Activity 6.1 Homework – Design a lesson plan

Based on the scenario from Activity 2.1, and the framework from the previous slide, design a lesson plan to teach sound to this specific class. Describe the challenges you are facing as a teacher.
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