DEALING WITH DEFICIENCIES AND EXCELLENCY IN THE MATHEMATICS PROFICIENCY OF IMMIGRANT STUDENTS
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; Utrecht University, Netherlands; Norwegian University of Science and Technology, Norway; Jönköping University, Sweden; Constantine the Philosopher University, Slovakia.

The project Intercultural learning in mathematics and science initial teacher education (IncluSMe) has received co-funding by the Erasmus+ programme of the European Union under grant no. 2016-1-DE01-KA203-002910. Neither the European Union/European Commission nor the project’s national funding agency DAAD are responsible for the content or liable for any losses or damage resulting of the use of these resources.

IncluSMe project (grant no. 2016-1-DE01-KA203-002910) 2016-2019, lead contributions by Säfström, A.I., Nyman, R., and Boesen, J., School for Education and Communication, Jönköping University.
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General overview and aim

The aim of this module is to enable prospective teachers to foster an appreciative classroom atmosphere, create a good and shared learning environment, and develop teaching approaches in accordance to the different achievement levels of their pupils.

The module will prepare prospective teachers to work with immigrant pupils of secondary school age and above – all of them having widely divergent learning backgrounds in mathematics. On the one hand, there are those students who did not learn basic arithmetic operations or left school with only primary school knowledge. On the other hand, there are those pupils who may know mathematics on a level far ahead of the local or national curriculum. The public rhetoric about immigrant pupils often follows a deficiency perspective. But in this module, we will not only consider possible deficits, but will also take a strength-oriented perspective – and thus prepare prospective teachers for immigrant pupils who excel the local or national curriculum in parts (or entirely) (Clarkson (2006), Löwing (2000), OECD (2006), Zevenberger (2000)).

This module is part of:

- Mathematics and Science Subject dimension: (inter)cultural perspectives on the subjects themselves;
- Mathematics and Science Education dimension: pedagogical issues, in particular in respect to dealing with diversity in classrooms.
Module 7
Dealing with deficiencies and excellency in the mathematics proficiencies of immigrant students

Relevant topics

In this module, students will reflect on how assessment can be used in order to organise teaching in a way that challenge and support all students, with specific attention to students of different backgrounds and language skills. Topics relevant for this module are:

- mathematical competence
- assessment
- diversity in classrooms,
- building on pupils’ knowledge and abilities

Learning Outcomes

After completing this module prospective teachers will be able to:

- Describe the connection between language, culture and teaching in mathematics;
- Assess pupils’ pre-knowledge in mathematics in order to develop valid teaching strategies – and understand the importance and interdependence of diagnosis and the development of competences of the individual learner;
- Explain how pupils’ previous experiences and cultural backgrounds can be used as a resource and a starting point in mathematics teaching;
- Discern their own and the pupils’ understandings of fundamental concepts in mathematics and know how to address different understandings in class;
- Understand the need of collaboration between teachers of different age groups as well as collaboration with language teachers – in order to get support in working with pupils whose maths/science or language proficiencies are very different from the average level in class.
Flowchart and Module plan

This module involves three sections, all structured into several activities. It includes 4 sessions of varying length, and approximately 2–3 days of homework. It includes lecture parts, group discussions, pair work, and student presentations. The structure is as follows:

- Introduction to the topic: 105 min + 45 min homework
- Cultural experiences and mathematical competence: 90 min
- Assessing and challenging all students: 90 min + 2 days homework + presentations depending on the size of the group
I. Introduction to the topic “Dealing with deficiencies and excellency in the mathematics proficiency of immigrant students”

1.1. Preparation

<table>
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<th>Duration: 45 minutes</th>
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Before the first in class activity the students are required to prepare by reading about mathematical competence and reflect on their own classroom experiences.

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

- Describe the connection between language, culture and teaching in mathematics;

1.2. Classroom culture and mathematical competencies

<table>
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<th>Duration: 60 minutes</th>
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This activity consists of an introductory presentation of the topic (30 min), followed by a small group discussion about classroom culture (30 min), which is then summarized in the whole class. A video of an example of a classroom activity in China serves as an outset for the discussion. Other examples available to you can be used instead. The activity is meant to elicit reflection on variations in classroom culture and what and how different mathematical competencies are valued, and to sensitise the teacher students to the experience of entering into a new classroom culture.

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

- Describe the connection between language, culture and teaching in mathematics;

1.3: Classroom culture and language differences

<table>
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<th>Duration: 45 minutes</th>
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This activity consists of a small group discussion of different strategies for dealing with language diversity in the classroom. Let the students discuss the two cases and the following questions on the worksheet in small groups, and summarize the reflections in the end of the session.

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

- Describe the connection between language, culture and teaching in mathematics;
## Module 7
### Dealing with deficiencies and excellency in the mathematics proficiencies of immigrant students

#### II. Cultural experience and mathematical competence

<table>
<thead>
<tr>
<th>2.1. Language and mathematical concepts</th>
<th><strong>Duration:</strong> 45 minutes</th>
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<tr>
<td><strong>In this session you will introduce the idea of everyday language affecting the understanding of mathematical concepts. The table of number words in different languages is meant to raise questions about the learning of numbers and the discovery of patterns in the number system. You will then let your students discuss and reflect on the relationship between everyday language and mathematical concepts relevant for their future practice (20 min).</strong></td>
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<tr>
<td><strong>This session contributes to the achievement of the following learning outcomes:</strong></td>
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<tr>
<td>• Explain how pupils’ previous experiences and cultural backgrounds can be used as a resource and a starting point in mathematics teaching;</td>
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<tr>
<td>• Discern their own and the pupils’ understandings of fundamental concepts in mathematics and know how to address different understandings in class;</td>
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<tr>
<th>2.2. Different methods</th>
<th><strong>Duration:</strong> 45 minutes</th>
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<tr>
<td><strong>This activity problematizes the mathematical and personal aspects of methods, models and tools. The students are asked to figure out how and why different methods for multiplication and division works, as a basis for reflection on building on and valuing pupils’ different abilities (20 min).</strong></td>
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<tr>
<td><strong>This session contributes to the achievement of the following learning outcomes:</strong></td>
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## III. Assessing and challenging all students

### 3.1. Assessing mathematical competence

**Duration:** 90 min

This activity addresses different aspects of mathematical competence, and how tasks may or may not be helpful in assessing these aspects. You will discuss these issues in relation to two frameworks: imitative and creative reasoning, and mathematical competencies. Your students will then compare diagnostic materials from various sources and analyse what competencies and forms of reasoning they assess. They will also compile and/or construct a diagnostic test for use in Activity 3.2. The students’ part of the session will be 60 min.

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

- Assess pupils’ pre-knowledge in mathematics in order to develop valid teaching strategies – and understand the importance and interdependence of diagnosis and the development of competences of the individual learner;

### 3.2. Local resources for assessment and support

**Duration:** 60 min

In this activity, the students carry out an interview at a local school. They will present their results in class, preferably as they present the results of activity 3.3.

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

- Understand the need of collaboration between teachers of different age groups as well as collaboration with language teachers – in order to get support in working with pupils whose maths/science or language proficiencies are very different from the average level in class.

### 3.3. Using assessment in development of teaching

**Duration:** 60 min + 1 day analysis and preparation + 20 min presentation/group

This activity consists of using the diagnostic tests your students constructed in activity 3.1 in a class at a local school, compiling the results and presenting conclusions and implications in class, with special consideration of language and cultural factors.

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

- Assess pupils’ pre-knowledge in mathematics in order to develop valid teaching strategies – and understand the importance and interdependence of diagnosis and the development of competences of the individual learner;
- Discern their own and the pupils’ understandings of fundamental concepts in mathematics and know how to address different understandings in class;
Materials and resources

Presentation 1 (pptx). Teacher Educator. Slides for all classroom activities included.

Readings (listed in the Reference section)

Worksheets. Includes student activities for module 7.

Access to computers for internet research and collaborative work

Youtube videos (links included in worksheets and pptx)

Granularity

- Use only one of the discussions in Activity 1.2 and 1.3.
- Use only one of the discussions in Activity 2.1 and 2.2.
- Integrate part III in any similar activity you already have in your course.
- If you have a large group of teacher students, you may want to split the class up in groups of 15-25 for the presentations in Activity 3.3.
- Let the teacher students use the results of the diagnostic tests to design and conduct one or several lessons in the class they tested.
Module 7
Dealing with deficiencies and excellency in the mathematics proficiencies of immigrant students

References


Further readings

More on mathematical competence:


More on using pupils’ solutions and methods in class:

Assessment

All group discussions can be summarized by letting each group describe the highlights of their discussion, either orally or in text. Take special note to whether the students:

- Have taken active participation in the activity
- Show understanding of and reflection on differences in classroom culture, its relation to national/regional culture, and how it shapes teachers’ and pupils’ perception of deficiency and excellence (Activity 1.2)
- Reflect on the role of language proficiency in expressing mathematical competence (Activity 1.3)
- Give and discuss examples of how pupils’ experiences and backgrounds can be used in mathematics teaching (Activity 2.1)
- Show ability to detect key mathematical ideas in concepts, methods and pupils’ solutions, and give examples of how both correct and mistaken methods can be used in teaching (Activity 2.1 and 2.2)

You could assess the diagnosis tests developed by your students before they are used, as this may increase the value of the presentation in activity 3.3. Otherwise, you use the students’ presentations in activity 3.3 to assess whether students:

- Show ability to choose or design tasks that measure pupils’ pre-knowledge in ways that give important information for the planning of teaching
- Draw reasonable conclusions from the results of their tests regarding the students’ competence and the quality of the test
- Share insights regarding the benefits and limitations of diagnosis for planning teaching
- Discuss examples of how collaborations between teachers across age groups and language teachers work, with respect to benefits and limitations for designing a challenging and supportive learning environment for pupils of different achievement levels.
Module 7

DEALING WITH DEFICIENCIES AND EXCELLENCY IN THE MATHEMATICS PROFICIENCY OF IMMIGRANT STUDENTS

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 to the topic “Dealing with deficiencies and excellency in the mathematics proficiency of immigrant students”

Activity 1.1: Preparation

Homework 45 min

Read pp. 30–33 from Säfström (2013), and write down your reflections on the following questions:

• What competencies have been valued in the mathematics classrooms you have observed or participated in?
• What did constitute a successful student in these classrooms?
• What kind of activities would a student need to participate in, in order to develop these competencies?
I. Introduction to the topic “Dealing with deficiencies and excellency in the mathematics proficiency of immigrant students”

Activity 1.2: Classroom culture and mathematical competencies

Work in groups 30 min

Watch the classroom example from China:

https://www.youcubed.org/resources/a-visit-to-china/

Discuss the following questions, and write down your reflections:

• In what way is the Chinese lesson similar or different from mathematics lessons you have participated in?
• What competencies do the Chinese students exercise, and in what way? How is that similar or different from the lessons you have experienced?
• What kind of behaviour – which mathematical actions – does the teacher value in the Chinese lesson? How is that similar or different from the lessons you have experienced?
• How do you think a student from the Chinese class would experience coming to a class in your local school? What advantages might the Chinese student have, and what potential problems? Conversely, how would a student from your local school manage in the Chinese class?
• What role does language play in the exercising of different mathematical competencies?
• What could the students at a local school learn from a Chinese student? What could the Chinese class learn from a student at the local school?
I. Introduction to the topic “Dealing with deficiencies and excellency in the mathematics proficiency of immigrant students”

<table>
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<th>Activity 1.3: Classroom culture and language differences</th>
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<tr>
<td><strong>Work in groups</strong></td>
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Read the two case descriptions and discuss the questions below.

**Case 1**
Anna is a Swedish mathematics teacher, teaching a class consisting of students from various countries. During the mathematics lessons, the students are placed in small groups with others who speak the same language. During problem solving sessions, the students discuss within their group in their native language, but when Anna introduces a new topic or leads whole class discussions, she speaks Swedish.

**Case 2**
Bente is a Danish mathematics teacher, who also teaches a students from various countries. During the mathematics lessons, all students are required to speak exclusively in Danish. Students who share another language are spread out in the classroom to encourage them to speak Danish.

- What benefits and problems can you see in relation to Anna’s and Bente’s strategies?
- How and when would you use these strategies? Why?
- What strategies would you use if faced with teaching students who do not share any of your languages? How would you get access to those students’ mathematical competencies?
II. Cultural experiences and mathematical competencies

**Activity 2.1: Language and mathematical concepts**

**Work in groups** 20 min

Pick a mathematical concept relevant for your future mathematics teaching (e.g. the number sixty-two, volume, denominator, percentage, slope), and find out what it is called in different languages known in your group.

- What else do these words mean in each language? In which everyday contexts are these words used? How may that shape the understanding of the mathematical concept?
- What other terms or expressions are used in relation to the mathematical concept in each language? How may that shape the understanding of the mathematical concept?
- How can your students and you as a teacher benefit from discussing these questions? What other questions could guide the discussion towards the development of conceptual understanding?
II. Cultural experiences and mathematical competencies

Activity 2.2: Different methods

Work in pairs 20 min

Watch the different multiplication and/or division methods, and discuss the questions below. Write down your reflections.

MULTIPLICATION:
https://www.youtube.com/playlist?list=PLRG4iHU5uhLCilkx1N74K-vrr7ImSrDZj

DIVISION:
https://www.youtube.com/playlist?list=PLRG4iHU5uhLBs34Do2bkgKfxRddBJesn8

- Work out some examples with other numbers. Can you explain how the different methods work?
- What merits and deficits do you see in the different methods? When is each method efficient, and when is it not?
- What can students learn from discussing different methods? What aspects of the underlying concepts can become visible? What aspects of students’ knowledge can become visible for you as a teacher, by means of such discussions?
- How can you arrange a learning situation so that students are able to compare and evaluate different methods? What questions would you ask students in such a situation?
- Assume you would lead a classroom discussion about multiplication or division methods. Pick three methods which you think could be used by three students in your class. In what order would you let the students present their methods, and why? What aspects would you highlight, and how would you compare and contrast the methods?
- What are the benefits of including incorrect or mistaken methods? When would you let students who made mistakes present? How would you address the mistakes, in order for the student and the class to learn from them?
III. Assessing and challenging all students

Activity 3.1: Assessing mathematical competence

Work in pairs 60 min

Compare and analyse at least two different diagnostic assessment materials. Find out whether there are any diagnostic assessments adapted to your curriculum available. Such assessments may be provided by a national agency or developed by other organisations in your country. Choose a mathematical topic relevant for your future students, and pick out the diagnostic assessments for this topic from two of the following sets of assessment materials:

Your own

Australia

Germany
https://mathe-sicher-koennen.dzlm.de/node/336

New Zealand
https://nzmaths.co.nz/node/1599

Sweden
https://www.skolverket.se/bedomning/bedomning/bedomningsstod/matematik/diamant-1.196205

- Which mathematical competencies are tested by the diagnostic materials? Which are not tested?
- To what extent does language skills affect the outcome of these tests? How can you as a teacher adapt the tasks for immigrant students, in order to assess their mathematical rather than their language competence?
- Besides these tests, what do you as a teacher need to do in order to assess the mathematical competence of your students?
- Compile your own diagnostic test for the topic by picking tasks from the analysed tests and constructing additional tasks. You will use this test in Activity 3.3.
III. Assessing and challenging all students

Activity 3.2: Local resources for assessment and support

Homework in pairs 60 min

Find out what resources are available for assessing and supporting students at a local school.

Contact a local school and interview teachers and/or principals:

- Are you using any standardised or local tests for assessing students’ mathematical knowledge? Are these tests available in different languages? How do you use these tests with students who do not speak the native language?
- Are there language teachers or interpreters for the languages spoken by students at the school?
- Do teachers in different grades collaborate to support and challenge students who lie significantly above or below the average level of their class? What other strategies does the school use to address these students’ needs for challenge and support?

Write down the answers, as well as your conclusions and reflections.
### III. Assessing and challenging all students

**Activity 3.3: Using assessment in the development of teaching**

<table>
<thead>
<tr>
<th>Work in pairs</th>
<th>Homework 1 day and 20 min presentation/group</th>
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<td>1 day +</td>
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Use the diagnostic test you compiled in Activity 3.1 in a class or a group of students at a local school.

- Compile the results and describe the class or group as a whole. What is the overall level, and how large is the variation?
- Pick out three pupils, whose results you want to analyse in depth.
- What do these pupils know well? What deficiencies have you identified? What may be the cause of these deficiencies? To what extent may language skills have affected the outcome for these pupils?
- What teaching strategies and pupil activities do you intend to use in order to address the pupils’ deficiencies?

Make use of relevant literature from the required reading of the course in order to answer these questions.
DEALING WITH DEFICIENCIES AND EXCELLENCY IN THE MATHEMATICS PROFICIENCY OF IMMIGRANT STUDENTS
Aims

• Describe the connection between language, culture and teaching in mathematics;

• Assess pupils’ pre-knowledge in mathematics in order to develop valid teaching strategies – and understand the importance and interdependence of diagnosis and the development of competences of the individual learner;

• Explain how pupils’ previous experiences and cultural backgrounds can be used as a resource and a starting point in mathematics teaching;

• Discern their own and the pupils’ understandings of fundamental concepts in mathematics and know how to address different understandings in class;

• Understand the need of collaboration between teachers of different age groups as well as collaboration with language teachers – in order to get support in working with pupils whose maths/science or language proficiencies are very different from the average level in class.
Overview of the module

• Part 1 - 150 min
  • Preparation – reading and reflection (out of class)
  • Introductive presentation – competence, culture and language & discussion 1: a visit to China (in class)
  • Discussion 2: two ”extreme cases” (in class)

• Part 2 - 90 min
  • Presentation: Cultural experiences and mathematics (in class)
  • Discussion 1: Language and mathematical concepts (in class)
  • Discussion 2: Different methods (in class)

• Part 3 – depending on the group size
  • Analysing and compiling diagnostic tests (in class)
  • Interview with local school (out of class)
  • Conducting and analysing test, present and discuss results (out of/in class)
I. INTRODUCTION TO DEALING WITH DEFICIENCIES AND EXCELLENCY IN THE MATHEMATICS PROFICIENCY OF IMMIGRANT STUDENTS
1.1: Preparation – reading and reflecting

Read pp. 30–33 from Säfström (2013), and write down your reflections on the following questions:

• What competencies have been valued in the mathematics classrooms you have observed or participated in?
• What did constitute a successful student in these classrooms?
• What kind of activities would a student need to participate in, in order to develop these competencies?
Mathematical competence

• “...what counts as ‘competent’ gets constructed in particular classrooms, and can therefore look very different from setting to setting” — Gresalfi et al (2009, p. 50)

• “Competence in som domain of personal, professional, or social life is ability to handle essential aspects of life in that domain.” — Säfström (2013, p. 32).
1.2: Classroom culture and mathematical competencies

https://www.youcubed.org/resources/a-visit-to-china/
1.2: Classroom culture and mathematical competencies

- In what way is the Chinese lesson similar or different from mathematics lessons you have participated in?
- What competencies do the Chinese students exercise, and in what way? How is that similar or different from the lessons you have experienced?
- What kind of behaviour – which mathematical actions – does the teacher value in the Chinese lesson? How is that similar or different from the lessons you have experienced?
- How do you think a student from the Chinese class would experience coming to a class in your local school? What advantages might the Chinese student have, and what potential problems? Conversely, how would a student from your local school manage in the Chinese class?
- What role does language play in the exercising of different mathematical competencies?
- What could the students at a local school learn from a Chinese student? What could the Chinese class learn from a student at the local school?
1.3: Classroom culture and language differences

- **CASE 1**: Anna is a Swedish mathematics teacher, teaching a class consisting of students from various countries. During the mathematics lessons, the students are placed in small groups with others who speak the same language. During problem solving sessions, the students discuss within their group in their native language, but when Anna introduces a new topic or leads whole class discussions, she speaks Swedish.

- **CASE 2**: Bente is a Danish mathematics teacher, who also teaches a students from various countries. During the mathematics lessons, all students are required to speak exclusively in Danish. Students who share another language are spread out in the classroom to encourage them to speak Danish.
1.3: Classroom culture and language differences

- What benefits and problems can you see in relation to Anna’s and Bente’s strategies?
- How and when would you use these strategies? Why?
- What strategies would you use if faced with teaching students who do not share any of your languages? How would you get access to those students’ mathematical competencies?
II. CULTURAL EXPERIENCE AND MATHEMATICAL COMPETENCE
2.1: Language and mathematical concepts

• How is the understanding of mathematical concepts affected by everyday language used in related situations, and everyday use of the term associated with a concept?
### 2.1: Language and mathematical concepts

How, for example, do you think learning of the number system is affected by the number words? What patterns of the number system are visible in your language, and which are not?

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**IncluSMe**

Intercultural Learning in Science and Mathematics

Initial Teacher Education

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**ICSE**

International Centre for STEM Education

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**Dealing with Deficiencies and Excellency in the Mathematics Proficiency of Immigrant Students**

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13
2.1: Language and mathematical concepts

Pick a mathematical concept relevant for your future mathematics teaching (e.g. the number sixty-two, volume, denominator, percentage, slope), and find out what it is called in different languages known in your group.

• What else do these words mean in each language? In which everyday contexts are these words used? How may that shape the understanding of the mathematical concept?
• What other terms or expressions are used in relation to the mathematical concept in each language? How may that shape the understanding of the mathematical concept?
• How can your students and you as a teacher benefit from discussing these questions? What other questions could guide the discussion towards the development of conceptual understanding?
2.2: Cultural experiences and mathematical methods

- Different methods and models carry different qualities and meanings of numbers and operations
- ...but there is also personal aspects of efficiency. Ask your students about the methods and models they are used to!
2.2: Cultural experiences and mathematical methods

MULTIPLICATION METHODS
https://www.youtube.com/playlist?list=PLRG4iHU5uhLCSlkX1N74K-vrr7ImSrDZj

DIVISION METHODS
https://www.youtube.com/playlist?list=PLRG4iHU5uhLBs34Do2bkgKfxRddBJesn8
2.2: Cultural experiences and mathematical methods

- Work out some examples with other numbers. Can you explain how the different methods work?
- What merits and deficits do you see in the different methods? When is each method efficient, and when is it not?
- What can students learn from discussing different methods? What aspects of the underlying concepts can become visible? What aspects of students’ knowledge can become visible for you as a teacher, by means of such discussions?
2.2: Cultural experiences and mathematical methods

- How can you arrange a learning situation so that students are able to compare and evaluate different methods? What questions would you ask students in such a situation?

- Assume you would lead a classroom discussion about multiplication or division methods. Pick three methods which you think could be used by three students in your class. In what order would you let the students present their methods, and why? What aspects would you highlight, and how would you compare and contrast the methods?

- What are the benefits of including incorrect or mistaken methods? When would you let students who made mistakes present? How would you address the mistakes, in order for the student and the class to learn from them?
III. ASSESSING AND CHALLENGING ALL STUDENTS
3.1 Assessing mathematical competence

- Creative and imitative reasoning
- Creative mathematical reasoning is:
  - Novel
  - Flexible
  - Plausible
  - Mathematically founded
3.1 Assessing mathematical competence

• Some tasks test only imitative reasoning:

At Lidl a large soda costs 15 kr. At the local store it costs 2 kr more. How much does it cost at the local store?

IMITATIVE REASONING: $15 + 2 = 17$

• In order to test creative reasoning, the task must require novelty, flexibility, plausibility and mathematical foundation:

At Lidl a large soda costs 15 kr. That is 2 kr less than at the local store. How much does it cost at the local store?

IMITATIVE REASONING: $15 - 2 = 13$
3.1 Assessing mathematical competence

• Numerous frameworks set out to delimit strands, or aspects, or constituents of mathematical competence, e.g. OECD/PISA, Adding it up, NCTM standards and the Mathematical Competency Research Framework.
3.1 Assessing mathematical competence

• The OECD/PISA framework (OECD, 2017):
  • Communication
  • Representation
  • Devising strategies
  • Mathematisation
  • Reasoning and argument
  • Using symbolic, formal and technical language and operations
  • Using mathematical tools
3.1 Assessing mathematical competence

- Adding it up Kilpatrick, Swafford & Findell, 2001)
  - Conceptual understanding
  - Procedural fluency
  - Adaptive reasoning
  - Strategic competence
  - Productive disposition
3.1 Assessing mathematical competence

- The NCTM process standards (NCTM, 2018):
  - Problem solving
  - Reasoning and proof
  - Communication
  - Connections
  - Representations
3.1 Assessing mathematical competence

- The Mathematical Competency Research Framework (Säfström, 2013):
  - Problem solving
  - Reasoning
  - Applying procedures
  - Representations
  - Connections
  - Communication
3.1 Assessing mathematical competence

• What kind of task assesses:
  • problem solving skills?
  • reasoning and argumentation?
  • the use of mathematical representations?
  • forming and using mathematical connections?
  • mathematical communication?
3.1 Assessing mathematical competence

Compare and analyze at least two different diagnostic assessment materials. Find out whether there are any diagnostic assessments adapted to your curriculum available. Such assessments may be provided by a national agency or developed by other organisations in your country. Choose a mathematical topic relevant for your future students, and pick out the diagnostic assessments for this topic from two of the following sets of assessment materials:

- Your own national/regional diagnostic materials
- Germany: [https://mathe-sicher-koennen.dzlm.de/node/336](https://mathe-sicher-koennen.dzlm.de/node/336)
- New Zealand: [https://nzmaths.co.nz/node/1599](https://nzmaths.co.nz/node/1599)
- Sweden: [https://www.skolverket.se/bedomning/bedomning/bedomningsstod/matematik/diamant-1.196205](https://www.skolverket.se/bedomning/bedomning/bedomningsstod/matematik/diamant-1.196205)
3.1 Assessing mathematical competence

• Which mathematical competencies are tested by the diagnostic materials? Which are not tested?

• To what extent does language skills affect the outcome of these tests? How can you as a teacher adapt the tasks for immigrant students, in order to assess their mathematical rather than their language competence?

• Besides these tests, what do you as a teacher need to do in order to assess the mathematical competence of your students?

• Compile your own diagnostic test for the topic by picking tasks from the analysed tests and constructing additional tasks. You will use this test in Activity 3.3.
3.2: Local resources for assessment and support

Find out what resources are available for assessing and supporting students at a local school.

Contact a local school and interview teachers and/or principals:
• Are you using any standardised or local tests for assessing students’ mathematical knowledge? Are these tests available in different languages? How do you use these tests with students who do not speak the native language?
• Are there language teachers or interpreters for the languages spoken by students at the school?
• Do teachers in different grades collaborate to support and challenge students who lie significantly above or below the average level of their class? What other strategies does the school use to address these students’ needs for challenge and support?

Write down the answers, as well as your conclusions and reflections.
3.3: Using assessment in the development of teaching

Use the diagnostic test you compiled in Activity 3.1 in a class or a group of students at a local school.

- Compile the results and describe the class or group as a whole. What is the overall level, and how large is the variation?
- Pick out three students, whose results you want to analyse in depth.
- What do these students know well? What deficiencies have you identified? What may be the cause of these deficiencies? To what extent may language skills have affected the outcome for these students?
- What teaching strategies and student activities do you intend to use in order to address the students’ deficiencies?

Make use of relevant literature from the required reading of the course in order to answer these questions.
3.2: Local resources for assessment and support

Present your results from the interview:

- Are you using any standardised or local tests for assessing students’ mathematical knowledge? Are these tests available in different languages? How do you use these tests with students who do not speak the native language?
- Are there language teachers or interpreters for the languages spoken by students at the school?
- Do teachers in different grades collaborate to support and challenge students who lie significantly above or below the average level of their class? What other strategies does the school use to address these students’ needs for challenge and support?
3.2: Local resources for assessment and support

Based on the different results from the interviews, discuss the following questions:

• What is the overall picture of resources available at local schools? What language support is available for immigrant students? What support is there for students significantly below or above the average level of the class? How do these aspects affect your role as a teacher?

• How large are the differences between schools? As an immigrant student, to what extent will the school impact your education? As a student significantly below or above the average level of the class, to what extent will the school impact your education?
3.3: Using assessment in the development of teaching

Present the results from the diagnostic tests – on group level and for the three selected students:

- What did you learn from the results? What is the overall level of the class, and how large is the variation?
- To what extent may the language skills of the pupils have affected their outcomes on the tests?
- What do the three selected students know well? What deficiencies have you identified? What may be the cause of these deficiencies?
- What teaching strategies and student activities do you intend to use in order to address the students’ deficiencies? Why did you choose these strategies?

Make use of relevant literature from the required reading of the course in order to answer these questions.
3.3: Using assessment in the development of teaching

Based on the collected results of the tests, discuss the following:

- How large is the variation between schools? Have you changed any conclusions you made, based on the bigger picture?
- Are there any themes or commonalities in the deficiencies you found? Is there a pattern in the difficulties students face?
- Are there any themes or commonalities in the teaching strategies and student activities do you intend to use in order to address the students’ deficiencies?
- What new ideas and strategies have come up, that you will take with you into your future classroom?

Make use of relevant literature from the required reading of the course in order to answer these questions.
This presentation 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.

The project Intercultural learning in mathematics and science initial teacher education (IncluSMe) has received co-funding by the Erasmus+ programme of the European Union under grant no. 2016-1-DE01-KA203-002910. Neither the European Union/European Commission nor the project's national funding agency DAAD are responsible for the content or liable for any losses or damage resulting of the use of these resources.

IncluSMe project (grant no. 2016-1-DE01-KA203-002910) 2016-2019, lead contributions by Säfström, A. I., Nyman, R. and Boesen, J., School for Education and Communication, Jönköping University.

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