IncluSMe

Intercultural learning in Science and Mathematics initial teacher education

Module6

PEDAGOGICAL APPROACHES TO MATHEMATICS AND SCIENCE TEACHING IN MULTICULTURAL CLASSROOMS

IncluSMe
Intercultural learning in Science and Mathematics initial teacher 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; Utrecht University, Netherlands; Norwegian University of Science and Technology, Norway; Jönköping University, Sweden; Constantine the Philosopher University, Slovakia.

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ICSE International Centre for STEM Education

Pädagogische Hochschule Freiburg
Université des Sciences de l'Education · University of Education

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General overview and aim

The module aims to broaden prospective teachers' perspectives of mathematics and science education considering cultural diversity, and to help them develop competences for teaching in multicultural classrooms. In particular, it will support them to: identify critical incidents related to teaching and learning in multilingual and multicultural contexts; interpret these incidents on the basis of research findings; design relevant teaching interventions; and develop a reflective view on how teaching can affect the learning outcomes in diverse classrooms.

In particular, the prospective teachers are expected to:

- Identify issues related to mathematics and science teaching and learning through classroom scenarios (e.g., extracts from classroom dialogues, interviews with teachers and student in multicultural settings).
- Read research literature on pedagogical approaches and teaching methods suitable to deal with diversity, heterogeneity, multilingualism and to create equal opportunities for pupils in mathematics and science learning.
- Design teaching interventions on the basis of resources (e.g., curriculum materials, textbooks, research findings).
- Reflect on their teaching designs and consider changes that they would make.

This module is part of

- Personal dimension: values, attitudes and intercultural competences of prospective teachers;
- Mathematics and Science Education dimension: pedagogical issues, in particular in respect to dealing with diversity in classrooms.

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Relevant topics

In this module, the main focus is on developing prospective teachers' noticing by providing them with real classroom contexts for identifying critical incidents. They will interpret them on the basis of theoretical knowledge, and design teaching and reflecting on this by linking theory and practice. For this purpose, we will work on the following topics:

- Teaching dilemmas
- Visual approaches
- Register and code switching
- Equity and socio-political perspectives
- Culturally responsive teaching approaches

Learning Outcomes

The expected learning outcomes are:

- **Becoming aware** of dilemmas and particularities of teaching mathematics and science in diverse classrooms.
- **Developing knowledge** related to teaching approaches in diverse classrooms through reading research literature.
- **Designing classroom tasks** and planning teaching on the basis of existing resources.
- **Becoming reflective and flexible** in adapting teaching in diverse classrooms.

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Flowchart and Module plan

This module involves four teaching sessions, structured in 13 activities, including 4 face-to-face 245 minutes sessions and 195 minutes of homework. The module includes group discussions and group and individual presentations.

1st session

- Activity 1.1: Sharing prior teaching experiences in multicultural settings
- Activity 1.2: Working with empirical data from multicultural settings (1)
- Activity 1.3: Working with empirical data from multicultural settings (2)

2nd session

- Activity 2.1: Reporting on the activity 1.3
- Activity 2.2: Addressing theoretical issues concerning multicultural mathematics teaching
- Activity 2.3: Addressing theoretical issues concerning multicultural science teaching.
- Activity 2.4: Readings from relevant research literature

3th session

- Activity 3.1: Reporting on the activity 2.4
- Activity 3.2: Observing and analysing videoclips from multicultural classrooms
- Activity 3.3: Designing a cultural responsive mathematics lesson
- Activity 3.4: Designing a culturally resposive science lesson

4th session

- Activity 4.1: Reflecting on lesson designs
- Activity 4.2: Preparing your final assigment of the module

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I: Introducing pedagogical approaches to mathematics and science teaching in multicultural classrooms

1.1. Sharing prior teaching experiences in multicultural settings



Duration: 15 minutes

This is an introductory classroom activity. The prospective teachers share teaching experiences in multicultural settings coming from discussions with others or from their own teaching. This activity aims to bring to the fore prospective teachers' beliefs about multicultural learning and teaching.

Keywords: mathematics; prior beliefs; science; sharing prior experiences

This activity contributes to the achievement of the following learning outcome:

- Reflecting on prior experiences from teaching mathematics and science in diverse classrooms.

1.2. Working with empirical data in multicultural settings (1)




Duration: 45 minutes

This activity extends the activity 1.1 as it becomes more focused on specific classroom episodes. We provide three episodes (two concerning mathematics and one science teaching in multicultural settings) and we ask the prospective teachers to identify classroom practices in the four settings and justify their importance. The intention of this activity is to introduce the prospective teachers with classroom phenomena related to mathematics and science teaching in multicultural classrooms.

Keywords: mathematics; multimodal teaching; photos; pictures; representations; science; symbols

This activity contributes to the achievement of the following learning outcome:

- Becoming aware of dilemmas and particularities of teaching mathematics and science in diverse classrooms.

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I: Introducing pedagogical approaches to mathematics and science teaching in multicultural classrooms

1.3. Working with empirical data in multicultural settings (2)




Duration: 30 minutes

This is a homework activity. We ask the students to read extracts of empirical data from a research paper and report in groups on certain issues addressed there. The homework is related to mathematics but the science teacher educator could extend the example related to science in the activity 1.2 and give this as homework.

Keywords: language; mathematics; multilingual; representations

This activity contributes to the achievement of the following learning outcome:

- Becoming aware of particularities of teaching mathematics in diverse classrooms.

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II: Considering pedagogical approaches to mathematics and science teaching in multicultural classrooms through the lens of research and theory

2.1. Reporting on the activity 1.3




Duration: 15 minutes

This is a classroom activity. In this session two or three prospective teachers will present in the whole class their work on activity 1.3.

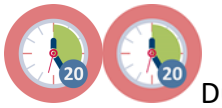
Keywords: language; mathematics; multilingual; representations; sharing work

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

- Becoming aware of particularities of teaching mathematics in diverse classrooms.

2.2. Addressing theoretical issues concerning multicultural mathematics teaching





Duration: 40 minutes

This is a classroom activity. We ask the students to read extracts of theoretical issues from a research paper on mathematical teaching in multicultural settings and reflect on these.

Keywords: mathematical language; everyday language; representations

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

- Developing knowledge related to teaching approaches in diverse mathematics classrooms through reading research literature.

2.3. Addressing theoretical issues concerning multicultural science teaching





Duration: 15 minutes

This is a classroom activity. We ask the students to read an extract on theoretical issues from a research paper on science teaching in multicultural settings and reflect on these issues in the class.

Keywords: active involvement; equity; science

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

- Developing knowledge related to teaching approaches in diverse science classrooms through reading research literature.

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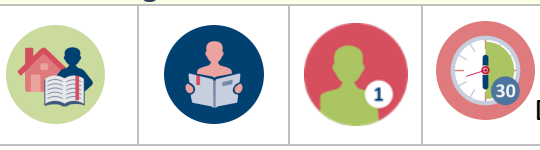
II: Considering pedagogical approaches to mathematics and science teaching in multicultural classrooms through the lens of research and theory

2.4. Readings from relevant research literature



Duration: 30 minutes

This is a homework activity. The prospective teachers will read three extracts from research papers, identify issues related to a theoretical framework concerning classroom practices in multicultural and multilingual contexts for mathematics and science and write a relevant report.

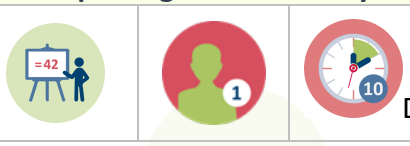
Keywords: equity; diverse meanings; language; society

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

- Developing theoretical knowledge related to teaching approaches in diverse classrooms through reading research literature.

III: Designing mathematics and science teaching for multicultural and multilingual classrooms

3.1. Reporting on the activity 2.4



Duration: 10 minutes

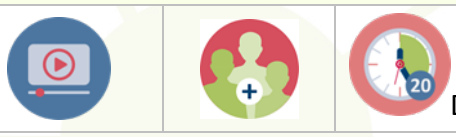
This is a face-to-face classroom activity. In this session two or three prospective teachers will present in the whole class their report on activity 2.4 and share ideas in the class.

Keywords: equity; diverse meanings; language; society

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

- Developing theoretical knowledge related to teaching approaches in diverse classrooms through reading research literature.

3.2. Observing and analyzing video clips from multicultural and multilingual classrooms



Duration: 20 minutes

This is a face-to-face classroom activity. The prospective teachers observe a lesson and identify a critical incident related to culturally responsive teaching.

Keywords: culturally responsive teaching; mathematics; video clips

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

- Designing classroom tasks and planning teaching on the basis of existing resources.

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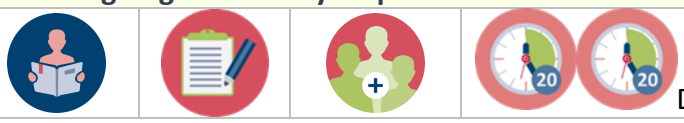
III: Designing mathematics and science teaching for multicultural and multilingual classrooms

3.3. Designing a culturally responsive mathematics lesson



Duration: 40 minutes

This is a face-to-face classroom activity. In this session key aspects for designing culturally responsive lessons and tasks will be discussed (use the following link as a basis).

http://www.mathconnect.hs.iastate.edu/documents/CRMTLessonAnalysisTool.pdf

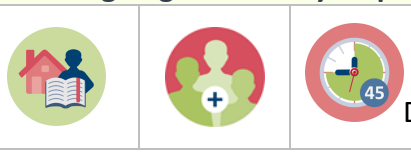
These aspects will be provided to the prospective teachers in advance and they will be contrasted to those reported in a text from Smile (1993).

Keywords: culturally responsive lesson; lesson design; mathematics; task analysis

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

- Designing classroom tasks and planning teaching on the basis of existing resources.

3.4. Designing a culturally responsive science lesson



Duration: 45 minutes

In this homework activity resources will be given to the prospective teachers to design a scenario for culturally responsive science lesson.

Keywords: culturally responsive lesson; lesson design; science; task design

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

- Designing classroom tasks and planning teaching on the basis of existing resources.

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IV: Reflecting on and synthesizing ideas from the module

4.1. Reflecting on lesson designs



Duration: 45 minutes

This is a face-to-face classroom activity. In this session the groups of prospective teachers will evaluate each other's scenarios on the basis of key designing principles that would have been discussed in the previous activities. Examples of scenarios and reactions will be presented in the whole class.

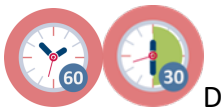
Keywords: designing principles; lesson evaluation; scenarios

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

- Becoming reflective and flexible in adapting teaching in diverse classrooms.

4.2. Preparing your final assignment of the module





Duration: 90 minutes

This is a homework activity. In this session we will ask the prospective teachers to read two extracts taken from the research papers and then produce a text (500 words) with their personal reflection and suggestions, synthesizing their experiences from the module.

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

- Becoming reflective and flexible in adapting teaching in diverse classrooms.

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Materials and resources

Students present their homework (activities1.1, 1.2, 2.1, 3.1, 4.1)

Students' readings in homework (activities1.3, 2.2, 2.3, 2.4, 3.3, 4.2)

Homework (individual) (activities 2.4, 4.2)

Homework in groups (activities 1.3, 3.4)

Students´ handouts (activities 1.2, 2.2, 2.3, 3.3)

Single work (activities 3.1, 2.4, 4.2)

Students are working in groups (activities 1.1, 1.2, 2.1, 2.2, 2.3, 3.2, 3.3, 4.1)

Granularity

- Select fewer episodes in Activity 1.1
- Choose Activity 2.2 or Activity 2.3
- Select fewer extracts in Activity 2.4.
- Instead of the Activity 3.3 you can use the resources on Activity 3.2. for the design of a mathematics lesson.

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Further readings

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The Culturally Responsive Mathematics Teaching –TM Lesson Analysis Tool

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Assessment

The module will be assessed through the prospective teachers' individual and group assignments as well as from test items that will be included in the end of course examination. Assessment criteria and methods will be based on the four expected learning outcomes:

- **Becoming aware** of dilemmas and particularities of teaching mathematics and science in diverse classrooms.
- **Developing knowledge** related to teaching approaches in diverse classrooms through reading research literature.
- **Designing classroom tasks** and planning teaching on the basis of existing resources.
- **Becoming reflective and flexible** in adapting teaching in diverse classrooms.

The final assignment in the activity 4.2 can be one of the main assignments that will be evaluated in a summative way. All the other course assignments can also be evaluated and contribute to the overall evaluation of the module (in a summative way). However, it is important the prospective teachers' work to be assessed during the module and the teacher educator to provide appropriate feedback.

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