Science, mathematics, diversity and IBL in multicultural settings

PD Module 3 of the MasDIV project

MaSDiV

Co-funded by the Erasmus+ Programme of the European Union

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Université des Sciences de l'Education · University of Education

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Aims of the session

- To acquire knowledge and understanding of cultural diversity and social inclusion in science and mathematics education, focusing on schools and the classroom and the challenges that.
- Discovering and understanding of the main challenges related to teaching in multicultural classrooms, but also the opportunities to include culture-related aspects in creating an inclusive classroom culture
- To become reflective of one's own normative position and values in relation to cultural diversity
- To learn how IBL can support students by taking into account their various cultural backgrounds

Methods

- Diversity in (sub)cultural groups as a starting point for your lessons.
- Apply the course knowledge into a practical knowledge related to interventions in multicultural classrooms.
- We are going to use IBL to promote students' intercultural competences by using realistic relevant contexts situated in different cultures.
- Designing a lesson plan for the multicultural class

Connection

- Bringing all the theory of module 1 & 2 together in a multicultural perspective.

ACTIVITY 1

Teaching your own diverse class (3 x 30 minutes)

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How (culturally) diverse is your class?

Describe or visualize the (cultural) diversity of the student population in one of your classrooms

(individually 5-10 minutes)

Share results: (in small groups)

Are there any common elements of diversity?

How do you interprete the term 'culture'? (10-15 minutes)

IBL in a multicultural setting

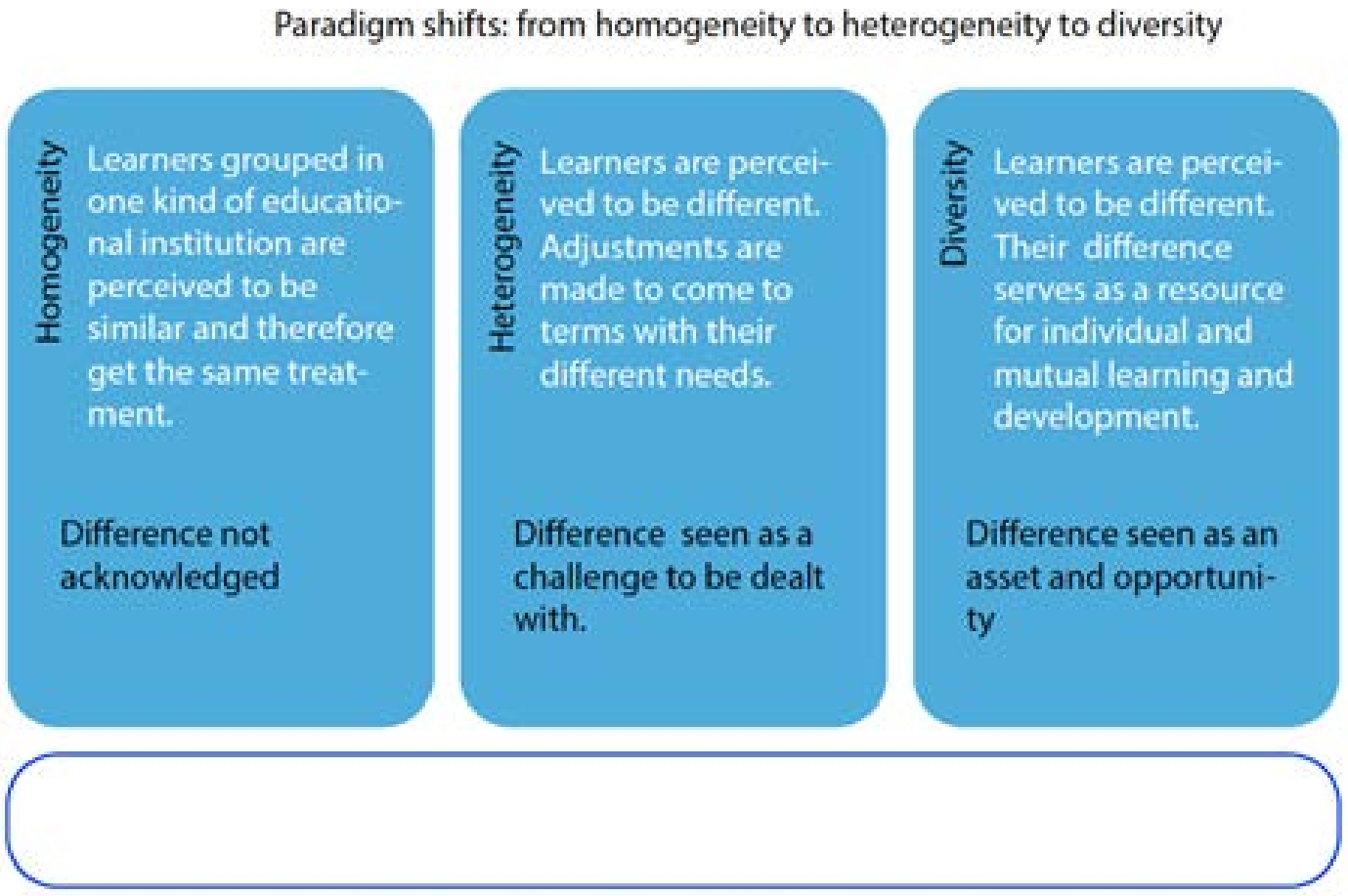
- Worksheet 1

‘design a healthy multicultural menu for your school-canteen’

Questions:

- What characteristics of IBL do you recognize in this assignment?
- What subject-specific content and concepts can be related to this context?
- What benefits and advantages does the use of this context present?
- Which opportunities and challenges does this context present for:
    - Relating to the different cultural backgrounds of all students?
    - Addressing fundamental values? (see module 2)
    - Inclusive education? (see module 1 for a list of characteristics).

Culture and diversity



Culture and diversity

- Worksheet 2

‘definitions of diversity’

What is meant by diversity and culture? :

- Which aspects of diversity are particularly important for mathematics and science education and why?
- Which of these aspects do you meet in your classes?
- Do you recognize the way ‘culture’ and ‘intercultural situations’ is being defined here?
- Can you give an example of ‘intercultural situations’ from your own teaching practice?
- How would you define cultural diversity?

ACTIVITY 2

Cultural roots of science and mathematics (45 minutes)

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‘What is science/mathematics to you? (3 lines)

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Debate:
Mathematics/Science is an intercultural subject

Statements:

- Science/mathematics is a neutral subject.
- Science/mathematics has nothing to do with culture.
- I can only recall famous Western scientists and mathematicians.
- Science and mathematics are objective disciplines based on a fixed body of knowledge that has been proven over time
- I do not have to pay attention to culture in my science/mathematics lessons because in my class there is no variety in cultural backgrounds amongst my students.

Mathematics/Science is an intercultural (or multicultural) subject.

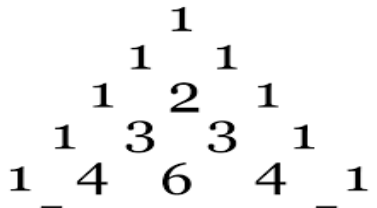
Study one or more of the following examples and answer the questions presented by the edUcator:

- *Science-group:* Science vs indigenous science (worksheet 3)

- *Biology-group*: Biology of race and DNA evidence

https://www.youtube.com/watch?v=VnfKgffCZ7U

- *Mathematics-group*: 'Who invented Pascal's triangle?' (worksheet 4).



ACTIVITY 3

Dilemma cards (30 minutes)

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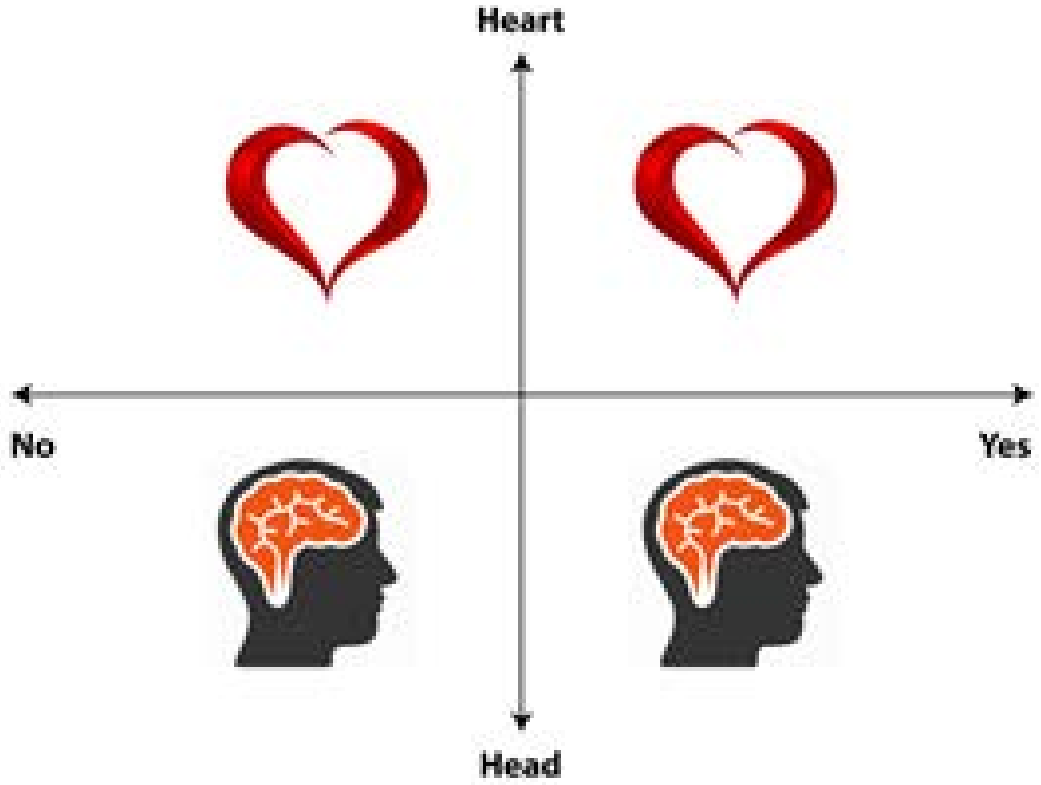
'Move reasoning'



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'Move reasoning'

Did including the 'head-heart'-axis help with reasoning this dilemma?

Is it possible and desirable to use this type of activity (move-reasoning) with your students to address for example cultural or socio-scientific issues?

Dilemma cards

- Have participants choose the dilemma's they are most likely to encounter in their daily teaching practice, and discuss these in small groups.
- Create three areas (poster or table for example) in the room and label these: irrelevant, relevant, very relevant. Hand out 5 cards to each participant let them divide their cards over these areas. Present the distribution of cards to the group and discuss if anyone wants to change the position of a card and motivate that decision. Can they convince the group to agree on changing the position of the card?
- Hand out or let the participant pick three dilemma's and let them describe how they would overcome these dilemma's in their classroom. In doing so have them share good practises from their own teaching.
- Ask participants to think of more dilemma's, for example ones that they did encounter in their daily practice. Add them to the list and discuss them briefly: do other participants have similar experiences

Homework: design of a teaching activity

Prepare an IBL-teaching activity for your diverse class using a context-based approach and incorporating elements addressed in the previous activities.

Choose to focus on (1) using a context that uses cultural diversity of students as a 'resource', (2) addressing the cultural roots of mathematics or science or (3) including moral dilemmas or socio-scientific issues related to cultural diversity.

Preparation Homework assignment

Work together in small **subject specific** groups on designing a first draft of the teaching activity. Let them prepare a general outline in which they :

- Identify the class, the topic and the elements you want to include
- Formulate (SMART) learning goals and make sure the activity and teaching method fit the intended goals.

Briefly discuss the following questions:

- How will your teaching activity (the context and IBL) ensure the involvement of **all** students and take into account the (cultural) diversity in your class? What is your role as a teacher?
- Will it be possible for all your students to relate the activity to their own cultural background? Which elements in the activity support this? What is your role as a teacher to achieve this?

Homework --> Design & try-out

ACTIVITY 4

Different ways to tackle and solve problem (45 minutes)

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Different ways to count and calculate (examples from mathematics)

Worksheet 7 contains examples of different ways to work out calculations (multiplication and division) on paper.

- Analyse each calculation method and compare it to the one would use and one your students may use.
- How could you deal with these differences?

Part b: Different ways to react to open problems (and IBL)

Make groups of three participants: two will act as problem-solvers and one as observer/note-taker.

1. How much water will you save while brushing your teeth if instead of leaving the tap open you close it?
2. How could you separate the salt from the sand taken from a beach?

The two solvers together solve the problem out loud. The observer makes notes about the process.

Different ways to react to open problems (and IBL)

(in subject specific) small groups:

Discuss how you think your students would react to these (or similar) open problems and IBL?

- What would be students first reaction and how would they proceed?
- What influences the way in which different students react. Do background, culture, language, previous experiences play a role?

ACTIVITY 5

Students as scientists (30 minutes)

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What is science and mathematics?

The definition of science/mathematics differs substantially between people (activity 2) this may be influenced by factors such as (cultural) background, age, education, gender etc..

- How would you be able to figure out how your students see, do and think about science and mathematics? 5 minutes

Case study

Boyan Slat Worksheet 9

In small groups discuss:

- What message does this example present to you?
- Can you relate this example to science/mathematics?
- What scientific qualities of the student contributes to the success of their actions?

- Would you present this example to your students? If so, how would you do this? What tasks would you give your students?
- How do you expect your students to react? You may want to distinguish different reactions of different (groups of) students.

Case study

Further discussion:

- What do you picture your students doing with the scientific knowledge and skills you taught them, in 5 or 10 years from now? How about the more general skills like: IBL, Problem solving, research techniques etc.

- What other skills would you like to teach your students to be successful in their career or adult life?

Scientific role models

- Do you know of scientists your students admire or see as a role model? Which scientist do you expect your students to identify with? Take into account the diversity in your student population.
- Do you think it important to stimulate your students to broaden their perceptions on science and scientists? Why?
- What can you do in your lessons (activities, tasks, assignments) to help students to identify more with scientist and to relate their perceptions of science and scientists to their own background/history/gender/culture/….?

ACTIVITY 6

Language in multicultural science and mathematics classrooms (30 minutes)

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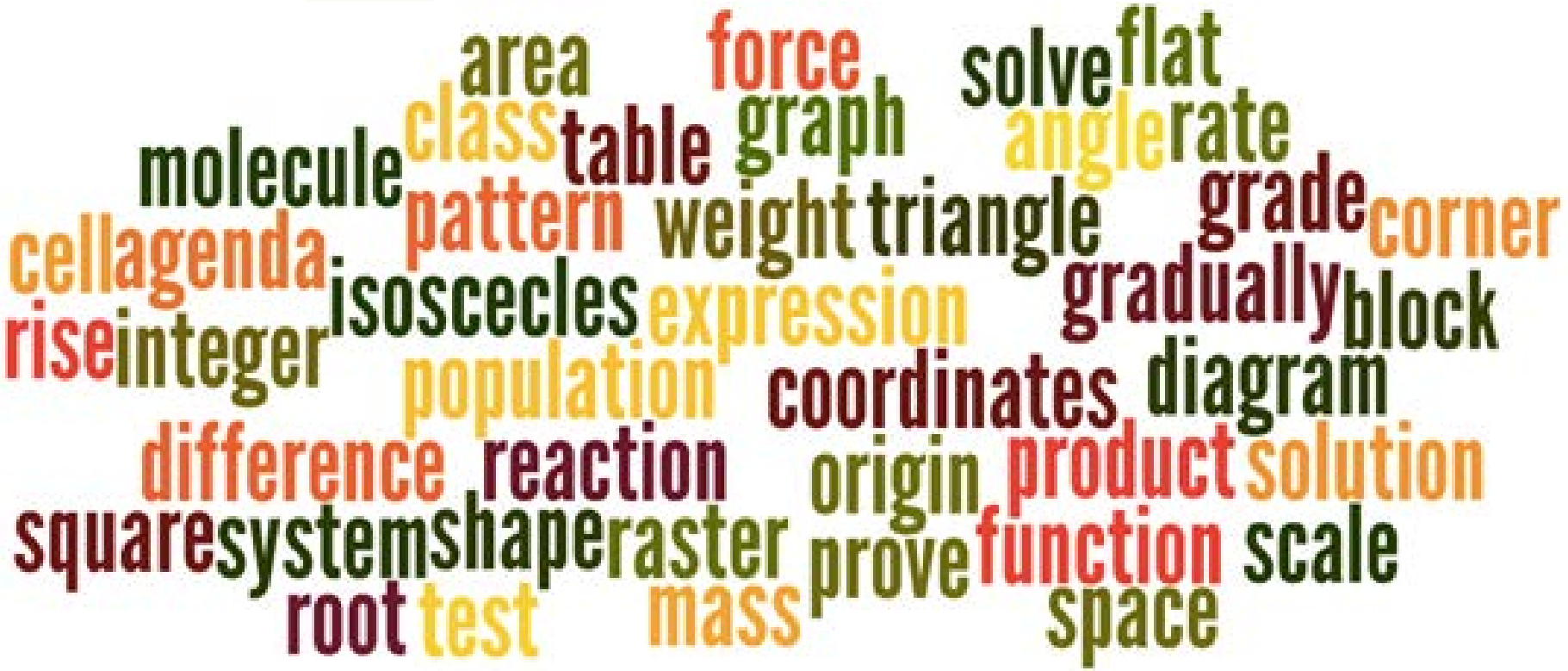
The relevance of language for learning mathematics and science



Actvity with the word-cloud

- Individually select 3-5 words that are typical for your subject.
- Next form small mixed-subject groups and discuss the questions below:
  - Which of these words are also part of our daily language? How is the meaning different in your subject and in daily life?
  - Write down two typical expressions (or sentences) using one of these words. One in daily language and one for your subject.
  - What problems do you expect your students may have regarding this ‘shift of’ meaning? Is this different for students who are native speakers in your language and for students who are not?
  - Think of ways to help your students acquire the ‘language of mathematics/science’.

Read the text

- Teachers can help all students learn science by allowing diverse approaches to scientific reasoning in their classrooms. For example, students might use both their first and second languages to engage in science. Jean-Charles, a student in a sixth-grade bilingual classroom, used English to clarify technical terms not present in his first language, Haitian Creole. **By expressing his ideas in two languages, he used his full range of linguistic capabilities to develop more in-depth arguments and understanding of metamorphosis in mealworms** (Warren, Ballenger, Ogonowski, Rosebery, and Hudicourt-Barnes 2001)

Multilingual classrooms

Discuss in small groups:

- What is your opinion about students in your classes using more than one language?

- Do you have students in your classroom with a bilingual background? Are they allowed to use their 'mother tongue' language for peer communication? Exchange arguments for and against the use of students first language (T1).

Evaluation

Please fill out the questionnaire to help us evaluate and further enhance the PD course.

This Module outline is based on the work within the project *Supporting mathematics and science teachers in addressing diversity and promoting fundamental values* (MaSDiV). Coordination: Prof. Dr. Katja Maaß, International Centre for STEM Education (ICSE) at the University of Education, Freiburg. Partners: Universidad de Jaen, Jaen, Spain; Universita ta Malta, Msida, Malta; University of Nicosia, Nicosia, Cyprus; Ministry of Education and Culture, Nicosia, Cyprus; Ministerio de Education, Cultura y Deporte, Madrid, Spain; National Ministry of Education, Ankara, Turkey; Hacettepe Universitesi, Cankaya Ankara, Turkey; Ministry for Education and Employment, Floriana, Malta; Ministerium für Kultus, Jugend und Sport Baden-Württemberg, Stuttgart, Germany; Universiteit Utrecht, Utrecht, Netherlands; Leibniz-Institut für die Pädagogik der Naturwissenschaften und Mathematik, Kiel, Germany; Ministerie van Onderwijs, Cultuur en Wetenschap, Den Haag, Netherlands.

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