DIVERSITY AND ACHIEVEMENT IN SCIENCE AND MATHEMATICS CLASSROOMS

PD Module 1 of the MasDIV project









Aims of the session

- Discuss beliefs and practices for addressing diversity in science and mathematics
- Explore resources and teaching methods that take the opportunity of diversity in achievement in the classroom
- Learn about the relation between diversity and inquiry-based learning
- Prepare a lesson plan





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Introduction and exploring experiences with diversity (30 minutes)









Experiences with diversity (act 1)









Experiences with diversity

- Think of two students in your class, one who is particularly strong and one who is finding the work very difficult
- Describe to your neighbour the students' strengths and difficulties and include the evidence for your judgements (e.g. test results, responses during lessons, student work, ...)
- In what ways do your experiences with these students affect your lesson planning? Give examples





Characteristics of inclusive education









Diversity asks for inclusive education

What could be characteristics of inclusive education?









Diversity asks for inclusive education

 Explore what inclusive education involves according to Booth & Ainscrow:

http://www.eenet.org.uk/resources/docs/Index%20English.pdf

 Which point do you recognize in your practice and which are new to you?









Collecting information to build on what students know









Diversity asks for information

- Teacher: "It's all very well telling us to build on what students know, but how can a busy teacher know what is going on inside 30 individual heads?"
- How would you respond?









'visible' reasoning (Handout activity 3)

- <u>http://primas.mathshell.org/pd/modules/6_Building</u>
 <u>on_Knowledge/html/videos_c1.htm</u>
- How would you apply one of these strategies in your lesson next week?
- Discuss suitable topics and how to approach them → Peer feedback/suggestions.
- Design lesson plan/activity.





Diversity asks for information

- Two examples for collecting and sharing information:
 - Use the mini whiteboard to:
 - Make a drawing that can be used to explain climate variations during the four seasons
 - Find rectangles that have value-wise the same area and circumference
 - Draw a velocity-time graph of a parachute jump
 - Use the poster:
 - Four groups order submarine sandwiches: 5 persons buy 4 sandwiches; 4 buy 3; 5 buy 3 and 8 buy 7 Create a poster to illustrate in which group each of the persons gets most (when equally divided)
- Watch the videos on the use of mini whiteboards and posters and discuss their potential

http://primas.mathshell.org/pd/modules/6_Building_on_Knowledge/html/videos_c1.h tm





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Diversity asks for information

- Identify a topic that you have to teach shortly after this session that seems suitable for one of these approaches
- Discuss idea(s) with your neighbor(s)
- Formulate conjectures on how this method could help to collect information and to inform your further (inclusive) teaching





IBL and diversity in achievement









IBL and diversity

• Take a look at a lesson in which students inquire:

http://primas.mathshell.org/pd/modules/1_Student_led_inquiry/html/videos_1.htm

- What are students doing?
- What elements of doing research yourself do you recognize?
- How are the teacher and the task supporting students' inquiry?







IBL and diversity

Draw out and work with students pre-existing understandings to make student 'thinking' visible and central to the learning.

Investigate

Create

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Reflection activities helps students take control of their learning by facilitating thinking about their learning (i.e. metacognition).

Ask

Students gain competence in their area of study by organizing factual knowledge around conceptual frameworks, to facilitate knowledge retrieval and application.

Reflect

Students engage with research by discussing, debating and present their findings to communicate their understanding and results. An inquiry may seek to help students learn about existing knowledge, or it may challenge them to produce new knowledge.

Discuss





IBL and diversity

- What is the relation between IBL and dealing with diversity?
- Design a lesson with IBL characteristics (task, resources, teaching method, learning goals) inspired by the Building a School situation.
- Compare the lesson plans and discuss the differences and similarities (in groups).





Findings from research

- Minner et al. 2010
- Bruder & Prescott, 2013, Amaral et al. 2002
- Deci & Ryan 2002
- EU working group (EC 2015, 2013)









Teaching methods that involve all students









Teaching methods

- Methods to address diversity are:
 - Creating level groups and using differentiated materials
 - Providing out of school support for low- and/or high achievers
- What are advantages and disadvantages of these approaches?









Teaching methods

What methods can you think of that involve all students to participate?









Addressing diversity by providing students sample work









Peer review

- Diversity in achievement levels can be addressed through organizing (peer) feedback
- The key issue is to provide students with information they can act on and that improves their learning
- Peer review assignments helps them to appreciate and learn from different solution methods





Peer review – watch video

http://primas.mathshell.org/pd/modules/7_Self_and_Peer_Assessment/html/videos_ b.htm_

Consider the following questions:

- What aspects of the provided work do students attend to?
- What criteria do students use as they assess the sample work?
- What do students learn from assessing the sample work?





Peer review

- Discuss possible concerns
- What criteria would you use for choosing sample work to use with students?









Design and prepare a lesson for your diverse classroom









Summary

- Differentiate in teaching methods
- Differentiate in level and type of tasks
- Differentiate in time for a learning route
- Use open inquiry tasks (with low floor and high ceiling) on which all students can work on their own level of performance









Prepare a teaching activity (homework)

- Be explicit about aim, tasks, teaching methods and learning goals
- Identify in advance some (e.g. three) students in your classroom on different performance levels
- Plan how to use, build on or take account of contributions of these students in your lesson plan
- Include a reflective activity for all students









Annex: Escape room challenges

See activity 5: Teaching methods









To avoid staying clueless solve the



I 30

Goal:

→ Small but mentally challenging jigsaw puzzle for example "Wasgij".

Clue on the back of the puzzle (letterring), and extra piece with number on it (which they need in the final assignment)

http://www.wasqij.co.uk/ http://www.wasqij.co.uk/online-puzzles/mini-puzzle-4





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Challenge 2

- My liquid content shall not be touche
- Use simple physics to get my solid ma clutched



Goal

→ An opaque liquid is given with this text. Extract the object "solid matter" with help of the magnet to reveal a note with a number (contributing to final assignment) and the code for translation A=Q (in this example)





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White's move to win?!

Goal:

Figure out which move generates the win for white.
 Call of the number from that piece for Counted by the second seco

final assignment.



International Centre for STEM Education

Sorted by atomic number, only use the first nine to complete

	Н	В	He					
	He	0	Be	N		В	С	
	F	С			Li	He	Н	
0	N	F	Li	Н	He			С
		Li	F	0	с	N		
н			Ν	Be	В	0	F	Li
			C			Н	Li	
	Li	Н		He	0	С	Be	
	В	Be			N	F	0	

Goal:

- The clue leads the participants to the elements-Sudoku (or hand it out to save time).
- → Finished the puzzle? Get a number you will need in the final task and the second letter ring.





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- I like to move it move it!
- Part 1: Combine the models of the joints with the number on the skeleton. Which important synovial joint is missing?, add this to the table with model drawing.
- Part 2: Calculate the movement of joints you use in this dance:

(shake your head to the sound) * (swing your arms round and round) + (just wave with your hands) - (kick your leg in and out) - (show of your biceps!) + (thumbs up!)= answer

Goal

MaSD

- → Combine table with skeleton and knowlegde of joi
- → Part 1 succeeded? Hand out Part 2 "calculate the
 = number final assignment
- → Get the second part of the incrypted code: A2



Bringing it all together!

Q1 (translated)

- Great Team effort!
- Bringing it all together to reveal the code

A2 (translated)

- From the inside out
- Count on your teams and it will all add up

Goal:

- → Get all the teams to work together and try to figure out how their clues will fit in the bigger picture
- → Crack the encrypted code → last clue combine al the collected numbers to open the lock.





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