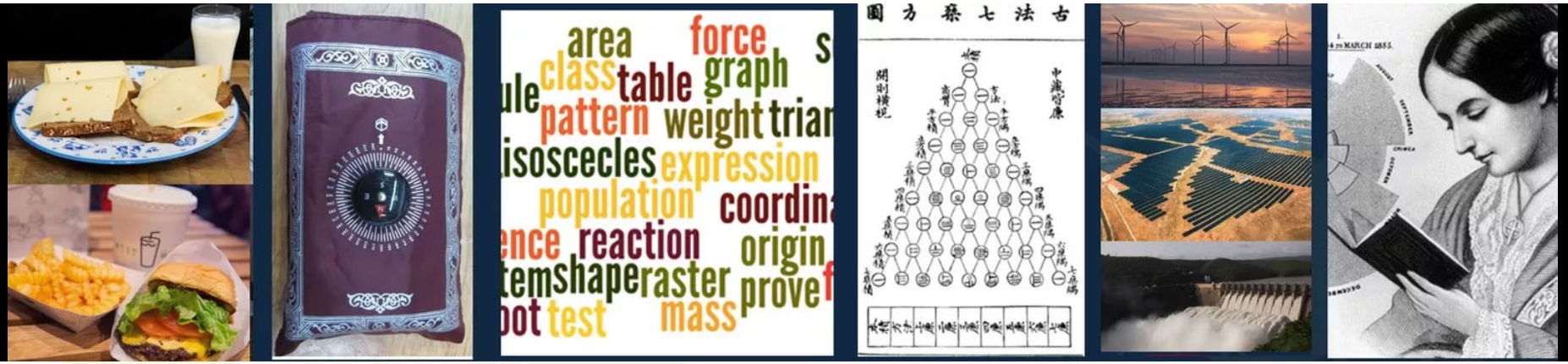


ICSE Academy

Diversity and inclusion in STEM - Session 2

Analysing and designing STEM tasks for diversity and inclusion

Monica Wijers, Vincent Jonker, Sanne Korte & Michiel Doorman
Utrecht University, The Netherlands

ICSE Academy
Co-funded by the European Union
Utrecht University
Pädagogische Hochschule Freiburg
Université des Sciences de l'Education · University of Education
ICSE International Centre for STEM Education

Plenary lecture

AIM

Understand how tasks can be used to organize activities that take the opportunity of diversity (on various dimensions) in your STEM classroom

Plenary lecture

PROGRAM

- Introduction – plenary
  - Looking back and sharing example tasks
- Working groups
  - Reflection on the examples

Break

- Feedback on reflections – plenary
- Introduction of activity design template – plenary
- Working groups
  - Start designing an activity that takes the opportunity of diversity in your STEM context
- Sharing, feedback & closure – plenary

RECALL SESSION 1

- Underrepresented (risk of excluded) groups in STEM: (dis)ability, culture, gender, SES
  https://padlet.com/kdemetriou/underrepresented-minorities-in-stem-education-7nnifrr4b987otjn

- Plea for becoming (culturally) responsive to meet the needs of learners
- Paradigm shift from acknowledging diversity to taking the opportunity of diversity
- Reflections on diversity and inclusion (homework)

REFLECTION ON HOMEWORK

Homework:

- Self reflection tool
- Diversity in your teaching setting

Post one eye-opener of session 1

https://app.wooclap.com/MDAFJO

RECALL SESSION 1

- Underrepresented (risk of excluded) groups in STEM: (dis)ability, ethnicity/culture, gender, SES
- Plea for becoming (culturally) responsive to meet the needs of learners
- Paradigm shift from acknowledging diversity to taking the opportunity of diversity

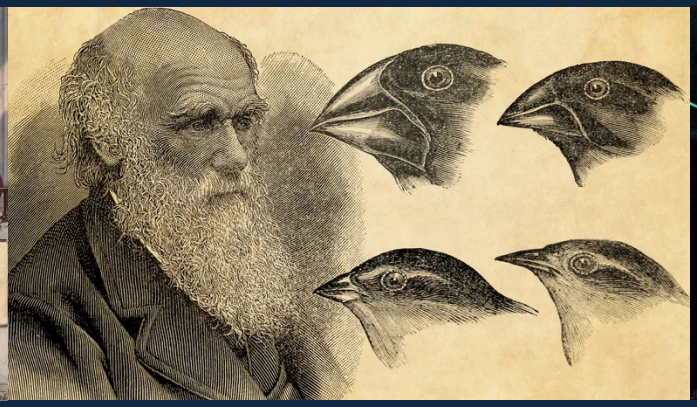
We will focus on:

- **How to take the opportunity of diversity in STEM education?**
- Diversity in cognitive ability, multiculturality & gender related to STEM
- Your (classroom) context and possible activities with tasks

Diversity & inclusion

The science stories we tell

Science is developed by Western, white, male scientists (needs debunking)

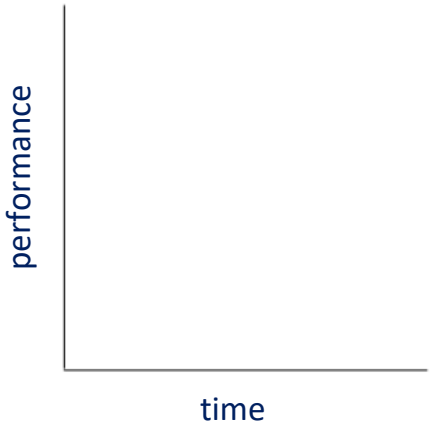



Diversity & inclusion: Adapt to needs

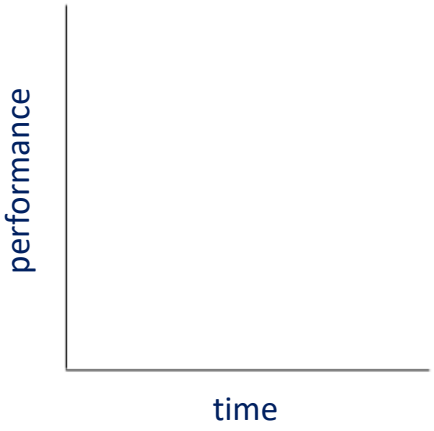
Risks of creating homogeneous groups on ability, gender, culture, …

Diversity & inclusion: Adapt to needs

Risks of creating homogeneous groups on ability, gender, culture, …



Whole class
Learning from each other
Extra support for specific students



Adapt to needs
Grouping
All groups same amount of support

Journal of Mathematics Teacher Education (2020) 23:463–482
https://doi.org/10.1007/s10857-019-09436-1

Hidden mechanisms of differentiation: teachers' beliefs about student diversity

Galina Larina[1] · Valeria Markina[1]

Published online: 17 May 2019

Differentiation: grouping resulted in labelling of and fixed effect among students
Inclusion: teachers tended not to organize and label students in categories

Addressing diversity in Science education

"Diversity seen as an opportunity"

Why?

- Tell the full story of science (Ash e.a., 2018)
- Avoid divergence between groups (Deunk e.a., 2015)
- Avoid labeling, fixed-effect (Larina and Markina, 2019)
- Create a culture of belonging (Rainey e.a., 2018)
- Prepare for participating in a diverse society (Sorge e.a., 2023)

Also see slides/references of session 1 by Kyriakos Demetriou!

Examples of HOW to take the opportunity of diversity in STEM education

Pro-active (planning inclusive classroom practices & responsive pedagogies)

1 – Use of rich contexts

2 – Address culture in (history of) science

3 – Involve variety in home situation, local ecological knowlege

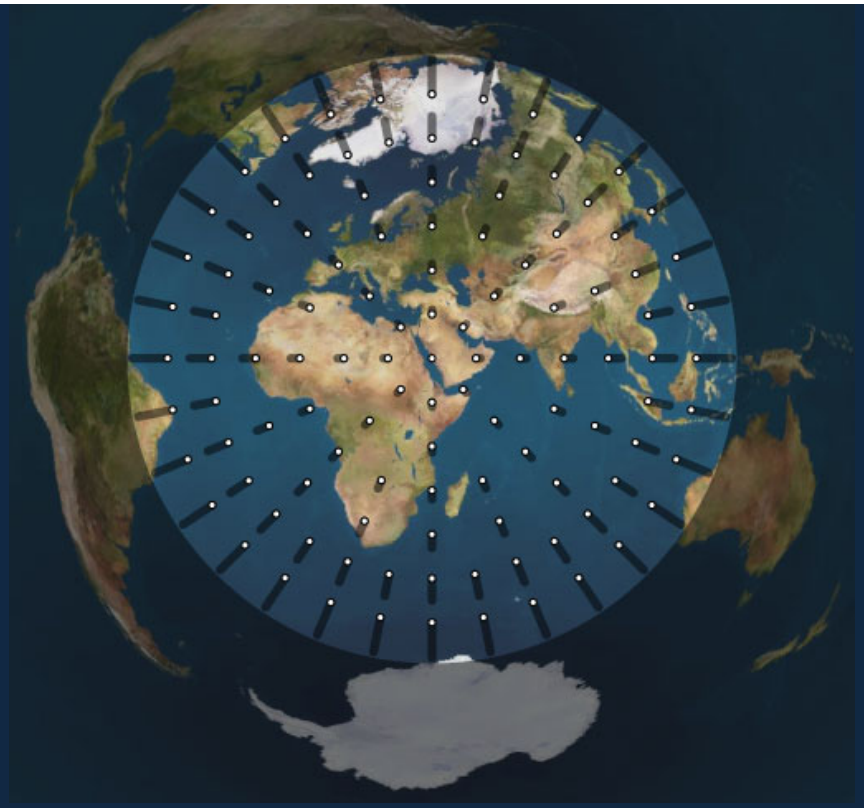
4 – Use role models

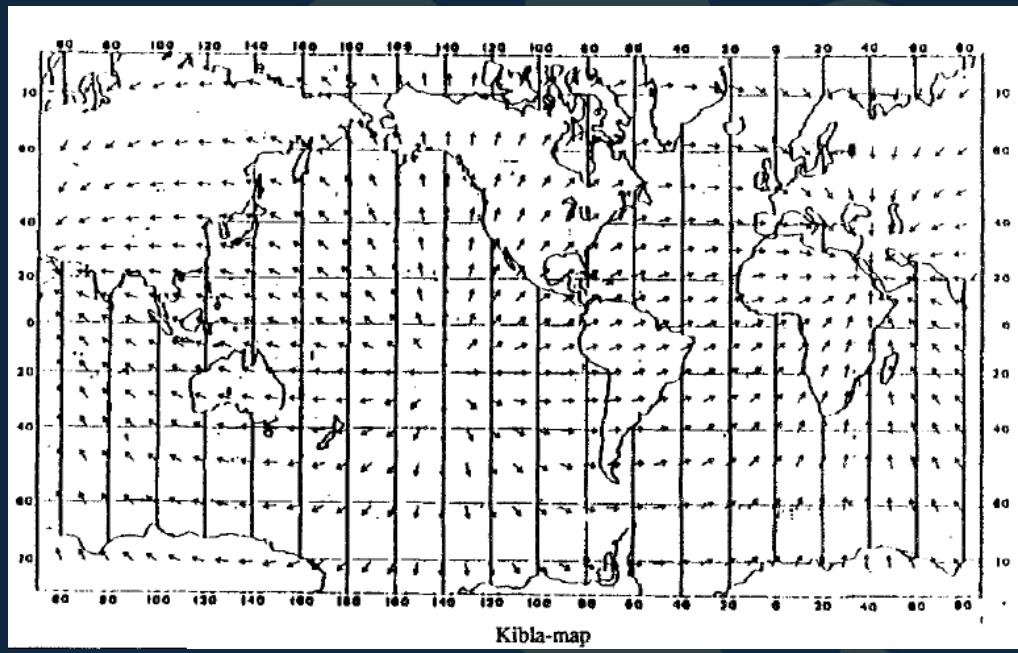





1. Dimensions of diversity: culture & region & …
2. Design: encourage sharing of traditions & underpinning
3. Learning based on multiple voices: variety of meals is a resource for discussing healthiness, ingredients, …

Use rich, multicultural contexts





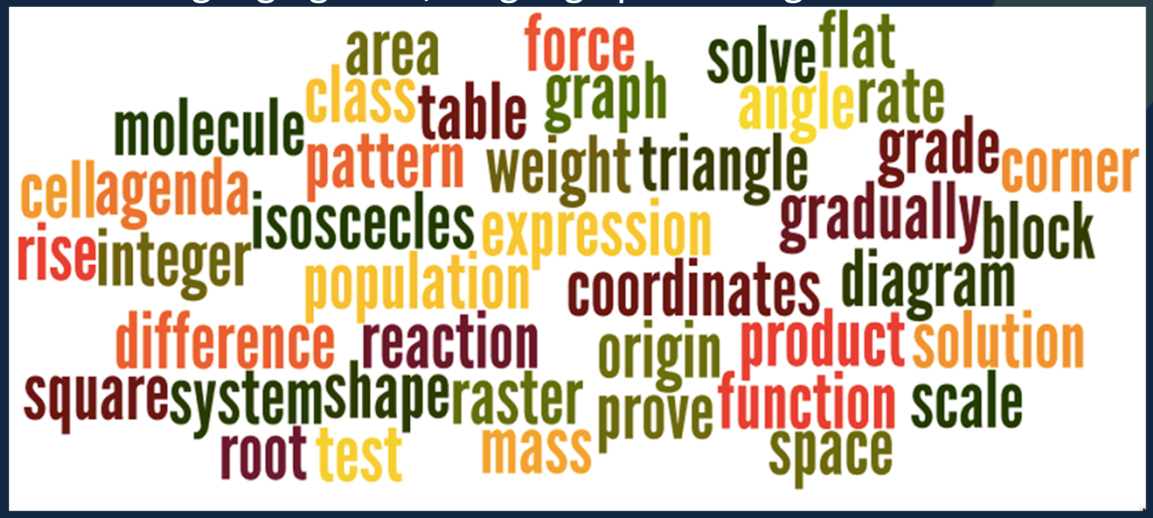
WHERE IS MECCA?

Use rich, multicultural contexts

ICSE Academy

Rich contexts bring language

- Include language games, language promoting activities

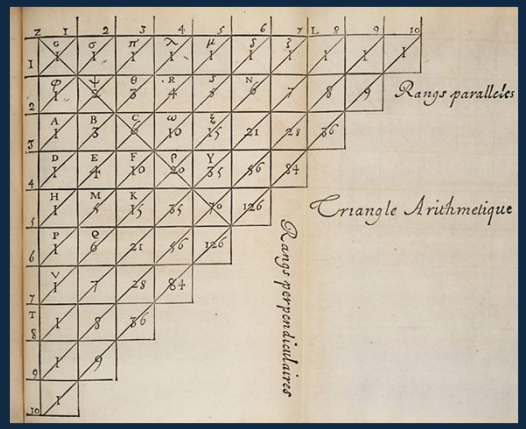


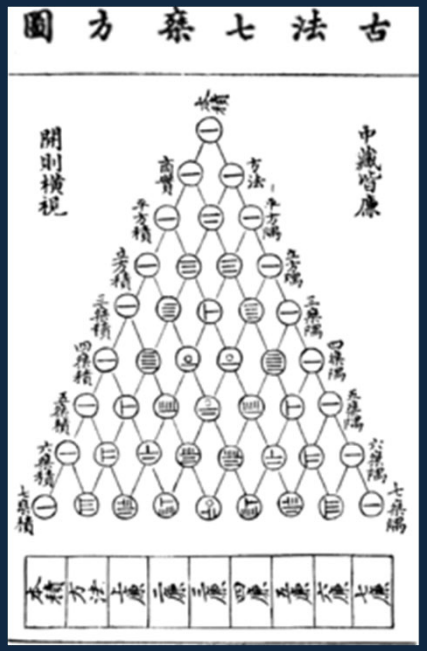
Include language promoting activities

- Select 5 words that are typical for science or mathematics
- Which of these words are also part of our daily language? How is the meaning different?
- What is a typical sentence using this word in daily language and in science?

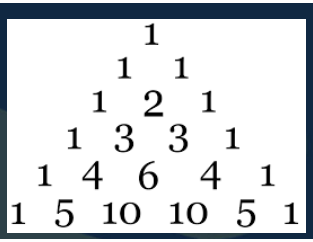
Multi-Cultural history as a resource

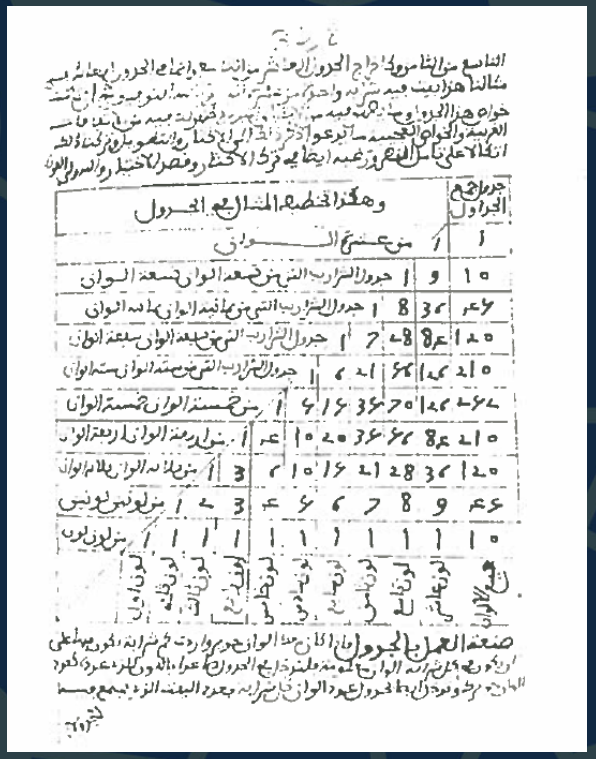
Blaise Pascal (1665)





Zhu Shijie, 1303





Ahmad al-Ad'dari ibn Mun'im around 1200

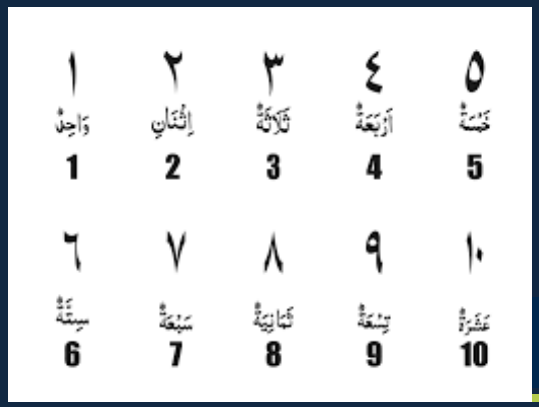
Address the multicultural history of science

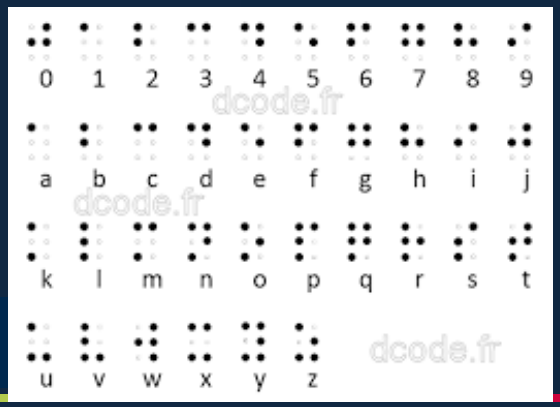
diverse methods as a resource

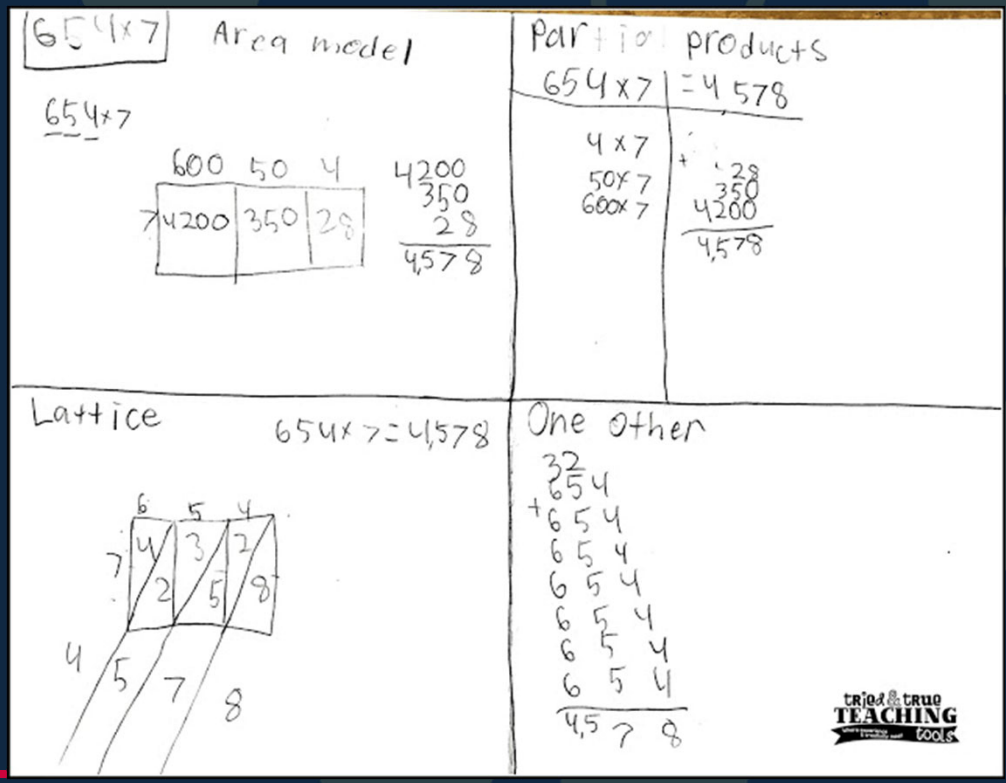
Involve knowledge from home situation

Algorithms: 654 x 7

- How do you calculate?
- And how do your parents calculate?
- How do you write/read numbers?

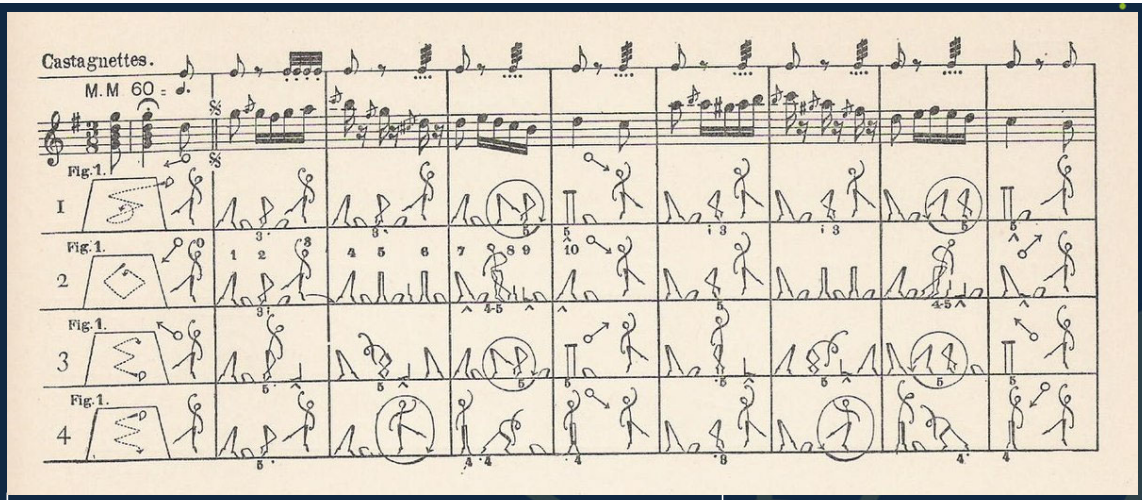






Dance and Music (STEAM)

Sound
Patterns, rhythm and movement
Notation
Balance
Cultural practices
Creativity



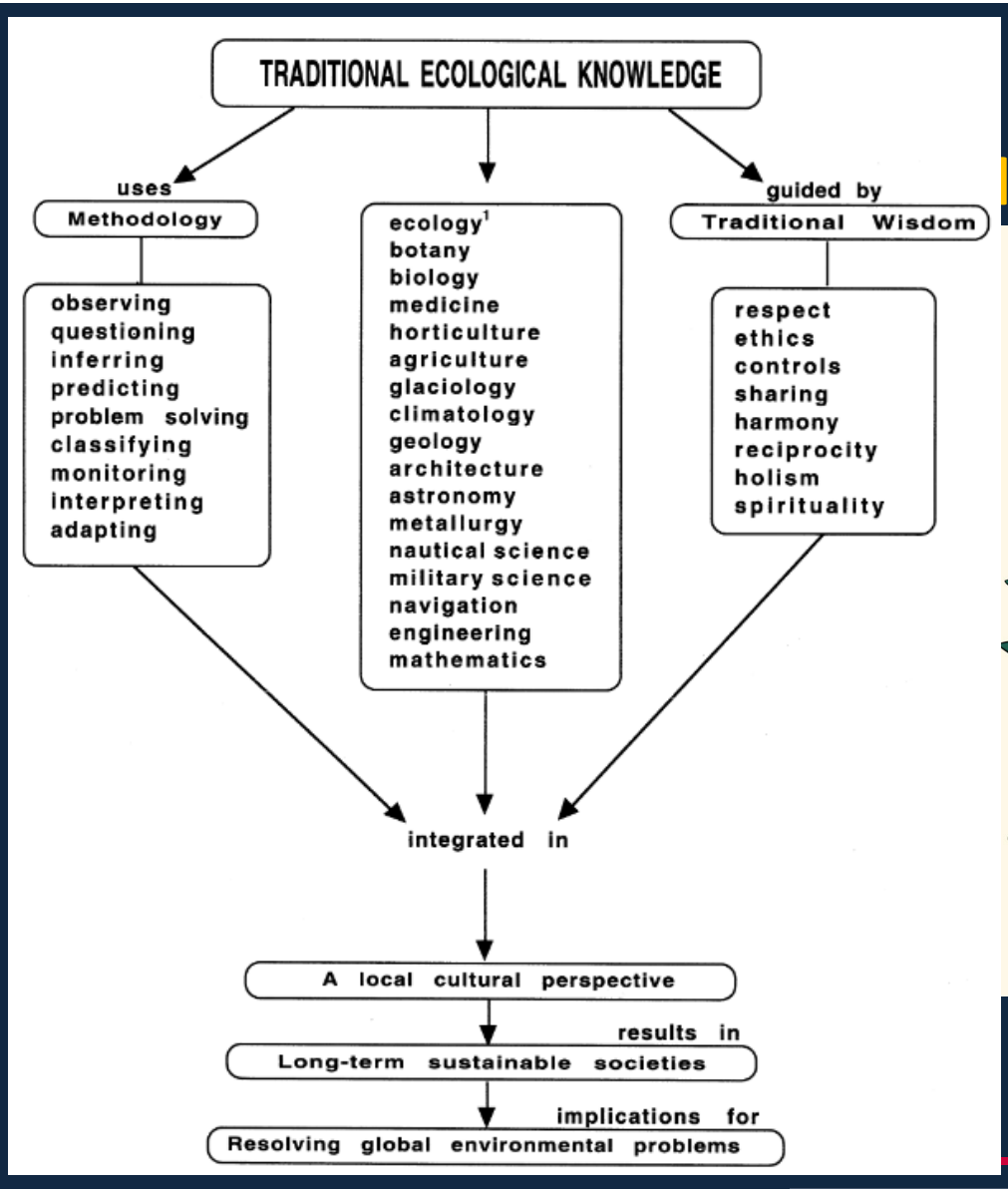
Source: https://en.wikipedia.org/wiki/Dance_notation

Source: Utilizing dance resources for learning and engagement in STEM
https://doi.org/10.1080/10508406.2021.2023543

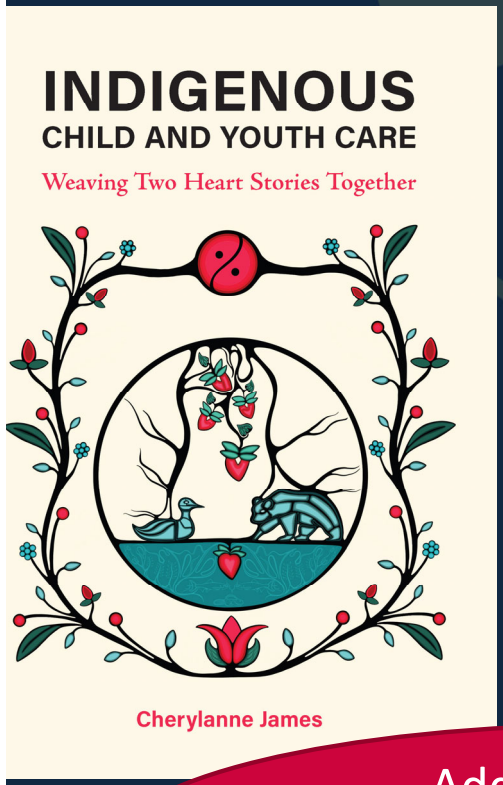
Figure 1. Students form structure to explore balance and opposing forces.

Consider creative opportunities from STEAM

ICSE Academy
International Centre for STEM Education



ls as a resource



Address variety in cultures/countries and study various perspectives on science

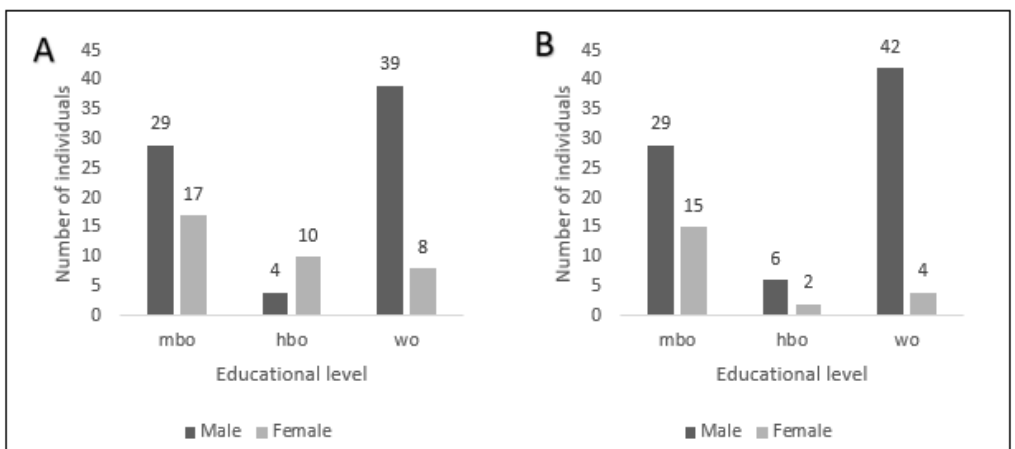


Figure 2 | *The number of individuals mentioned in biology textbooks (A) and physics textbooks (B) categorized by the educational level of the occupation per gender.*

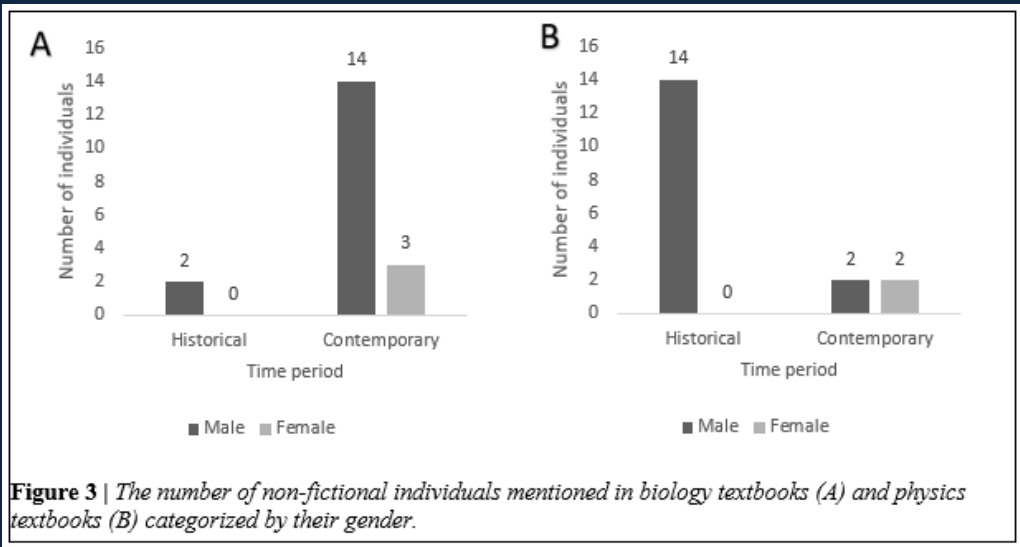
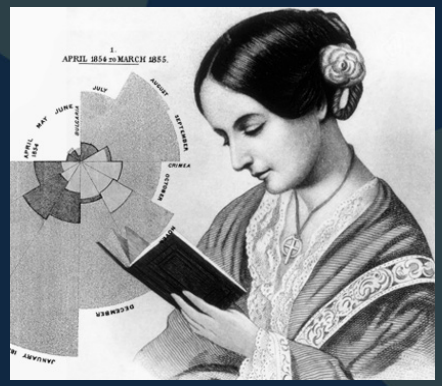


Figure 3 | *The number of non-fictional individuals mentioned in biology textbooks (A) and physics textbooks (B) categorized by their gender.*

Include a variety of role models

Florence Nightingale



Alice Ball

Melanie Montizaan (2022)

How can you take the opportunity of diversity?

Formats for planning inclusive classroom practices

1 – Use rich contexts (& language promoting activities)

2 – Address culture in (history of) science

3 – Consider opportunities of STEAM

4 – Involve variety in home situation, culture and country

5 – Use role models

Group work on examples

- Join the same breakout room as in session 1 one of this cluster (6 rooms – new ones can join room 7)
- Which examples inspired you?
- Which can you use in your classroom and why (connecting content to a dimension of diversity – ability, culture/language, gender, …)
- Formulate (short) how students' contributions might be a resource for (inclusive) science/STEM teaching

Make notes in the padlet

https://padlet.com/mdoorman/stem-teaching-diversity-inclusion-kshcos8kjf31f33y

BREAK

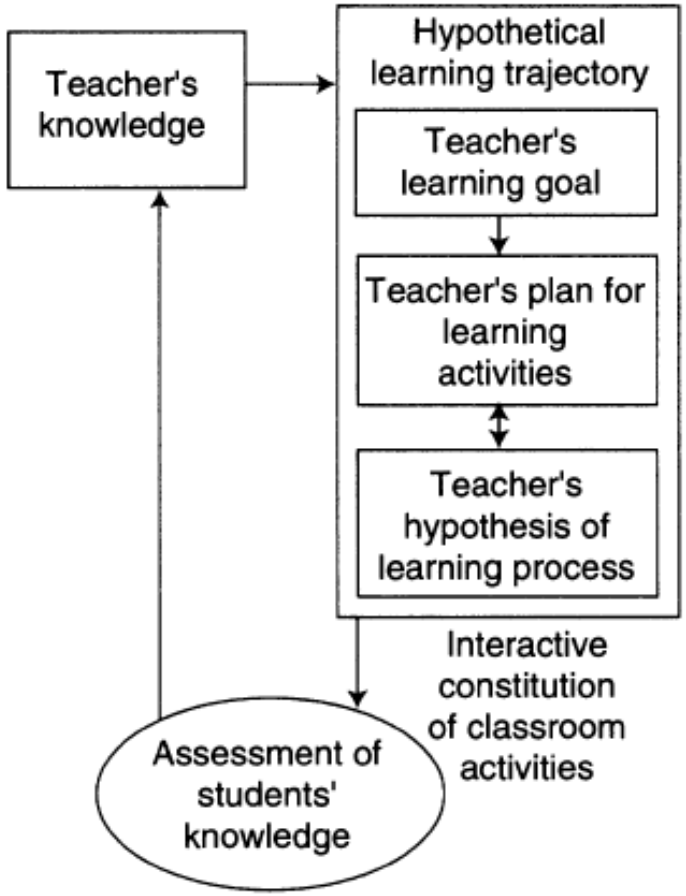
Reflection on examples

- Which examples inspired you
- Which can you use in your classroom and why (connecting to a dimension of diversity – ability, culture/language, gender, …)
- Why? How can learning be based on multiple voices?

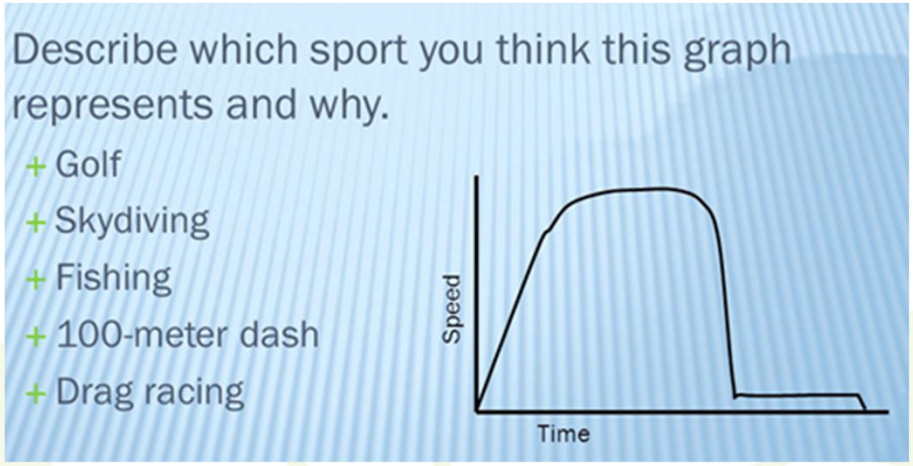
Towards an activity design template

- A model for teacher decision making with respect to activities/tasks
- Central to this model is the creative tension between the teacher's goals with regard to student learning and the responsibility to be sensitive and responsive to the thinking of the students (Simon, 1995)

➢ Importance of formulating hypotheses for extending teacher's knowledge



Example design



Expected answers:

"Golf, because the ball is first going into the air before it drops on the grass."

"Skydiving since first speed is increasing when you dive out of a plane and after your parachute opened you drop with constant speed."

"Fishing, because it looks like how you throw with a fishing rod and in the end the bobber floats on the water."

Name				
School				
Subject			Grade level	
Which topic did you choose for the activity you design. Give a brief description of the teaching material(s), the assignment(s) or tasks for the pupils and the teaching method(s).	Reasoning about a graph with two axes and a changing quantity; introduce language of change (go up, down, increase, decrease, constant, …)			
Plan for the activity.	time	Activity teacher	Activity pupils	Other relevant info
	1. Provide graph & task and let students work in small groups: choose sport and describe what is represented 2. Collect on blackboard sports and their words 3. Group math-related words and connect them to graph characteristics (address misconceptions)			
For what dimension of diversity did you design this activity (e.g. achievement, culture, gender, language, …) and how do you take care of inclusion?	Dimensions: Cognitive ability, culture, language Inclusivity: ensure that not only sportsman feel addressed			
How and why do you think that your activity will take the opportunity of diversity for teaching the topic?	Language of students in familiar contexts provides opportunities to connect graph talks to words that are meaningful for students with diverse backgrounds and to tackle misconceptions			
Experiences during the lesson (or expectations): what student behaviour did you observe (different than normal)? What did you observe with respect addressing diversity with this task?				

Design an initial idea (for try-out)

In your group:

- Choose a topic and a dimension of diversity
- Build on the examples and your context
  - Take into account your answers to the self-reflection tool
- Think of a problem or guiding question for your student activity
- Write how this (hypothetical) addresses
  - How diversity in students' voices/contributions can be a resource for your teaching

Use the Activity design template of your breakout room in Google drive:

https://drive.google.com/drive/folders/1-5M0PBdJw7KDpapf4H-Cj7jVEnuEk6sp?usp=drive_link

Activity design template

Name				
School				
Subject		Grade level		
Which topic did you choose for the activity you design. Give a brief description of the teaching material(s), the assignment(s) or tasks for the pupils and the teaching method(s).				
Plan for the activity.	**time**	**Activity teacher**	**Activity pupils**	**Other relevant info**
For what dimension of diversity did you design this activity (e.g. achievement, culture, gender, language, …) and how do you take care of inclusion?				
How and why do you think that your activity will take the opportunity of diversity for teaching the topic?				
Experiences during the lesson (or expectations): what student behaviour did you observe (different than normal)? What did you observe with respect addressing diversity with this task?				

Share group work experiences

From initial idea to activity design

- Use the activity design template (in Moodle) to design an activity addressing an aspect of diversity, for your (hypothetical) classroom situation

- Be inspired by the examples and resources for STEM teaching:
  - https://www.fi.uu.nl/publicaties/subsets/masdiv_en/
  - https://www.fi.uu.nl/publicaties/subsets/icse_en/
- Multicultural meal:
  - https://www.fisme.science.uu.nl/toepassingen/28638/

Activity design template

Name				
School				
Subject			Grade level	
Which topic did you choose for the activity you design. Give a brief description of the teaching material(s), the assignment(s) or tasks for the pupils and the teaching method(s).				
Plan for the activity.	**time**	**Activity teacher**	**Activity pupils**	**Other relevant info**
For what dimension of diversity did you design this activity (e.g. achievement, culture, gender, language, ...) and how do you take care of inclusion?				
How and why do you think that your activity will take the opportunity of diversity for teaching the topic?				
Experiences during the lesson (or expectations): what student behaviour did you observe (different than normal)? What did you observe with respect addressing diversity with this task?				

Plenary lecture

Points to reflect on before this session

- Which aspects of diversity (cognitive ability, multiculturality & gender) related to STEM have you chosen? Give reason for your choice.
- What kind of tasks have you organized for your classroom to address diversity?
- What difficulties have you met in designing the lesson or in enacting it?

The collaborative groups will prepare a 4-5 minutes presentation around these three points (2-3 slides)

HOMEWORK FOR THIRD SESSION

- **Design** an activity addressing diversity; use the design template
  NOTE: this can also be a short activity of for example 15 minutes
- If possible: **try-out** your activity/lesson plan and evaluate and reflect on this
- Submit the filled in template on Moodle platform and be prepared to report about it in the next session (Role of teacher) with 2-3 slides:
  - Which aspects of diversity (cognitive ability, multiculturality & gender) and why?
  - What kind of tasks have you organized for your classroom to address diversity?
  - What difficulties have you met in designing the lesson or in enacting it?

Thank You

Michiel Doorman

References

- Ash, A., & Wiggan, G. (2018). Race, multiculturalisms and the role of science in teaching diversity: Towards a critical post-modern science pedagogy. *Multicultural Education Review, 10*(2), 94-120. https://doi.org/10.1080/2005615X.2018.1460894
- Deunk, M., Doolaard, S., Smale-Jacobse, A., & Bosker, R.J. (2015). *Differentiation within and across classrooms: A systematic review of studies into the cognitive effects of differentiation practices*. Groningen: GION onderwijs/onderzoek. https://www.nro.nl/sites/nro/files/migrate/Differentiation-within-and-across-classrooms-Review.pdf
- Larina, G., & Markina, V. (2020). Hidden mechanisms of differentiation: Teachers' beliefs about student diversity. *Journal of Mathematics Teacher Education, 23*(5). https://doi.org/10.1007/s10857-019-09436-1
- Sorge, S., Doorman, M., Maass, K., Straser, O., Hesse, A., Jonker, V., & Wijers, M. (2023). Supporting mathematics and science teachers in implementing intercultural learning. *ZDM - Mathematics Education, 55*(5), 981–993. https://doi.org/10.1007/s11858-023-01478-3
- Rainey, K., Dancy, M., Mickelson, R., Stearns, E., & Moller, S. (2018). Race and gender differences in how sense of belonging influences decisions to major in STEM. *International journal of STEM education, 5*(1). https://doi.org/10.1186/s40594-018-0115-6
- Simon, M. A. (1995). Reconstructing mathematics pedagogy from a constructivist perspective. *Journal for research in mathematics education, 26*(2), 114-145. https://www.jstor.org/stable/749205
- Snively, G., & Corsiglia, J. (2001). Discovering indigenous science: Implications for science education. *Science education, 85*(1), 6-34.
- Solomon, F., Champion, D., Steele, M., & Wright, T. (2022). Embodied physics: Utilizing dance resources for learning and engagement in STEM. *Journal of the Learning Sciences, 31*(1), 73-106. https://doi.org/10.1080/10508406.2021.2023543