



Welcome

Nationale Wiskunde Dagen Eindhoven



Culture-related contexts for mathematics (and science)

Contexts and Socio-Scientific Issues in Mathematics Education

Katharina Flößer

Monica Wijers

Agenda for today

- **About us**
- **Mathematics and (cultural) contexts**
 - Building with bottles
 - Equal Pay Day
 - Round up, please!
 - Sleep well!
 - Zero waste stores
- **Mathematics in court**

About us

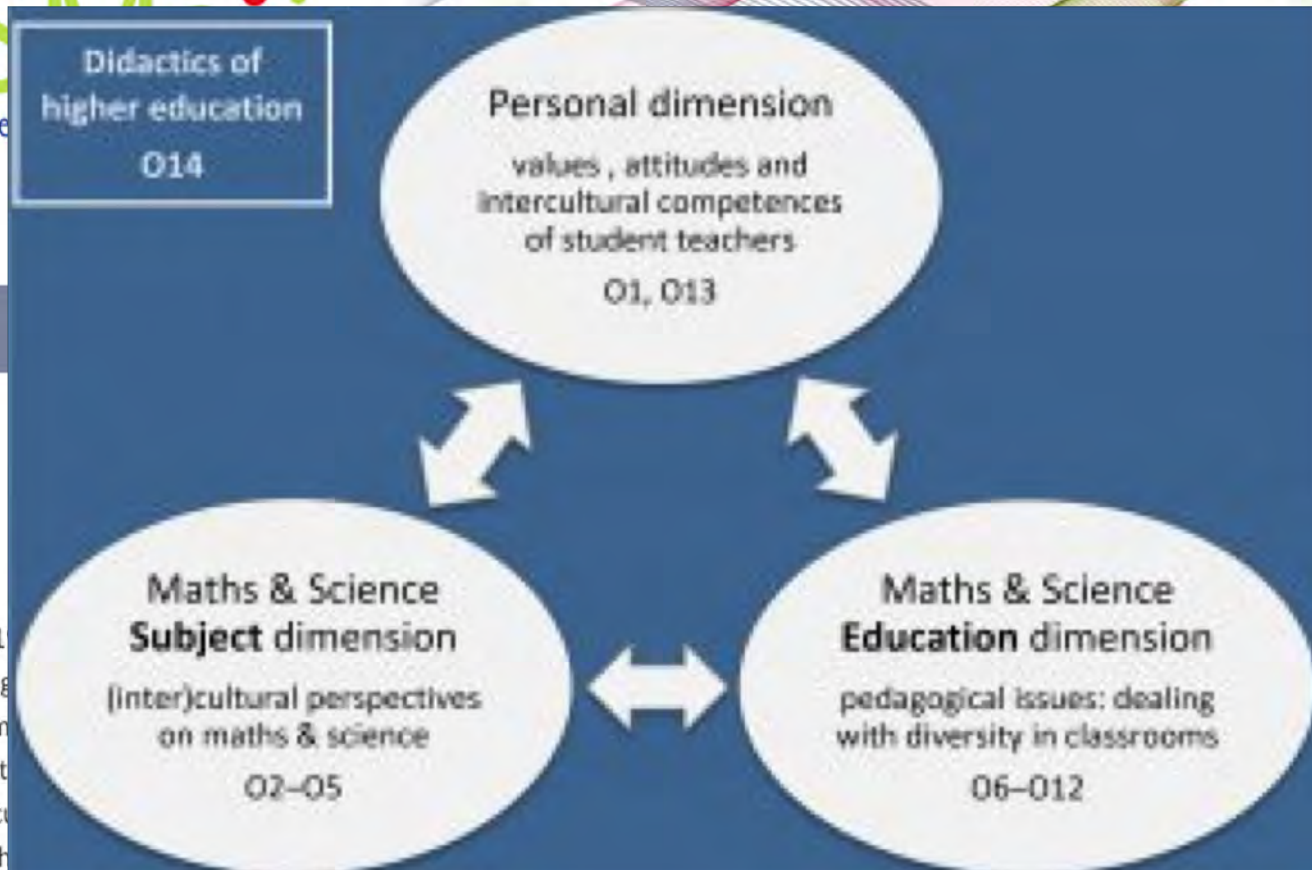


Pädagogische
Hochschule
Freiburg



International Centre for STEM Education





HOME

IncluSMe (2016-2018) is a project funded by the Erasmus+ Programme of the European Union. It aims to develop a framework for an increasing number of initial teacher education societies. The project focuses on initial teacher education with intercultural learning as a core. Core to IncluSMe is the

education. IncluSMe addresses challenges: education for a socially cohesive society in maths and science for science teachers.



MODULE 2

CULTURE-RELATED CONTEXTS FOR MATHEMATICS AND SCIENCE

General overview and aim

Relevant topics

Learning Outcomes

Downloads

In this module teachers at ITE (initial teacher education) are introduced to the role and the use of culture-related contexts for the teaching and learning of mathematics and science.

Background

Students will perform better in science and mathematics when the central concepts are grounded in contexts that can be recognised from daily life – which is dependent on the cultural background of the students and the (prospective) teachers. To prepare future teachers for teaching in cultural diverse classrooms, acknowledging and appreciating the cultural background of their students

From the conference guide



In this workshop, **contexts** like these will be discussed and we will talk about how these contexts relate to different cultures and how they connect to students' and teachers' backgrounds.

Additionally, **mathematics** itself will be **put on trial**. A concrete case will be looked at and we will discuss whether all students are supported by such contexts and how we could make mathematics more meaningful and inclusive for our students.

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What went wrong?

Ges.: R Rechnung: $\frac{230V}{0,2603A} \approx 881,5639 \Omega$ beträgt $881,5638 \Omega$ (u)

f) Wie viel Energie wird vom Stabmixer in 5 min umgewandelt?

Ges.: $t = 5 \text{ min} \cdot 60 = 300 \text{ s}$ Formel: $P = \frac{E}{t} \hat{=} P \cdot t = E$ $\frac{2P}{2P}$

$P = 60 \text{ W}$ Rechnung: $300 \text{ s} \cdot 60 \text{ W} = 18000 \frac{\text{J}}{\text{s}} = 18 \frac{\text{kJ}}{\text{s}}$ $300 \text{ s} \cdot 18000 \frac{\text{J}}{\text{s}} = 5400000 \frac{\text{J}}{\text{s}}$ (u)

Ges.: E Der Stabmixer wandelt $18 \frac{\text{kJ}}{\text{s}}$ pro Sekunde um, also in 5 min 5400 kJ . (u)

g) Wie viel kostet das, wenn eine kWh ca. 30 Ct kostet in Deutschland? $\frac{2P}{2P}$

geg.: $1 \text{ kWh} = 30 \text{ ct}$ Rechnung: $\frac{5400000 \frac{\text{J}}{\text{s}}}{3,6 \frac{\text{J}}{\text{s}}} = 1500000$

$\hat{=} 3600 \text{ kWh} = 30 \text{ ct}$

$\hat{=} 3,6 \text{ W/s} = 30 \text{ ct}$

$\hat{=} 3,6 \frac{\text{J}}{\text{s}} = 30 \text{ ct}$ $30 \text{ ct} \cdot 1500000 = 45000000 \text{ ct}$

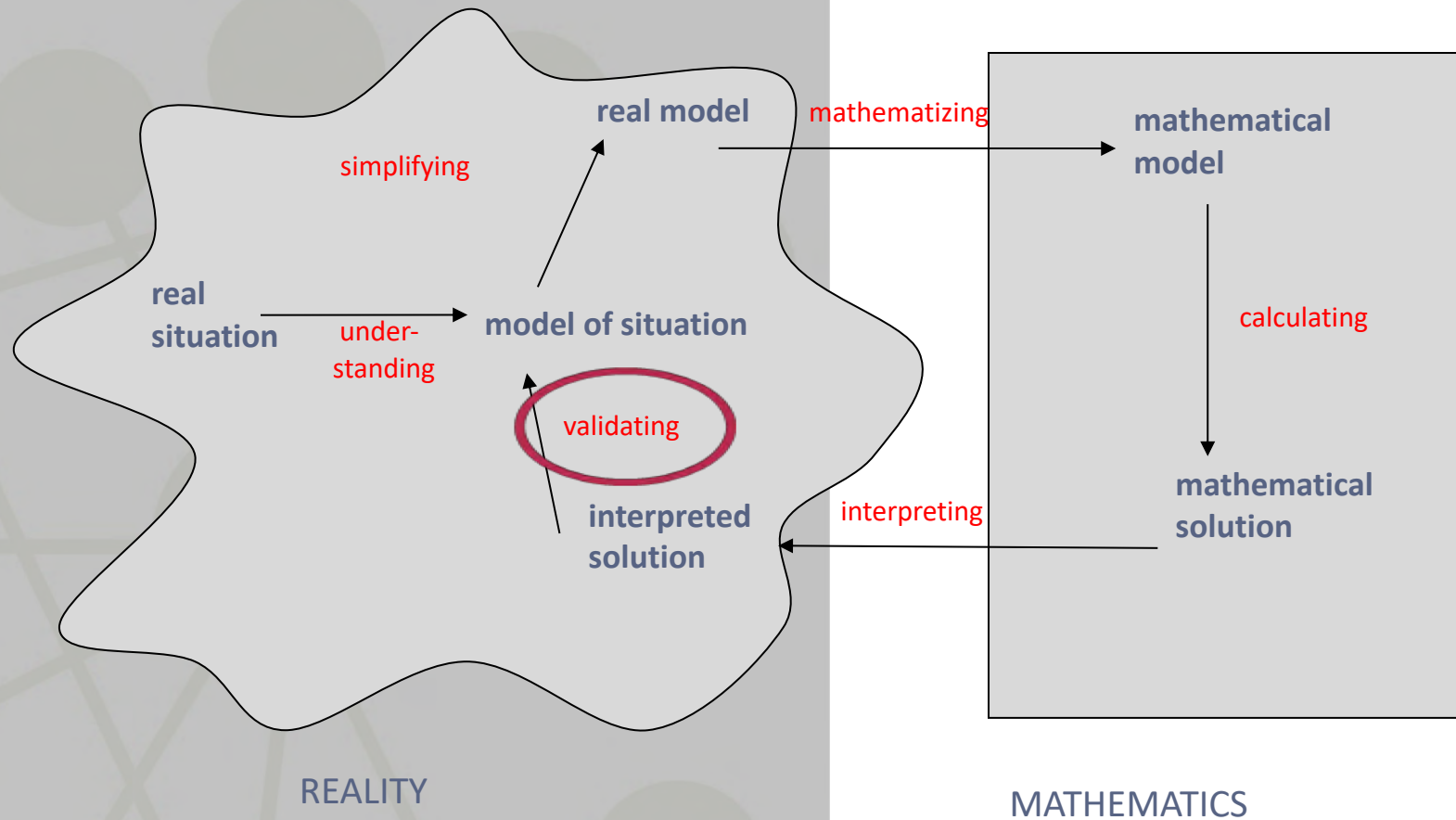
A: Es kostet 450000 € .

\therefore Kosten für $5400000 \frac{\text{J}}{\text{s}}$

Hicks 5M

1400 : 100 = 14%

Research circle



How could one avoid such situations?



Make maths meaningful!!

Mathematics and culture-related, relevant contexts

- Building with bottles
- Caution, Statistics: Equal Pay Day
- Round up, please!
- Sleep well!
- Zero waste stores



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See worksheet



Summarizing

- Is this a culture-related context?
- What mathematics relates to this context?
- Is this context of interest to (all) students?
- Is this a context relevant for society (Socio-scientific issue)?
- What is your opinion on using contexts to address cultural issues or socially relevant issues?



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Caution – Statistics!

Equal Pay Day

Wretched percentage calculation

The so-called Equal Pay Day is commemorated yearly with many events and quite a lot of media attention. In 2014, it was celebrated on the 21st of March. It is worth questioning the timing of this date: the 'Business and Professional Women e.V.' (BPW), who organizes the Equal Pay Day, writes, that it symbolically marks the day, up until which, on average, women had to work longer to earn as much money as men had earned at the end of the previous year. In 2013, the gender-specific wage gap was at 22%. Converted, this makes a time-period of exactly 80 days - from new years to the 21st of March. Women have to work for free in this time.



There is something wrong here!!

Caution – Statistics!

Equal Pay Day



How can this context be used in class? Come up with specific tasks and questions that could be asked.



Caution – Statistics!

Equal Pay Day

As described, the wage gap between men and women is around 22% at the moment. The question on how much longer women have to work until they reach the same amount as men is a simple percentage calculation. Since women earn 78% of what men do, they would have to work $1/0.78 = 128\%$ of the time. Transformed into a year it is around 1 year and 102 days. The “Equal Pay Day” should then take place on the 12th of April, the 102nd day of the year.

How did the 21st of March become the date for the “Equal Pay Day”? It happened because of the idea that women should actually work 22% more, if they earn 22% less so that they could reach the same pay men get. This is not correct, however, since with 22% more work they only reach $0.78 \times 1.22 = 95\%$ of what men earn.

This is a very common mistake, even though it is a simple percentage calculation. The key is that percentages are always seen as relative. Someone who in one day loses 50% in stock and the next day wins 50% did not win their original capital, but only $50\% \times 150\% = 75\%$.



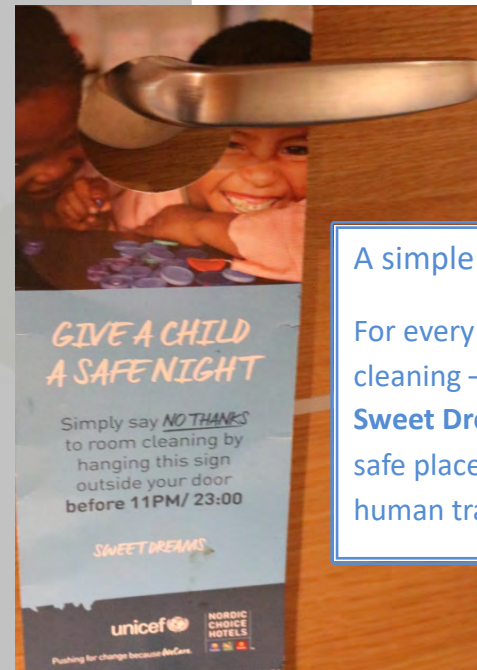
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Round up, please!



Sleep well!



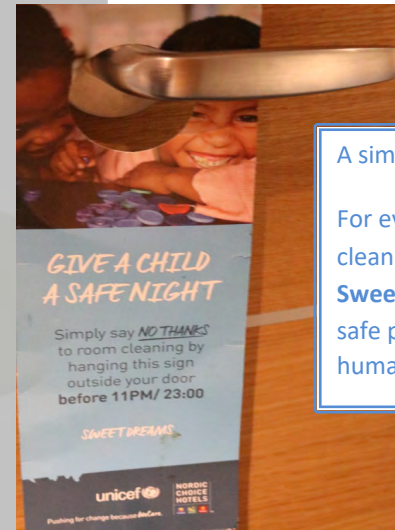
A simple act for a great cause

For every day you say no thanks to room cleaning – we will make a donation to our **Sweet Dreams** project. The project provides a safe place to stay for children victimized by human trafficking.

Round up, please!



Sleep well!



A simple act for a great cause

For every day you say no thanks to room cleaning – we will make a donation to our **Sweet Dreams** project. The project provides a safe place to stay for children victimized by human trafficking.

- Would you use these examples in your class? Why/why not?
- What learning opportunities do you see?
- What challenges do you see?



Round up, please!

Student answers

Aufrunden bitte!

Wieviele Kunden gehen am Tag in den Supermarkt?

→ Öffnungszeit: ≈ 12 h

Schnitt von Wochentag u. Wochenende

ca. $45 \text{ Leute/h} \cdot 12 = 540$ $85 \text{ Leute/h} \cdot 12 = 1020$

(man bedenke die Menschen die nichts kaufen nur dabei sind)

$$\frac{540 \cdot 5 + 1020 \cdot 1}{6 \text{ ausgewählte Sonntage}} = 620 \text{ Leute/d}$$

Wieviele entschließen sich davon zu spenden?

→ viele Zahlen mit Kaste \Rightarrow dort kann nicht aufgerundet werden

$620 \cdot 0,1 = 62$

$62 \cdot 0,03 = 1,86$ spende pro Superm./Tag

(\Rightarrow Zahl der Supermärkte in DE ca. 15.000)
(Spende pro Tag von allen Supermärkten:)

$1,86 \cdot 15.000 \approx 27.900 \text{ €}$

\rightarrow pro Jahr ca. 8.37 Mio spenden

Antwort: Pro Tag gehen ca. 620 Leute in einem Supermarkt einkaufen davon entschließen sich ca. 62 zu spenden.

Antwort Hauptfrage: Es kommen ca. 1,86 € in einem normalen Supermarkt an einem Tag zusammen.



The problem of the quaters: round up, please!

Important information:

- > round up at the cash register
- > cent amounts are donated to children in need
- > 8.3 million €
- > promotion by supermarkets

example: LIDL

consideration: > not everybody buy their products at the same supermarkets

> not everybody buy products everyday

1. searching for sales on the internet for our selected supermarket
41.4 billion € sale in Germany
3200 branches in Germany
2. sales per year at Lidl:
 $41.400.000.000 : 3200 = 12.937.500 \text{ €}$
3. sales per day at Lidl:
 $12.937.500 \text{ €} : 365 = 35.445,21 \text{ €}$
4. customers buy products for 75€
 $35.445,21 : 75 = 473 \text{ persons per day}$
5. around 60% donate cent amounts
 $100\% - 473$
 $60\% - \frac{473 \cdot 60}{100} = 284 \text{ person per day donate}$
6. minimum and maximum of donation
 $284 \cdot 0,09 = 25,56 \text{ €}$ $25,56 + 2,84 : 2 = 14,20 \text{ €}$ ✓
 $284 \cdot 0,01 = 2,84 \text{ €}$ per day
7. 50% are paying with credit cards
 $14,20 \text{ €} : 2 = 7,10 \text{ €}$ ✓
or 10% known as the solution

Round up, please!

Student answers

Aufrunden bitte!

Wieviele Kunden gehen am Tag in den Supermarkt?

→ Öffnungszeit: = 12 h

Schnitt von Welttag u. Wochenende

ca. $45 \text{ Leute/h} \cdot 12 = 540$ $85 \text{ Leute/h} \cdot 12 = 1020$

(man bedenke die Menschen die nichts kaufen nur dabei sind)

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Wieviele entschließen sich davon zu spenden?

→ viele Zahlen mit Kaste ⇒ dort kann nicht aufgerundet werden

$620 \cdot 0,1 = 62$

$62 \cdot 0,03 = 1,86$ spende pro Superm./Tag

(Zahl der Supermärkte in DE ca. 15.000) zusatz

(Spende pro Tag von allen Supermärkten:

$1,86 \cdot 15.000 \approx 27.900 \text{ €}$

→ pro Jahr ca. 8.37 Mio spenden

Antwort: Pro Tag gehen ca. 620 Leute in einem Supermarkt einkaufen davon entschließen sich ca. 62 zu spenden.

Antwort Hauptfrage: Es kommen ca. 1,86 € in einem normalen Supermarkt an einem Tag zusammen

- What do you think of the student answers?
- What do you like?
- What would you criticize?
- Where are differences to answers you would expect from Dutch students?



The problem of the quarters: round up, please!

Important information:

- > round up at the cash register
- > cent amounts are donated to children in need
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- > promotion by supermarkets

example: LIDL

consideration: > not everybody buy their products at the same supermarkets

> not everybody buy products everyday

1. searching for sales on the internet for our selected supermarket
- 41.4 billion € sale in Germany
- 3200 branches in Germany
2. sales per year at Lidl: $41.400.000.000 : 3200 = 12.937.500 \text{ €}$
3. sales per day at Lidl: $12.937.500 \text{ €} : 365 = 35.445,21 \text{ €}$
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Zero waste store

Should one buy at the Zero waste store?

1.



Weigh
container

2.



Fill
container

3.



Pay at the
register



Zero waste store

What is a zero waste store?

- Shop without packaging and with Your own container.
- Price comparison between Zero waste store and Discount store
Ze.g. 100g Pasta 0,35 € in contrast to 0,20 € Bio own brand
250g Butter 1,29 € in contrast to 1,24 € Bio own brand



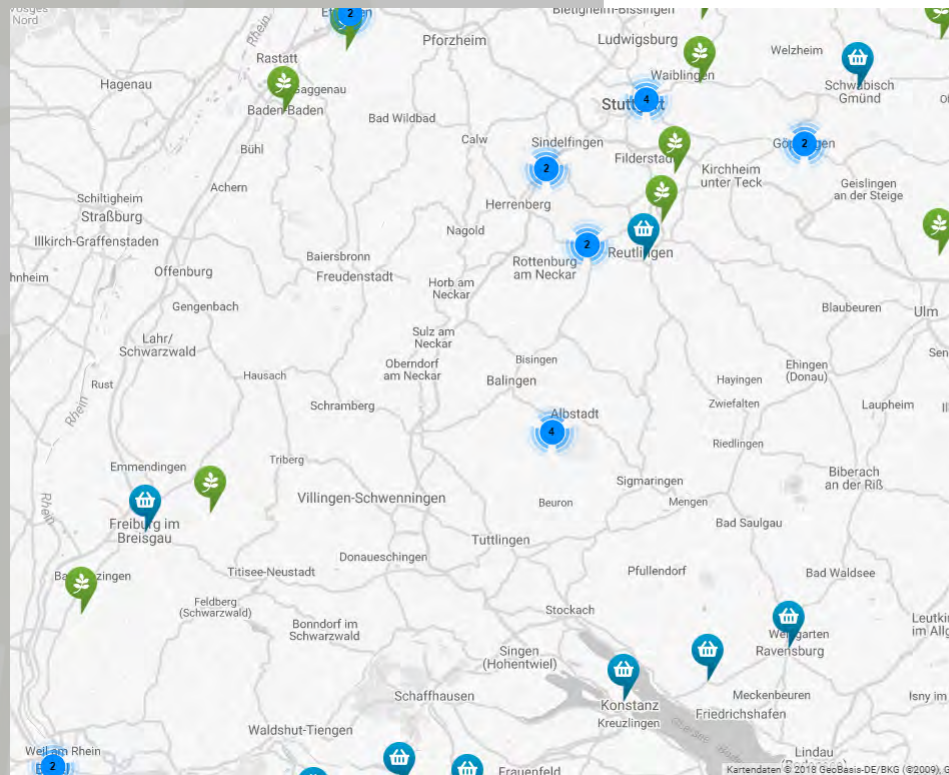
Zero waste store

What is a zero waste store?



Zero waste store

Where are zero waste stores?



<https://www.smarticular.net/verzeichnis/>

How about zero waste 'stores' worldwide?



Zero waste store



- How could you include this topic in your math-class?
- What questions would you discuss?

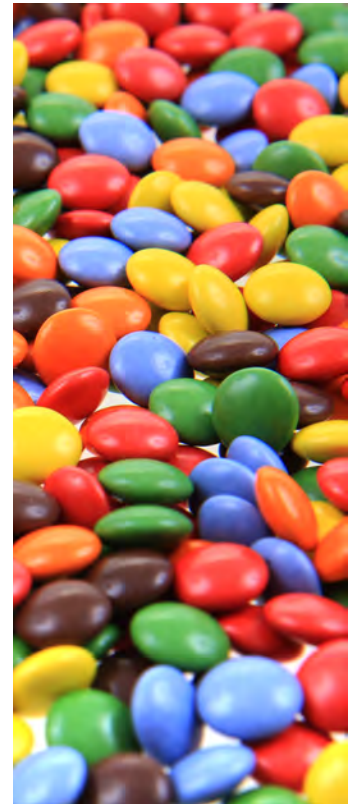


Zero waste store – possible questions

- By how much could a household reduce the amount of waste produced if one were to buy everything at these stores?
 - Per Week, Per Month, Per Year?
- By how much could our city reduce the amount of waste produced, if all its citizens would buy at that store?

Theoretical background: Culture (OECD)

- Any kind of social group can have its own distinctive culture: national groups, ethnic groups, faith groups, linguistic groups, occupational groups, generational groups, family groups, etc.
- All individuals belong to multiple groups, and therefore have multiple cultural affiliations and identities (e.g. national, religious, linguistic, generational, familial, etc.).
- Cultural affiliations intersect, and each individual has a unique cultural positioning.



Background intercultural learning:

Intercultural learning promotes the view that no culture is better or worse than the other, that there is no hierarchy of cultures. It leads to an understanding that the definition of groups of belonging, of in-groups and out-groups, can be superficial and changing.



Theoretical background (Radcliff & Grace 2003)

Socio-scientific issues

- Based on STEM-knowledge, and often lead the way (e.g. climate issues)
- Require that one builds ones own opinion
- It is being addressed in the media
- Often there is only incomplete or contradictory information, as well as necessarily incomplete coverage available
- Often require a cost-benefit analysis
- Are influenced by questions of sustainable development, values and ethical aspects
- Politicians often expect the “right” answer from scientists

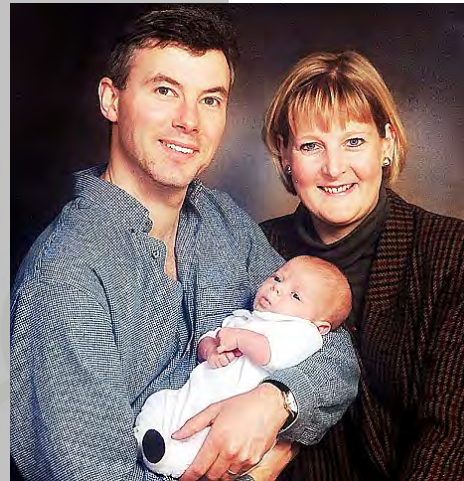


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Mathematics in court

The case of „Sally Clark“



Read the text

- How/ Where could one make use of this text in the classroom?
- What other learning opportunities, other than mathematical, are there?



Mathematics in court: Discussion

„Should [mathematics] really play an important role in the mediation and evidence of a crime? The clear drawback [...] is when [...] mathematicians, who don't have a lot of experience using math in real situations, misinterpret the situation and make use of the mathematic tools in some way incorrectly.“

Quelle: Schneps, L. & Colmez, C. (2013). *Wahrscheinlichkeit Mord. Mathematik im Zeugenstand*. München: Carl Hanser Verlag München.

Discuss with the group. Pick a side for this statement!



Mathematics in court: Should maths be used?

<u>Should maths be used in court?</u>	
Pros	Cons
<ul style="list-style-type: none"> - Allegations can be supported with calculations - Judges can not pick a side 	<ul style="list-style-type: none"> - Judges, lawyers can not check the calculations most of the time, so they agree with them - Mistakes in the calculations - Feelings and emotions can not be considered anymore - There are no exceptions
<p>⇒ Calculations can be considered, however however, they should not be the only / most important argument. It sh should be done by experts.</p>	

Make maths meaningful!

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$\hat{=} 3,6 \text{ W/s} = 30 \text{ Ct}$

$\hat{=} 3,6 \frac{\text{J}}{\text{s}} = 30 \text{ Ct}$

\therefore Kosten für $5400000 \frac{\text{J}}{\text{s}}$

$30 \text{ Ct} \cdot 1500000 = 45000000 \text{ Ct}$

$= 450000 \text{ €}$

A: Es kostet 450000 € .

1400 : 100 = 14%

Discussion and reflection



- What conclusions do you draw about the use of culture-related and societal relevant contexts in mathematics education?
- What would be the most important reason for you to use culture-related and societal relevant contexts?
- What in your opinion are the most important characteristics of a good culture-related and societal relevant context for your teaching?

Thank you
for your attention and your
participation!