

Two Dilemmas in Communicating Mathematics in Adult Basic Courses

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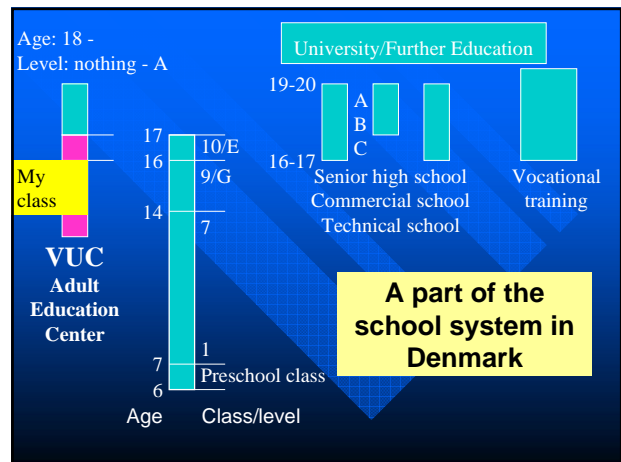
Lena Lindenskov

- 1980-1998 Teacher at upper secondary schools for adolescents
- 1993 Ph.D. thesis *Everyday Knowledge and Mathematics*
- 1993-1997 A combination
 - Teacher at upper secondary schools for adolescents and adults
 - Research projects e.g. in adult vocational training
- 1998 Research and teacher training as associate professor at the Royal Danish School of Educational Studies for research in Mathematics Education



Eigil Peter Hansen

- Adult teacher since 1975
- Math, Computers and guidance counsellor
- Textbook writer

The Research Project

Here I learned new things about mathematics in work and education of unskilled workers

Tools with poetic names

dansemester (dance master)

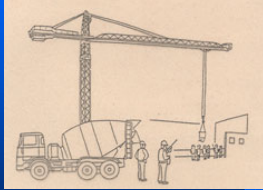
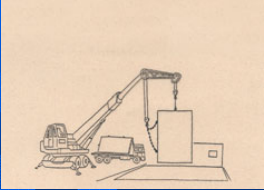
hulpasser (inside callipers)

krumpasser (crooked compass)

outside callipers)

I saw new tools with poetic names
(Dance Master – Crooked Compass)

I realized the importance of mathematics

Without cranes you have no building industry

Crane work is dangerous. It is for the sake of safety you have to calculate

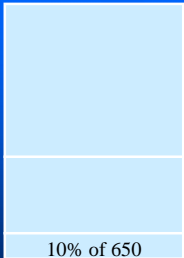
I learned that adults use different methods



Price: 650 DKR



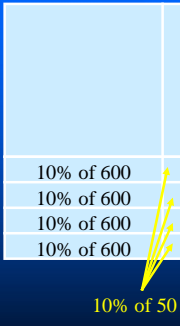
Here I saw seven different methods of calculation applied



The following drawings illustrate how to calculate the price 650 DKR after a discount of 40 per cent.

The price 650 is the whole box – the lower part is the 40 per cent, the upper part the price after the discount.

1) Calculate 10 per cent of 650 and multiply by 4

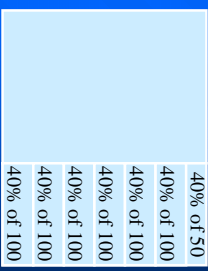


The following drawings illustrate how to calculate the price 650 DKR after a discount of 40 per cent.

The price 650 is the whole box – the lower part is the 40 per cent, the upper part the price after the discount.

1) Calculate 10 per cent of 650 and multiply by 4

2) Calculate 10 per cent of 600 and 10 per cent of 50. Then either multiply each part by 4 and sum, or make a sum and multiply by 4.



The following drawings illustrate how to calculate the price 650 DKR after a discount of 40 per cent.

The price 650 is the whole box – the lower part is the 40 per cent, the upper part the price after the discount.

3) Think of the price as 6 times 100 plus 50. Calculate 40 per cent of each and sum up.

4) The other methods consist of formulas

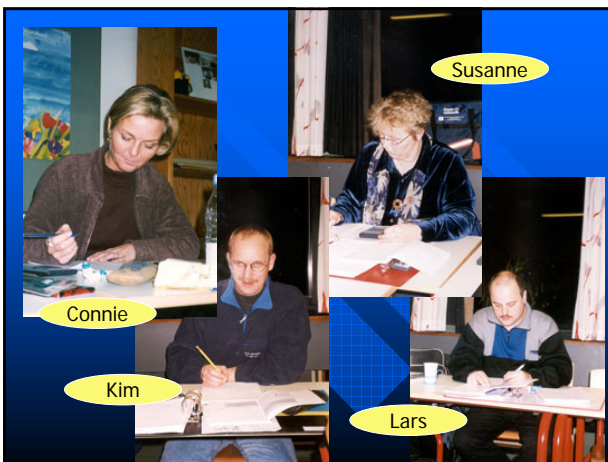
$$0,4 \times 650 \quad \frac{40 \times 650}{100} \quad 0,6 \times 650 \quad \frac{60 \times 650}{100}$$

Research Model

F o u r t h		
First Area The adults' experiences from inside and outside schooling	Second Area The adults' Math beliefs Math attitudes Math feelings Math conceptions and abilities	Third Area The adults' Perspectives Intentions Blockages Resistance Fascinations
A r e a		

The more specific questions are

1. How do elements in the fourth area facilitate the adults' intentions (of what and how to learn and use methods and wisdom in mathematics) in being expressed, lived, and developed.
2. How do elements in the fourth area facilitate the adults' blockages and resistances in being expressed and interpreted by others as blockages and resistance.
3. How do elements in the fourth area facilitate the adults' fascination in being expressed, lived, and developed.



Important considerations when starting a new class

- Get a good climate in the class
spend some time on MATTERING:
 - beliefs people have, whether right or wrong, that they matter to someone else, that they are the object of someone else's attention, and that others care about them and appreciate them

Dimensions of mattering

- Attention
 - The feeling that another person notices you or is interested in you
- Importance
 - Others seem to care about what you want, think, and do
- Dependence
 - You feel that you are a contributing member and others are counting on your participation
- Ego-extension
 - You believe that others are interested in your successes and disappointments and actively follow your progress

Cards – find a card, that matches your card

1 costs 2,17
 $(130/(2*30) = 2,16666..)$

1 costs 0,67
 $(15,99/24 = 0,66666..)$

Form groups of 2 or more persons/vary the complexity

Questions

- 1 costs 2,17
- 1 costs 0,56
- 1 costs 0,60
- 300 cost 650
- 10 cost 650
- 1 liter costs 6,50
- 1 liter costs 7,50
- 1 liter costs 1,80
- 1 liter costs 2

Hand out

1. Where were you born?
2. Where do you live now?
3. How many years did you go to primary and secondary school?
4. Which 3 subjects did you like best in school?
5. Where were you when you fell in love for the first time in your life?
6. Which subject did you really hate in school?
7. Where would you like to be in 10 years?
 (no restrictions—just dream away)

Hand out

- On one and the same map find all 4 places from answers 1, 2, 4, and 7.
- What's the distance between these places?
- Help each other. Ask if you want any help or if you need some tools.

Have a good time!

The First Dilemma

We define a dilemma as a right-right choice situation.

The first dilemma, faced by educational planners and teachers in adult mathematics, is how to handle the adult learners' already established conceptions and procedures in the materials and in the conversation.

From a problem dealing with area and volumen

Sketch of a swimming pool
 How much water can it contain?

$\frac{1}{2} \times 25 \times (1+2)$ $1 \times 25 + \frac{1}{2} \times 1 \times 25$ $2 \times 25 - \frac{1}{2} \times 1 \times 25$

Different methods calculating problems with per cent

150 increases with 15% 150 decreases with 15%

$150 + 15\% \text{ of } 150$
 $(150 + 0,15 \times 150)$
 or
 $115\% \text{ of } 150$
 $(1,15 \times 150)$

$150 - 15\% \text{ of } 150$
 $(150 - 0,15 \times 150)$
 or
 $85\% \text{ of } 150$
 $(0,85 \times 150)$

Different methods calculating problems with per cent

150 increases to 180 150 falls to 120
 How many per cent? How many per cent?

$180 - 150 = 30$
 $(30/150) \times 100 = 20\%$
 or
 $180/150 = 1,20 (=120\%)$
 an increase of 20 %

$150 - 120 = 30$
 $(30/150) \times 100 = 20\%$
 or
 $120/150 = 0,80 (=80\%)$
 a fall of 20%

The Second Dilemma

The power of the learners

"I feel shocked when a mathematics teacher approaches me... but as an adult it MUST be possible for me to understand mathematics"



The Second Dilemma

According to Danish legal provision, the learners participate in the on-going planning of the course.

In the class two themes were democratically chosen:

The first was art, the second was food. Most of the adults imagined 'food and mathematics' more relevant to everyday life than 'art and mathematics'.

Extracts from "Food"

Ræbedesuppe
(4 personer)

300 g kogte ræbeder
2 æg
200 g selleri
15 g mælk
300 g friskul
1 l bouillon
4 g salt
grøftvarevort eller
15 g hakket persille

Ræbederne vaskes og skrives i små biter.æg og selleri skæres i biter og sættes i mælk (for at sættes med en god smag). Hakkede selleri og selleri med bouillon, salt, peber og ræbeder tilføjes. Suppen simrer i ca. 20 minutter.
Drysses med hakket persille og serveres med godt brød og skaldet creme fraiche.

Vi kan nu gå i gang med at omregne først til 1 person, derefter til 11 personer.

Opkrift	Til 4 personer	Til 1 person	Til 11 personer
Kogte ræbeder	300 g	$\frac{300}{4} = 75$	$75 \text{ g} \cdot 11 = 825 \text{ g}$
Læg	2 stk	$\frac{2 \text{ stk}}{4} = \frac{1}{2} \text{ stk}$	$\frac{1}{2} \text{ stk} \cdot 11 = 5\frac{1}{2} \text{ stk}$
Selleri	200 g	$\frac{200}{4} = 50 \text{ g}$	$50 \text{ g} \cdot 11 = 550 \text{ g}$

Vi kan opstille følgende model for omregningen:
 ny mængde = $\frac{\text{mængde til det oprindelige antal} \cdot \text{ny antal personer}}{\text{oprindelige antal personer}}$

Med og omregninger
 Tælling af opskrifter **21**

Extracts from "Food"

1. Illustration fra det lokale supermarked Ender de blå...

Frøst Green Bean of Pork 2 nd Choice 2 nd	3 - lb. Carrots \$ 1	Fresh Mushrooms 12 oz. 99¢
1 lb. U.S. No. 1 Idaho Potatoes 49¢	One Gallon Star 2% Low Fat Milk 1 st	1 lb. Golden Delicious Apples 66¢
Cauliflower Florets 8 oz. 99¢	King Sandwich Bread 20 oz. 79¢	Coke Natural Creamy Butter 1 lb. 99¢
Rubikind Red Salmon 14,75 oz 2 ⁹⁹	Hood Sour Cream 16 oz. 99¢	6-Packs Borden Baking Ails 1/9 ⁹⁹
Militta Coffee Taste Premium 23 oz 4 ⁹⁹	Butter Cookies Danish 12 oz 1 ⁹⁹	Danish Coffee Cake 14 oz 1 ⁹⁹

Med og omregninger
 Tælling af opskrifter **21**

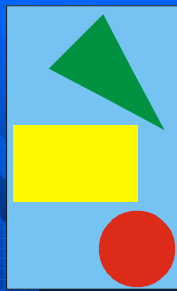
Extracts from "Food"

Fødevarer	(x) Mængde	(y) Energindehold i kJ pr. 100 g	(z) Energindehold i x: $x = \frac{y}{100} \cdot x$	Energindehold fra protein (protein % · z)	Energindehold fra kulhydrat (kulhydrat % · z)	Energindehold fra Sukker (sukker % · z)	Energindehold fra fedt (fedt % · z)
cornflakes	40 g	1593 kJ	627,2 kJ	49,5 kJ	557,0 kJ	33,2 kJ	20,7 kJ
letmælk	200 g						
sukker	5 g						
1 skive rugbrød	40 g						
m / smør	5 g						
ost	25 g						
1 skive franskbrød	35 g						
m / smør	10 g						
syrligtøj	15 g						
kaffe	400 g						
fløde	20 g						
sukker	10 g						
I alt							
I alt %							

Extracts from "Food"

Fødevarer	(x) Mængde	(y) Energindehold i kJ pr. 100 g	(z) Energindehold i x: $z = \frac{y}{100} \cdot x$	Energindehold fra protein (protein % · z)	Energindehold fra kulhydrat (kulhydrat % · z)	Energindehold fra Sukker (sukker % · z)	Energindehold fra fedt (fedt % · z)
cornflakes	40 g	1593 kJ	627,2 kJ	49,5 kJ	557,0 kJ	33,2 kJ	20,7 kJ
letmælk	200 g	204 kJ	408,0 kJ	119,1 kJ	166,5 kJ	0 kJ	121,6 kJ
sukker	5 g	1698 kJ	84,9 kJ	0 kJ	84,9 kJ	84,9 kJ	0 kJ
1 skive rugbrød	40 g	993 kJ	397,2 kJ	40,1 kJ	331,3 kJ	0 kJ	25,8 kJ
m / smør	5 g	3146 kJ	157,3 kJ	0,5 kJ	0,5 kJ	0 kJ	156,4 kJ
ost	25 g	1426 kJ	356,5 kJ	105,5 kJ	6,1 kJ	0 kJ	245,3 kJ
1 skive franskbrød	35 g	1174 kJ	410,9 kJ	46,0 kJ	305,3 kJ	0 kJ	60,0 kJ
m / smør	10 g	3146 kJ	314,6 kJ	0,9 kJ	0,9 kJ	0 kJ	312,7 kJ
syrligtøj	15 g	1144 kJ	171,6 kJ	1,5 kJ	170,1 kJ	167,5 kJ	0 kJ
kaffe	400 g	9 kJ	36,0 kJ	14,4 kJ	21,6 kJ	0 kJ	0 kJ
fløde	20 g	632 kJ	126,4 kJ	9,9 kJ	13,9 kJ	0 kJ	102,6 kJ
sukker	10 g	1698 kJ	169,8 kJ	0 kJ	169,8 kJ	169,8 kJ	0 kJ
I alt			3260,4 kJ	387,4 kJ	1827,9 kJ	454,4 kJ	1045,1 kJ
I alt %			100 %	11,9 %	56,1 %	24,8 %	32,1 %

Extracts form "Art"



Extracts form "Art"



hanging up the pictures

$$\begin{aligned}
 13 \times 21 + (13-1) \times r &= 450 & a \times 21 &\leq 450 \\
 273 + 12 \times r &= 450 & a &\leq 450 \\
 12 \times r &= 450 - 273 & a &\leq 21 \\
 r &= \frac{177}{12} & a &\leq 21,428571
 \end{aligned}$$

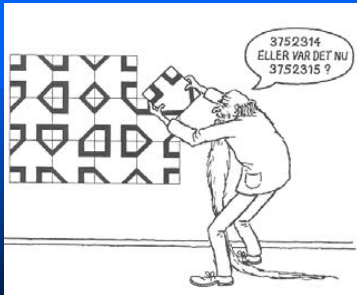
Extracts form "Art"



Extracts form "Art"

- The students deal with different items such as
- basic rules and tools for rectangle, circle, and triangle
 - permutation
 - the divine fraction and the golden rectangle
 - area measuring
 - the Pythagorean theorem
- And at the same time they learn and train rules about mathematic models, equations etc.

Extracts form "Art"



Make a work of art that lasts a lifetime

The Second Dilemma



Anett voted for food and mathematics, but she did not mention it in the questionnaire when asked of what her best experiences was during the course. Instead she wrote that working with mathematics in art was "cool". It was fun and exciting, combined with creativity, (cutting and pasting), measuring, calculating, hanging up the pictures and getting the photos of themselves.

The Second Dilemma

The second dilemma is how to provide the learners with adequate information to base their decisions upon.

Again it is not to be expected to find the one and only right answer, but to be able to reflect upon several good answers.

We have given some documentation on how some Danish adults choose between proposals.

I think we need two concepts on motivation in the reflection of the dilemma.

Motivation A that drives you to choose between proposals is not the same as motivation B that drives you through the ongoing work, the detailed mathematical ideas, the detailed tasks, the detailed calculations, etc.

The Second Dilemma

What kind of material should we then provide the learners with?

We might doubt that a discussion of the relevance of the theme (art, food) is suitable.

That only serves the purpose of involving motivation A, but not motivation B.

The examples given show that when a theme such as "mathematics in art" has the potential of expanding the horizon of the learners, but it is not directly applicable in everyday life, then motivation A might be low, and motivation B might be high.