



Research competences in mathematics

*An example of a good practice:
walking patterns and paper folding*

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Znanca

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- Member of the Editorial Board of *Matematika v šoli*
- Former teacher trainer in Holland and Belgium for resp. secondary and primary school teachers
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Dobrodošli



Program

- I. Introduction in the 'Inquiry Based Mathematics Education' setting in Flanders (15')
- II. An example: working with the bears of Meichenbaum (60')
- III. Discussion afterwards (15')



Part I

Short introduction in the setting in Flanders

« La tâche de l'éducateur est de faire repasser l'esprit de l'enfant par où a passé celui de ses pères, en passant rapidement par certaines étapes mais en n'en supprimant aucune. »

Henri Poincaré



Introduction

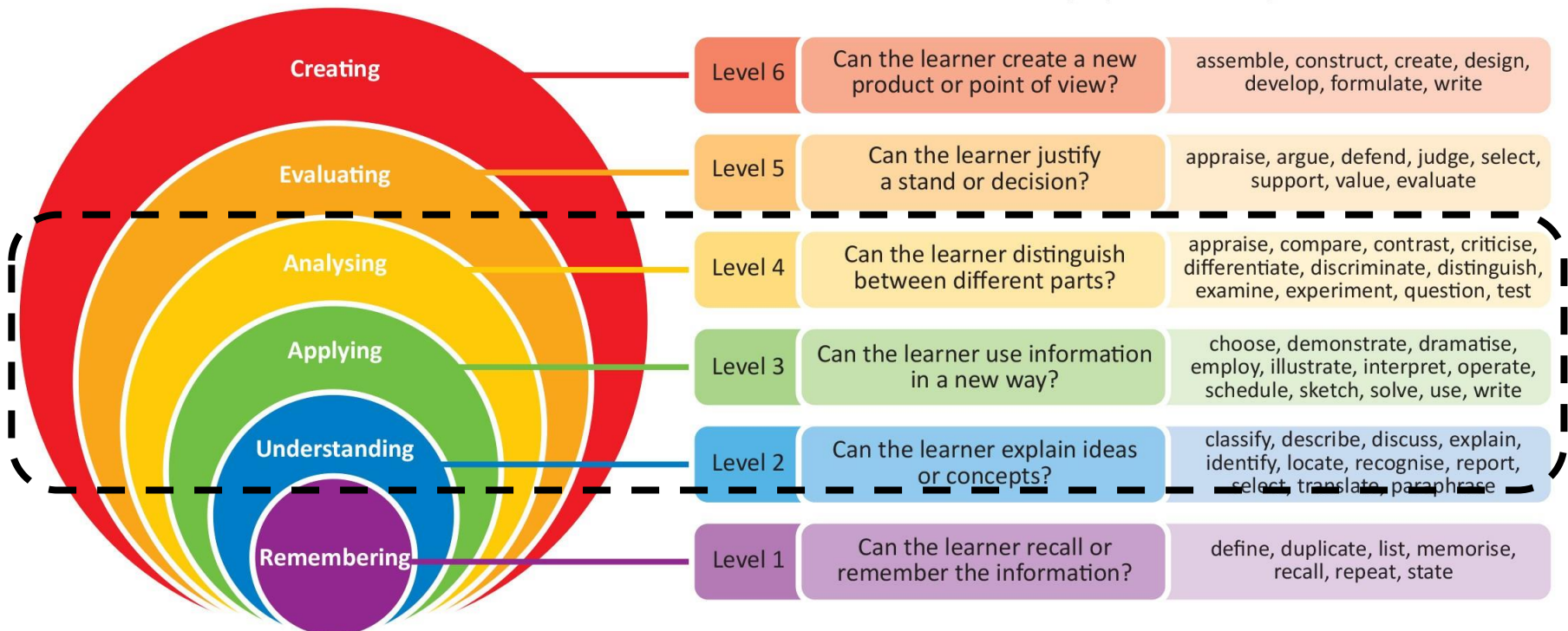
- In general secondary education in Flanders (Belgium), one finds on the curriculum:
“research competences” (since ca. 20 years)
- In Flanders the obligatory curriculum (for 17-18y old pupils) states:
Pupils can
 1. *orientate themselves on a research problems by collecting, organize and processing information;*
 2. *prepare, execute and evaluate a research project with a mathematical component;*
 3. *report their results and confront them with other viewpoints.*
- Start of introducing (more) Inquiry Based Mathematics Education in the classroom



Framework (for teachers)

- Bloom's taxonomy
- More focus on level 2-4, less on level 1

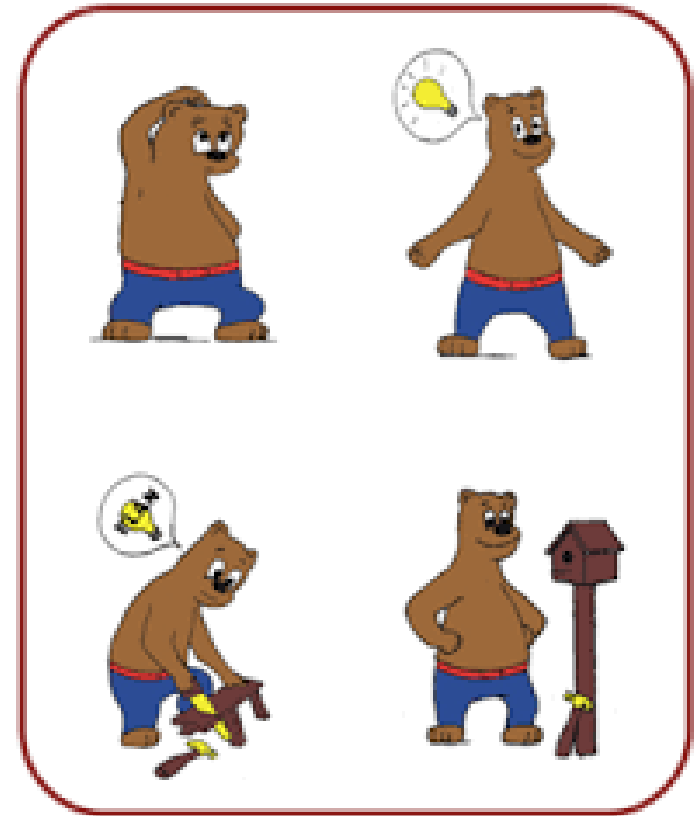
Bloom's taxonomy (revised)





Framework (for pupils)

- Following Meichenbaums ideas on self-instruction (originally for students with learning disorders, ADHD)
- In Flanders (& the Netherlands) we adopted/adapted this in order to make pupils aware of the 'thinking skills' (adaptation K. Timmerman)
- Use of picto's (start in primary school) to make the 4 steps visible (often bears)





Four steps (bear method)

1. Orientation

*What do I have to do
(precisely)?*



2. Strategy

*What ideas do I have?
Make a plan.*



3. Execution

I execute the plan.

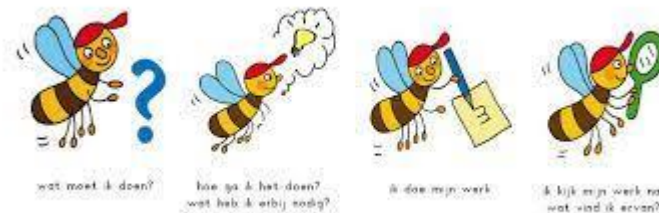




Comments

- A fifth step is used in secondary school.
5° Reflection. *What did I learn from it?*
- Not only for mathematics, also used for other courses (languages, science).
- In the beginning the teacher is doing steps together with pupils → they get more and more independent
- Many other themes than bears.

(source: <https://juflinn.wordpress.com>)





Part II

Example of 'good practice'

« Mimetic desire is essentially a good thing. »

René Girard



Self inquiry based working

1. Work in groups of four people
2. Follow the four bear-steps for every assignment
3. You can use all your mathematic knowledge, but try to formulate clear arguments
4. Take some time for the open questions (you get these after 20-30')
5. Afterwards: we shortly discuss the pros and cons of this way of working in a classroom (think again about the four steps)



Example



1. Folding the paper strip according to a folding recipe



2. Take a paper strip and mark a starting line (ALWAYS on the left)



- Folding: start with the starting line visible for you.
- Folding away from you, so to the left. The right-hand side will end up *behind* the left-hand side. We indicate this with the letter (ℓ).



- Analogous, we define folding to the right (r).



Folding recipe

- A folding recipe is series of letters l, r . These foldings should be executed one after another.
 - Remark that the letter says which half is on top after folding.
 - Starting line remains always on the left



3. Make the foldings l r and r l .





Walking pattern

1. Write down the corresponding walking patterns
2. Do the following: unfold the strip. Take care to have 90 degree angles on all folding lines. Put the unfolded strip on its side in front of you on the table, with the black mark facing you on the left.



- A walking pattern is the figure you obtain or the description of turns you have to take by walking from start to finish
- start with the black mark facing horizontally to the right

3. The folding lr leads to walking pattern RLL, and rl leads to LRR





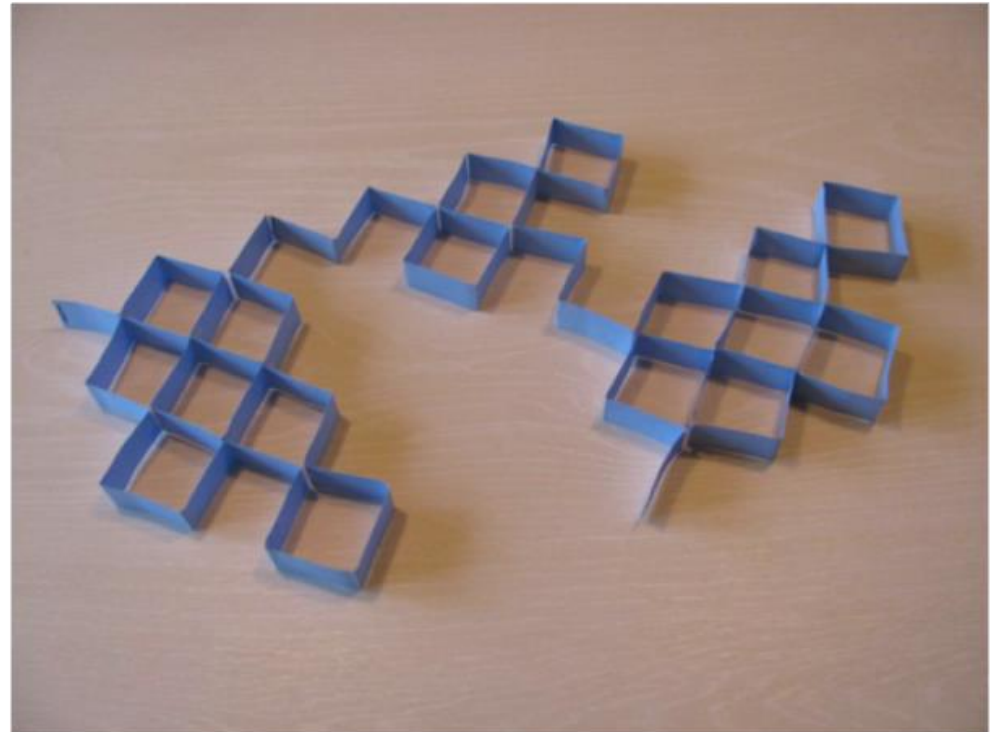
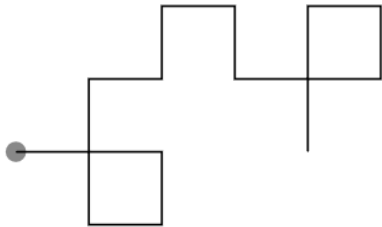
- Time to experience IBME yourself
- Applet (to check/work with):

<http://www.fi.uu.nl/wisbdag/opdrachten/sliderappletEN/eenvouwdigEN.html>

Folding recipe: (use only lower c

Angle (in degrees between 0 and 179):

RLLRRLRLLRRRL





Part III Discussion

« The person who looks for the error outside himself is never satisfied, while the person who look for the error within himself and says 'I have been stupid' becomes through this experience enriched and cheerful. »

‘Propos sur le bonheur’
Emile-Auguste Chartier



Discussion

- Did working with the bear method, made the thinking steps more visible?
- What are problems/opportunities (for pupils)?
 1. Repetition of the *exact* assignment.
 2. How can we make use of things we already know? What is worth to try in this context? Make a *systematic* plan.
 3. Work *carefully* and correct, stick to the plan.
 4. Take a look at the results: is there any logic in it? Can I *verify* the results?
- Without a method: pupils tend to do 'something' (step 3) fast without steps 1 and 2. They also tend to forget step 4.

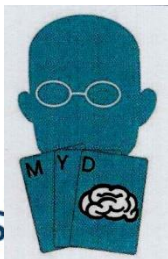


Challenges (for teachers)

- How to grade such work?
 - Since the *process* is important, it should get grading (logbook)
- Finding problems
 - In step 2, the *world wide web* is an important source → one should find problems that are accessible but where one do not find the answers (too easily) by googling.
 - Inspiration can be found:



- Wiskunde B-dag (<https://www.uu.nl/onderwijs/wiskunde-b-dag>)
Problems like today (no solutions)
- Mind Your Decisions (<https://www.youtube.com/user/mindyourdecisions>)
Presh Talwalkar





Agree or disagree?

- Working in this manner (IBME) is
 - (problem of today) a way to feel the connection between geometry and algebra?
 - (more general) a way to tackle some of the challenges in math education (cfr. lecture of *mag. Mojca Suban*)
 - a way to train modern working skills, e.g.
 - Problem solving skills
 - Working together in a team
 - Working on problems that do not have a (pre-)fixed answer
 - Organizing yourself within a fixed time to deliver decent work
 - Communicating about the work you have done and why it is useful

(*motivation Flemish government*)



Nasvidenje

