SoE | School of Education
Fakultät für LehrerInnenbildung

universität innsbruck

Challenges for a pattern shift in initial teacher education in mathematics

Christian Kraler
University of Innsbruck – School of Education
Christian.Kraler@uibk.ac.at

math teacher

via university…

„Teachers teach the way they have been taught.“

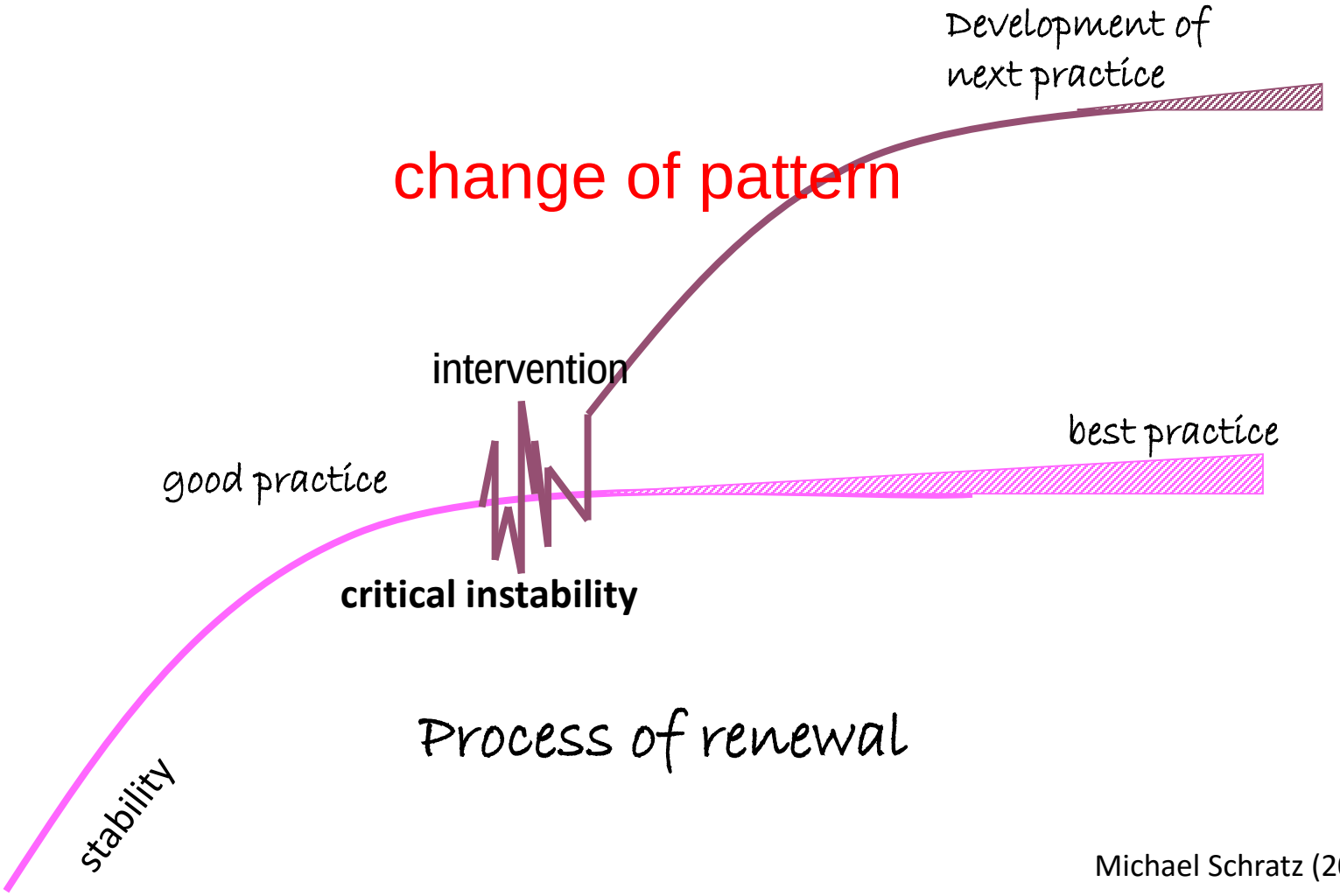
pupil

… „back“ to school …

→ system-reproducing higher education („cultur“)

→ self similarity (grades, transfere of knowledge, didactics,…)

A shift from best practice to next practice



Michael Schratz (2010)

Observations (big picture)

- Change
  - We live in a world of acceleration (Rosa 2005) and rapid change
- School as a mirror of society
  - Globalization
  - Societal changes
  - Dominance of economy
  - Technological developments
  - Individualisation
- Math courses at school are “conservative”
  - Follow rather traditional patterns in design (teaching/curriculum design)
  - Innovations are embedded in a conservative teaching culture
  - Teaching math is rather content and teaching oriented (what/how)

Observations (school view)

- Culture of teaching a subject is characterized by
  - Tradition (how, what, who)
  - Content developments and changes (innermathematical and technological developments)
  - Subject specific inner logic
  - Philosophy of teaching
- changes in education
  - Multiplication of knowledge (subject specific, interdisciplinary, …)
  - Technological developments
  - Globalization and glocalization (TIMSS, PISA, …, European Teacher,...)
  - Multiple societal changes (school as mirror of society)
  - Shift from teaching to learning
  - Use of technology in math classes
  - Teacher training programs
- Teaching math
  - Based on the logical and hierarchically structured subject
  - Usage of technology (calculator, computer, specialized software)
  - Schoolbook as hidden curriculum
  - Task oriented („wood of math problems“), but “task is correct when the teacher says it’s correct” (A. Beutelspacher, 26.7. 2016)

Consequences

- OECD philosophy
  - Evidence based
  - Driven by economy based “controlling philosophy”
  - quantitative figures and indicators as predictors
- Changing culture in educational governance and assessment
  - Competence oriented approach
  - Configuration of tasks to achieve
- Teaching math
  - Higher external regulation of the teaching process
  - Shift from schoolbook to external defined (competence derived) tasks

Published by BIFIE (Institute of Educational Research, Innovation & Development of the Austrian School System) – www.bifie.at - latest call up 2016.07.24

Drug Reduction

Number of task: B_340

Use of technology:	potential	required

Active ingredients end up in the blood circulation due to the drugs' taking. These ingredients will be reduced thereafter.

a) The amount of active ingredients after the taking of a pill can be modelled by the following function m:

$m(t) = 20 \cdot (1 - e^{-0,05 \cdot t}) - 0,125 \cdot t$ with $t \geq 0$

t … (past) time after the taking of the pill in minutes (min)
$m(t)$ … Amount of active ingredients in the blood circle at time t in milligramme (mg)

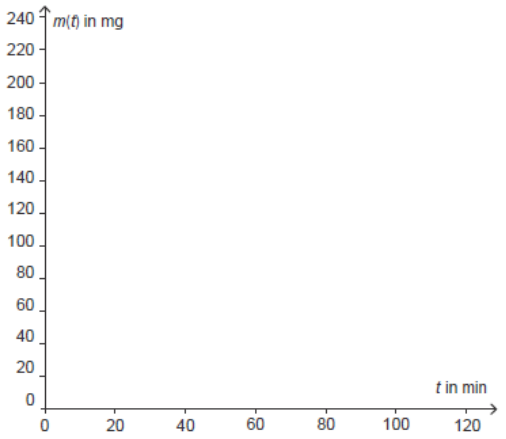
– Identify the point in time when the active ingredient will be reduced completely.
– Calculate the point in time when the instantaneous rate of change of the active ingredient in the blood circle is 0,5 mg/min.

– Find an argument that m is negative-curved using outcomes of the differential calculus.

b) Linear and exponential models can be used for an approximative description of drug reduction.

In the beginning (t = 0 min) 200 mg of active ingredients have been in the blood circle. After 120 minutes only an eighth of this amount remains.

– Illustrate the progress of the linear model in the following diagram:



– Identify the half-value time in minutes of those exponential model which describes the reduction process.
– Illustrate the progress of the exponential model using the identified half-value time in the diagram above.
– Explain for which model $\frac{dm}{dt} = -\frac{35}{24}$ applies for each point in time.

Note to the task:
Solutions must satisfy the problem statement and must be clearly recognizeable. Results must be declared in proper units. Diagrams must be labeled and the axes must be scaled.

Potential Approach

a) Solution of the equation using technology:
$m(t) = 0$
$t = 159{,}9... \approx 160$

The amount of active ingredients is reduced approximately after 160 minutes.

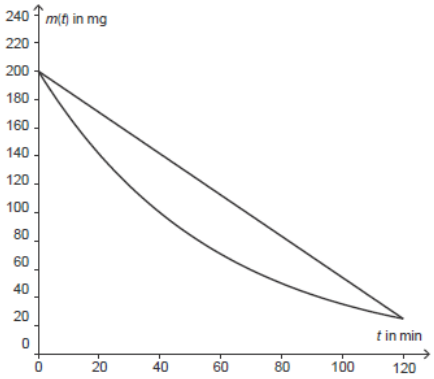
$m'(t) = e^{-0{,}05 \cdot t} - 0{,}125$

Solution of the equation $m'(t) = 0{,}5$ using technology: $t = 9{,}40... \approx 9{,}4$

The instantaneous rate of change of the active ingredients in the blood circle is 0,5 mg/min after approximately 9,4 minutes.

As the 2nd derivation $m''(t) = -0.05 \cdot e^{-0.05 \cdot t}$ yields an exponential function of the type $a \cdot e^{\lambda \cdot x}$ (where $a < 0$) all values of the 2nd derivation are negative. Function m is negative-curved for all (definied) t.

b) $\frac{1}{8} = \left(\frac{1}{2}\right)^3 \Rightarrow 120 = 3 \cdot T_{\frac{1}{2}} \Rightarrow T_{\frac{1}{2}} = 40\ min$



The instantaneous rate of change of active ingredients is constant. Thus it is a linear model.

Solutions' Key

a) 1×B1: for the correct calculation of the point of time when the active ingredients will be reduced totally.
1×B2: for the correct calculation of the point of time when the instantaneous rate of change of the active ingredients in the blood circle is 0,5 mg/min.
1×D : for the correct argumentation.

b) 1×A1: for the correct illustration of the linear model.
1×B : for the correct calculation of the half-value time in minutes.
1×A2: for the correct illustration of the exponential model using the identified half-value time.
1×D : for the correct explanation.

Questions

- Do our teacher education programs in math really face these changes and challenges?
  - Need for a coevolutionary development in TE and subject teaching
  - Critical thinking and understanding of the processes
  - Problem of self similarity and pattern change
- How can we better prepare our TES for their job
  - Diversity
  - Migration, inclusion, heterogeneity
  - Technological developments
- Which kind of tasks can foster an sustainable approach learning math?
  - Tasks as means for competence oriented assessments
  - Tasks as means for making the world accessible

Thank you for your attention!

Christian Kraler
Christian.Kraler@uibk.ac.at

… and greetings from Austria ☺