

Learning and teaching math: easy and hard. How ?

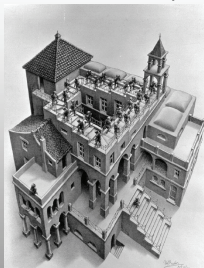
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Index Theory

with Applications to Mathematics and Physics



David D. Bleeker · Bernhelm Boß-Bavnbek

 International Press

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Introduction

- The meaning of math working experience

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Looking back - who/what has changed?

- Not the students: mind stability v. cataclysmic changes
- Way of talking about our subject
 - Today less metaphysical exaggerations
 - Seminal changes of math content widely ignored
 - Administrative frame: Continuing dismantling of the public sector

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Math is hard — How and why?

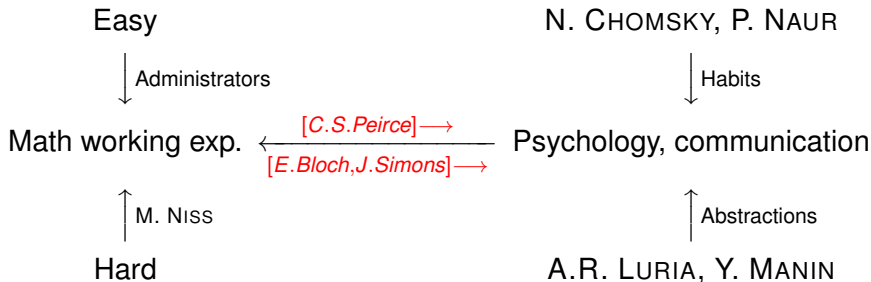
- Students
- LAGRANGE, GAUSS, PEIRCE, HIRZEBRUCH, SINGER, MANIN, ARNOL'D, HÖRMANDER

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Math is easy — Really?!

- SCHOPENHAUER V. GAUSS
- CHOMSKY, ATIYAH, LAGRANGE, PEIRCE, GRAMSCI, FREIRE, NAUR, KIERKEGAARD

Goal of this talk and basic assumptions



Looking back - student mind set changed?

The **mind of the students** - has it changed?

- General “wisdom”: The browse-generation, the me-generation?

No! Strong evolutionary evidence for **mind set stability** over time:

- 1 Case dog breeding.
- 2 Case Cromagnon aesthetics:

- **Curiosity** and
- **Imagination**

not destroyable.

- 3 Counterarguments: MARX, PEIRCE, JULIAN JAYNES.

⇒ No evidence for short term changes. Look elsewhere!

Meaning — Content — Frame

Mind set stability



Long-term mind stability



Students' short-term mind changes highly improbable



Bernhelm Booss und
Klaus Krickeberg (Hrsg.)
**Mathematisierung
der Einzelwissenschaften**

Biologie – Chemie – Erdwissenschaften – Geschichts-
wissenschaft – Linguistik – Medizin – Pädagogik – Physik –
Psychologie – Rechtswissenschaft – Soziologie – Theologie
Wirtschaftswissenschaft

SPRINGER BASEL AG

1970s' **metaphysical exaggerations** in
our way of talking about *mathematization*
and *structure*:

- Biology, Medicine
- Chemistry
- Physics, Geophysics
- Linguistics
- Educational Studies, Psychology
- Law, Theology
- History, Sociology
- Economy

⊕ Math supported military invincibility
perception

⊕ Pernicious structuralism proliferation

Looking back - changes of math content ignored?

Left: Turning Points in the History of Mathematics That Have Had Consequences in the Philosophy of Mathematics (PHILIP J. DAVIS)

1. Pythagorean Theorem; $\sqrt{2}$
(Existence)
2. Euclid's Elements
(Axiomatics; Idealization)
- ...
- ...
13. Gödel v. Hilbert's Program
(Destruction of Logicism)
14. Electronic digital computing machines (Preeminance of the discrete over the continuous)
15. Increasing relevance of stochasticism (Ontology)

2/15 came up in my time!

Right: The Seven Great Math Riddles

1

2

3

Continuum Hypothesis

4

Four Colours Suffice

5

Fermat's Last Theorem

6

Poincaré Conjecture

7

?

4/7 solved in my time!

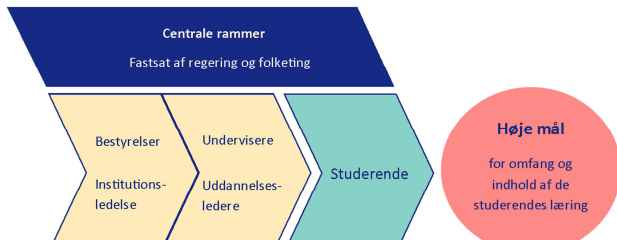
Administrative frame: Continuing dismantling of the public sector and over-administration

1961-63: IBM 7090 = 709-T



1966-76: Social recognition for young scientists.

2014:
Kvalitetsudvalg
wants **more**
leadership instead
of professional peer
and student debate.

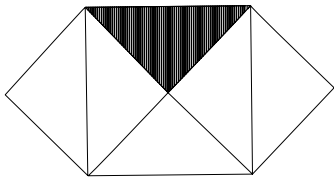


Math is hard — How and why?

- NatBatch project [CHRISTEL, CHRISTINA, AND MIKE]: *So confused*
- LAGRANGE (1813): *So sorry*
- I.M. SINGER: *So proud*
- V. ARNOL'D: *So sad*
- F. HIRZEBRUCH: *So demanding*
- Y. MANIN, based on A. LURIA: *Abstractions non-natural*
- C.S. PEIRCE: a) Fixation of belief in levels; b) *Anthropological message*
- C.F. GAUSS, L. HÖRMANDER: *Incomprehensible — wrong — I did it long time ago*
- Highest compliment: *It's clear*

Math is easy — Really?!

- SCHOPENHAUER, 1818:
EUCLID's complications are monstrous and dispensable



- GAUSS: Simplification by hiding the genesis of arguments
- CHOMSKY: Generative grammar

- ATIYAH: Evolving unity
- LAGRANGE: Natural approximations
- PEIRCE, GRAMSCI, FREIRE, NAUR:
 - : a) Trace the **habits of nature**,
 - b) relate to our **form(s) of life**, adolescence, clash of cultures
 - c) translational power by
 - ① coding **math experiences** and
 - ② make them **transferrable for adaption** in new contexts
- Two contradictions:
Result v. Process;
Abstraction v. Context
- KIERKEGAARD: Seduction and passion