



CENTRE FOR USER ORIENTED IT DESIGN / KNOWLEDGE MANAGEMENT RESEARCH GROUP



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Educational Design Patterns in Mathematics

Ambjörn Naeve

The Knowledge Management Research group
Centre for user-oriented IT Design (CID)
Numerical Analysis and Computer Science (NADA)
Royal Institute of Technology (KTH)
Stockholm / Sweden

amb@nada.kth.se

<http://kmr.nada.kth.se>



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Structure of today's math education system

Closed layered architecture based on:

- curricular-oriented "knowledge pushing".
- life long teaching with:
 - lack of subject understanding in the early layers.
 - minimization of teaching duties in the final layers.



Problems with today's math education

It does not:

- stimulate interest.
- promote understanding.
- support personalization.
- support transition between the different layers.
- integrate abstractions with applications.
- integrate mathematics with human culture.



Possibilities for improving math education

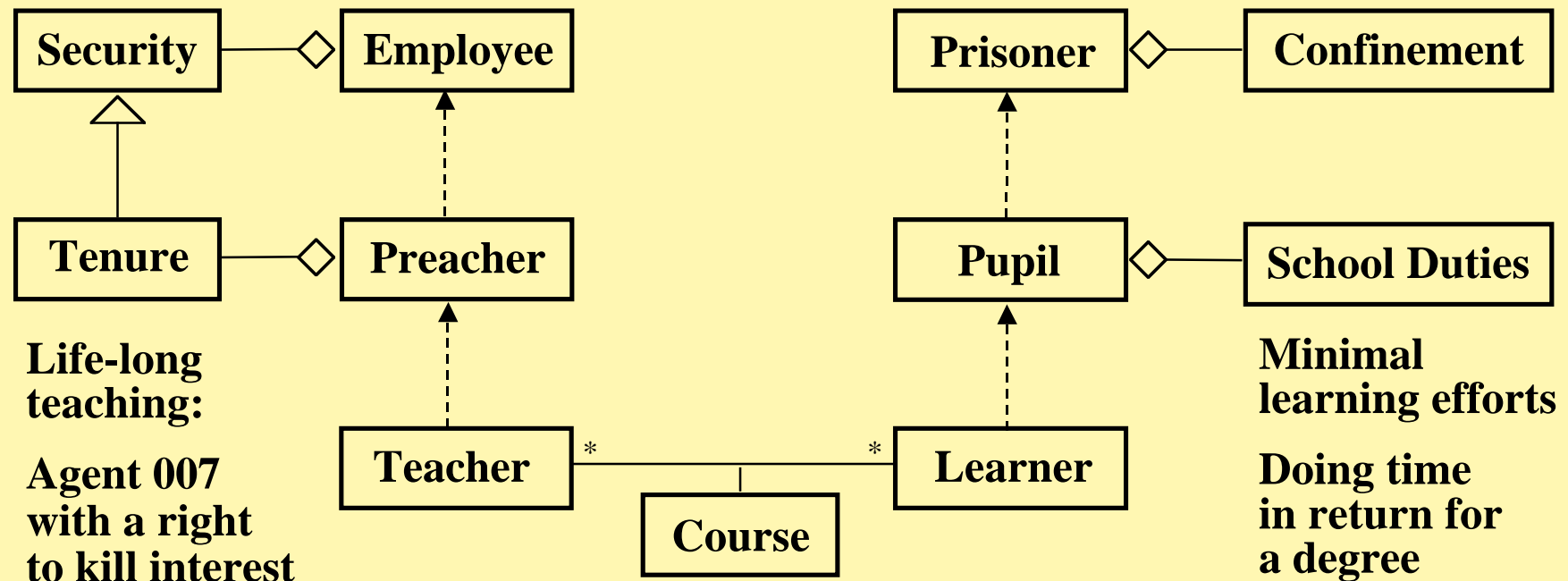
Promoting life-long learning based on interest by:

- using ICT to increase the "cognitive contact" by:
 - visualizing the concepts.
 - interacting with the formulas.
 - personalizing the presentation.
 - routing the questions to live resources.
- improving the narrative by:
 - showing before proving.
 - proving only when the need is evident.
 - focusing on the evolutionary history.



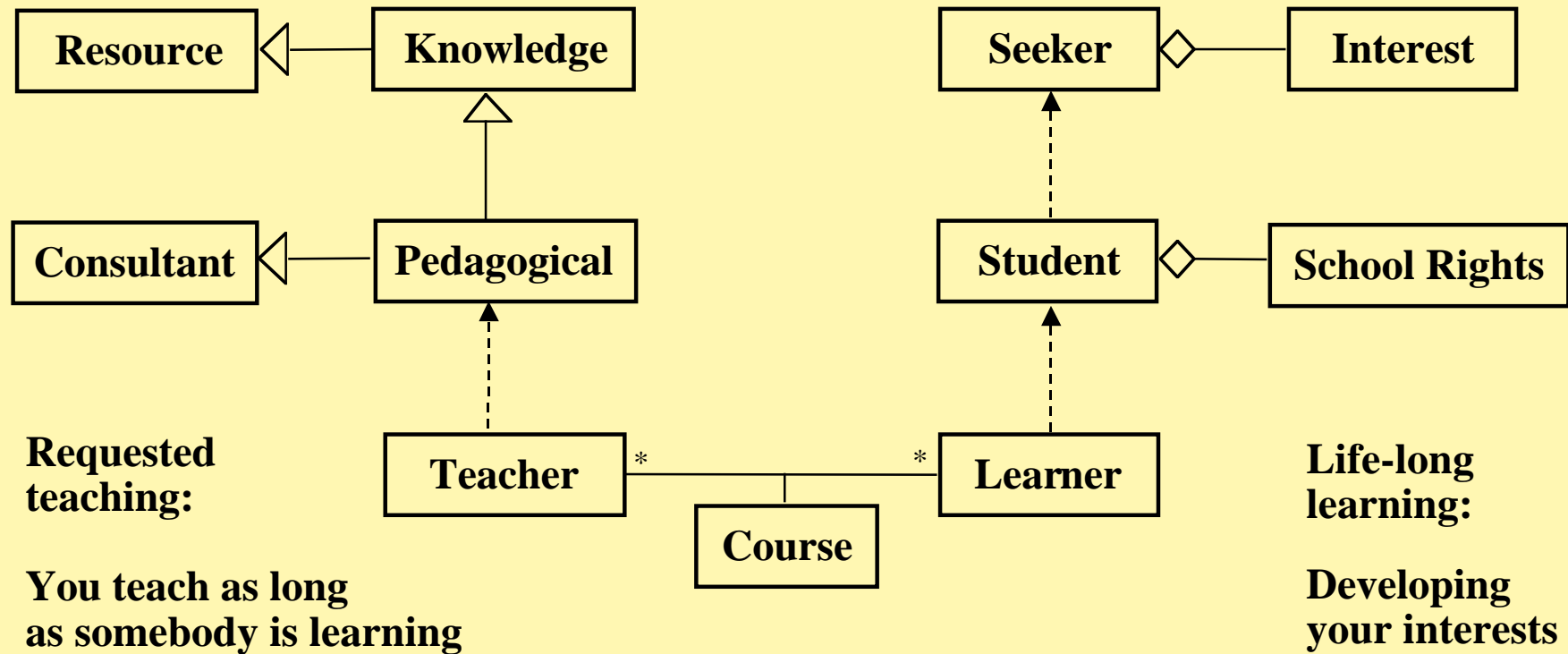
A traditional educational design pattern

(Tenured Preacher / Learner Duty)



An emerging educational design pattern

(Requested Preacher / Learner Rights)



A Knowledge Manifold

- is a **learner-centric** educational architecture that supports **question-based learning**.
- is designed in a way that reflects a strong effort to comply with emerging **international IT standards**.
- can be regarded as a **Knowledge Patchwork**, with a number of linked **Knowledge Patches**, each with its own **Knowledge Gardener**.
- gives the users the opportunity to ask questions and search for **live certified Knowledge Sources**.



A Knowledge Manifold (cont.)

- has access to distributed archives of **resource components**.
- allows teachers to **compose components** and construct customized learning environments.
- makes use of **conceptual modeling** to support the separation of **content** from **context**.
- contains a **conceptual exploration tool** (**concept browser**) that supports these principles.

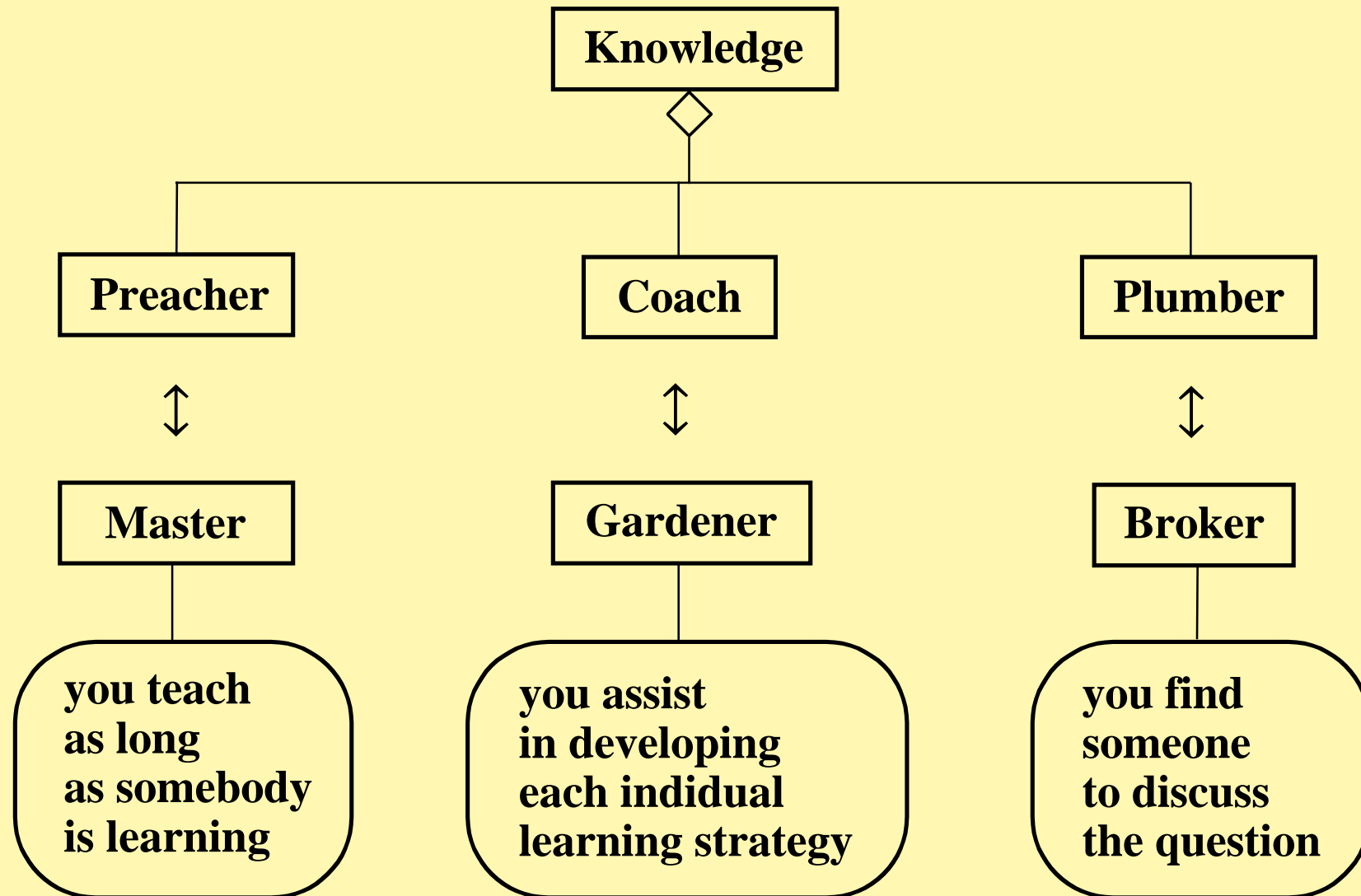


The seven different Knowledge Roles of a KM

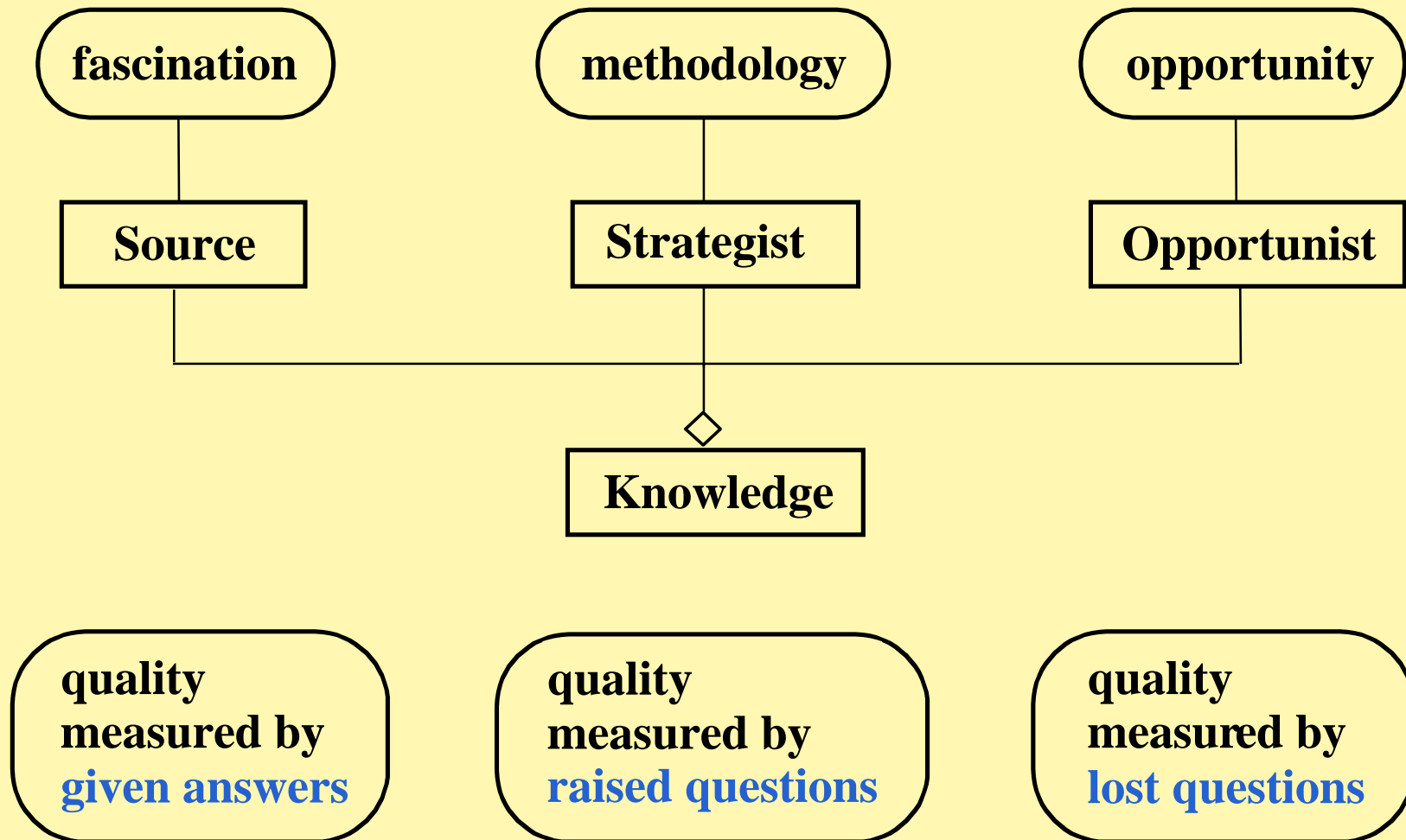
- The knowledge **cartographer**
 - constructs **context-maps**.
- The knowledge **librarian**
 - fills the context-maps with **content**.
- The knowledge **composer**
 - composes content components into **learning modules**.
- The knowledge **coach**
 - cultivated **questions**.
- The knowledge **preacher**
 - provides **live answers**.
- The knowledge **plumber**
 - connects questions with **appropriate preachers**.
- The knowledge **mentor**
 - provides **motivation** and supports **self-reflection**.



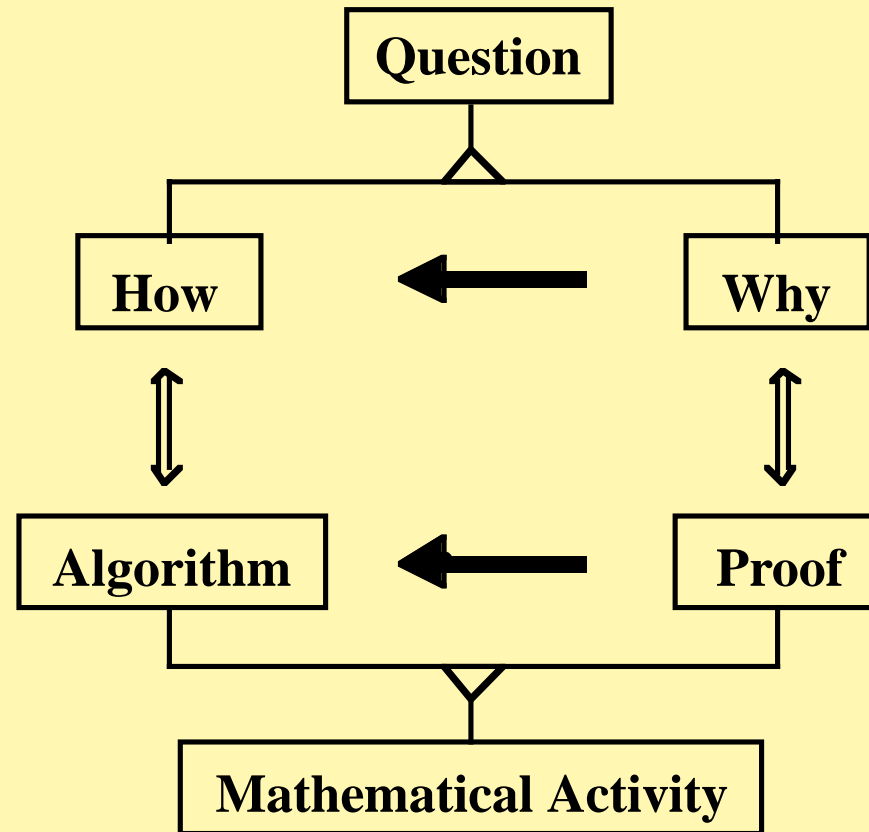
QBL: the 3 performing knowledge roles



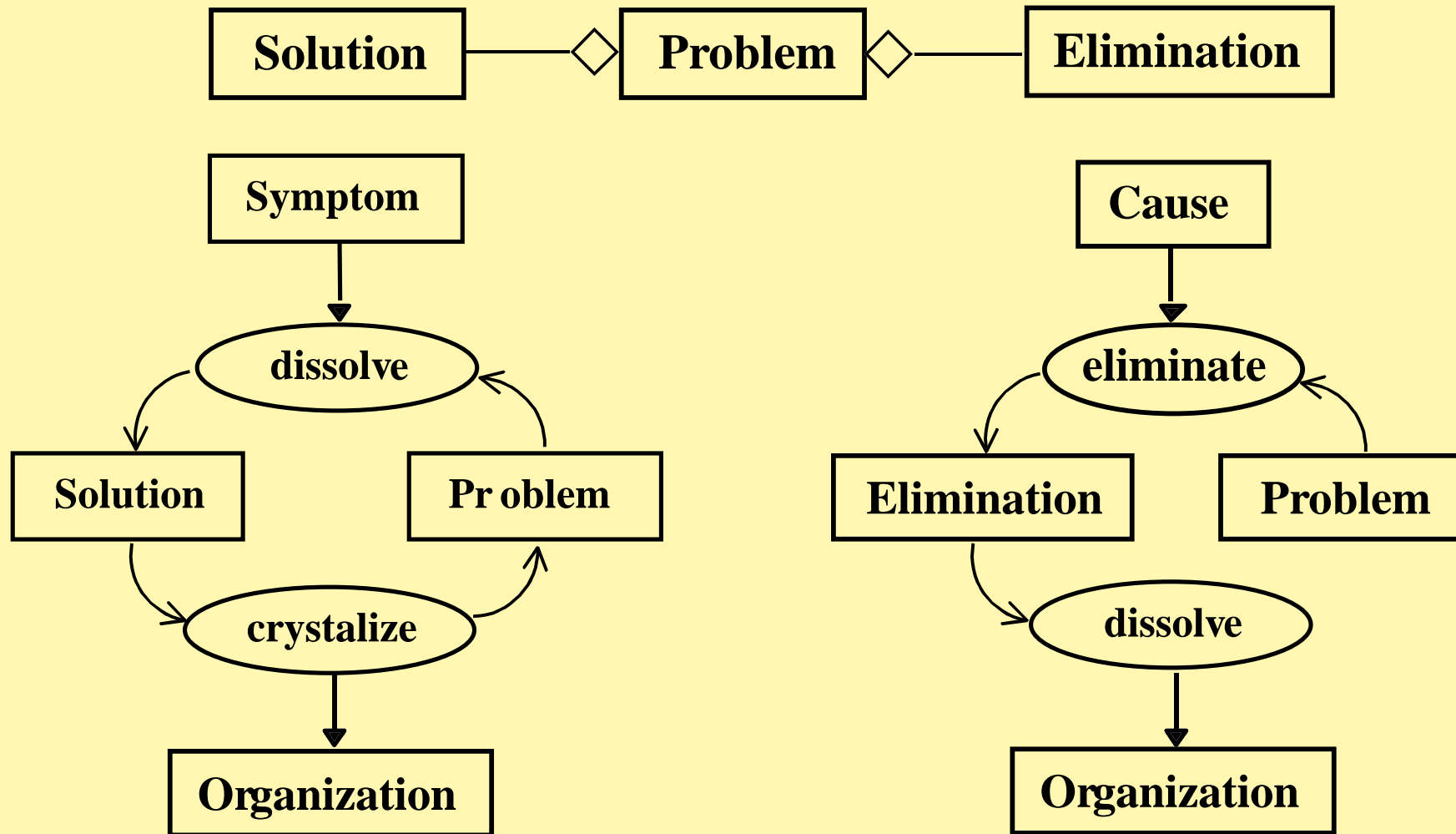
QBL: the 3 performing knowledge roles (cont)



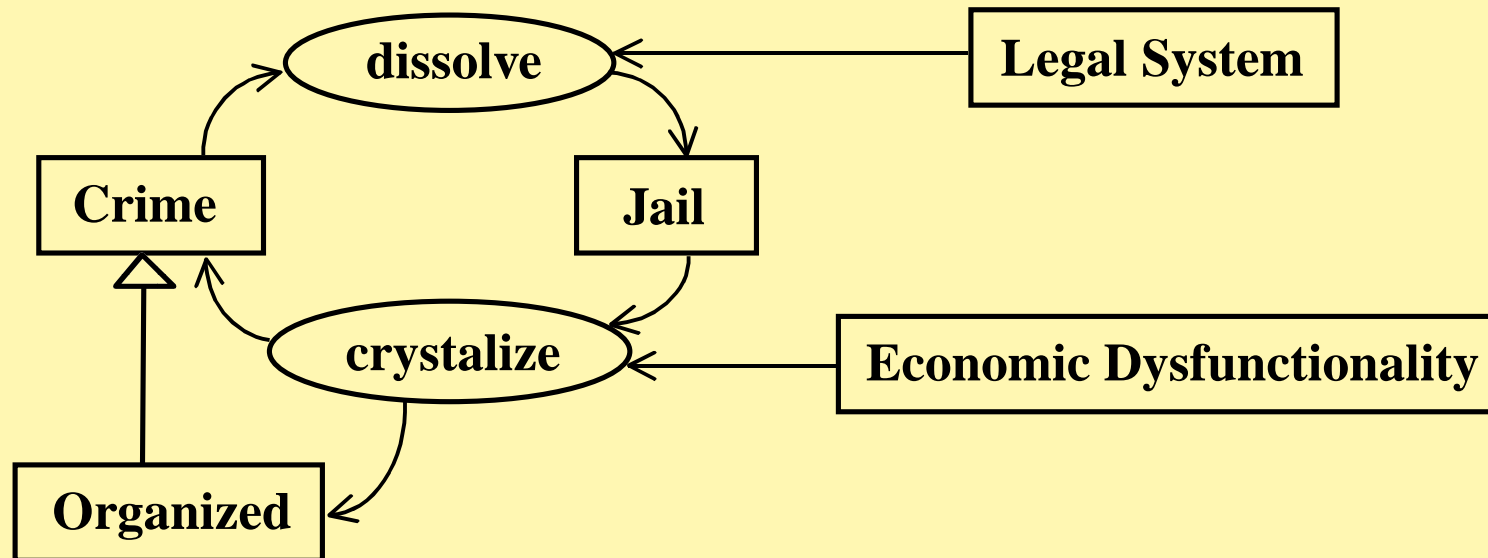
Long term trend in mathematics education



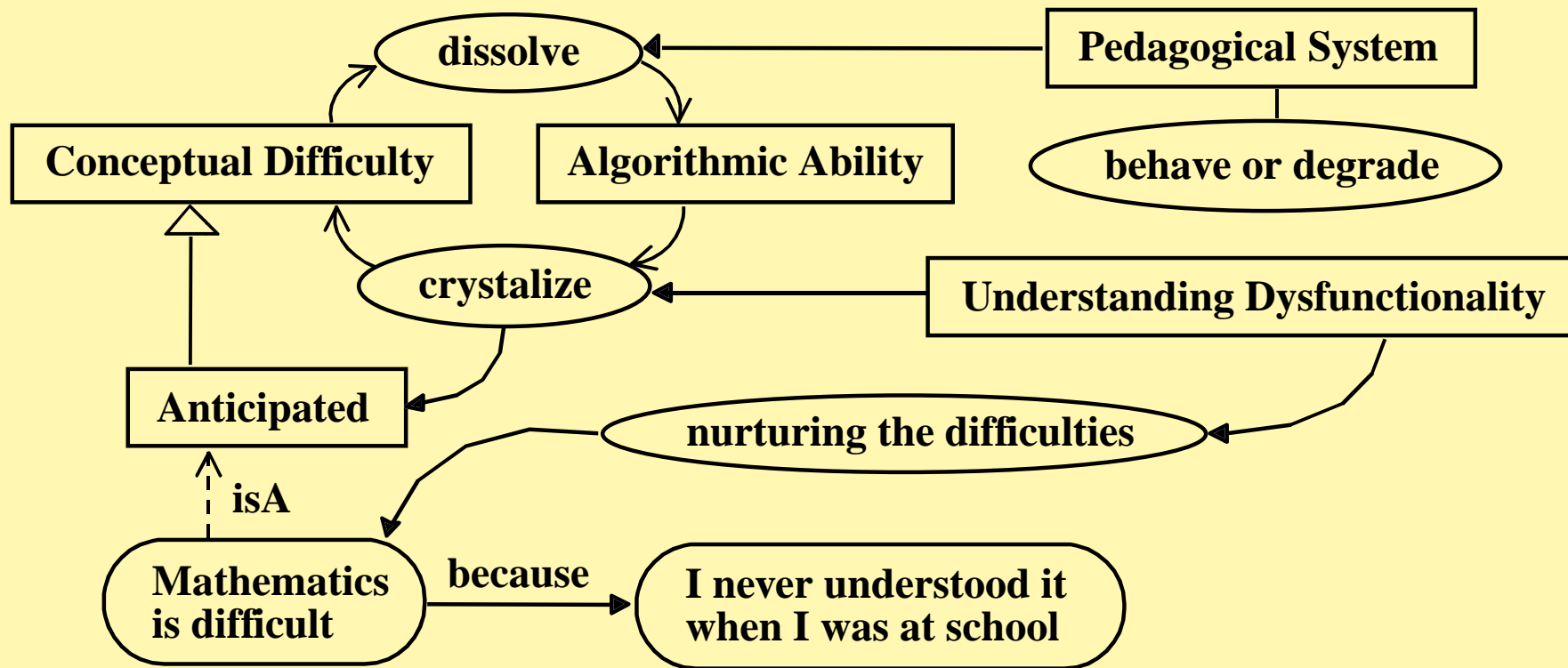
Problem / Solution versus Problem / Elimination



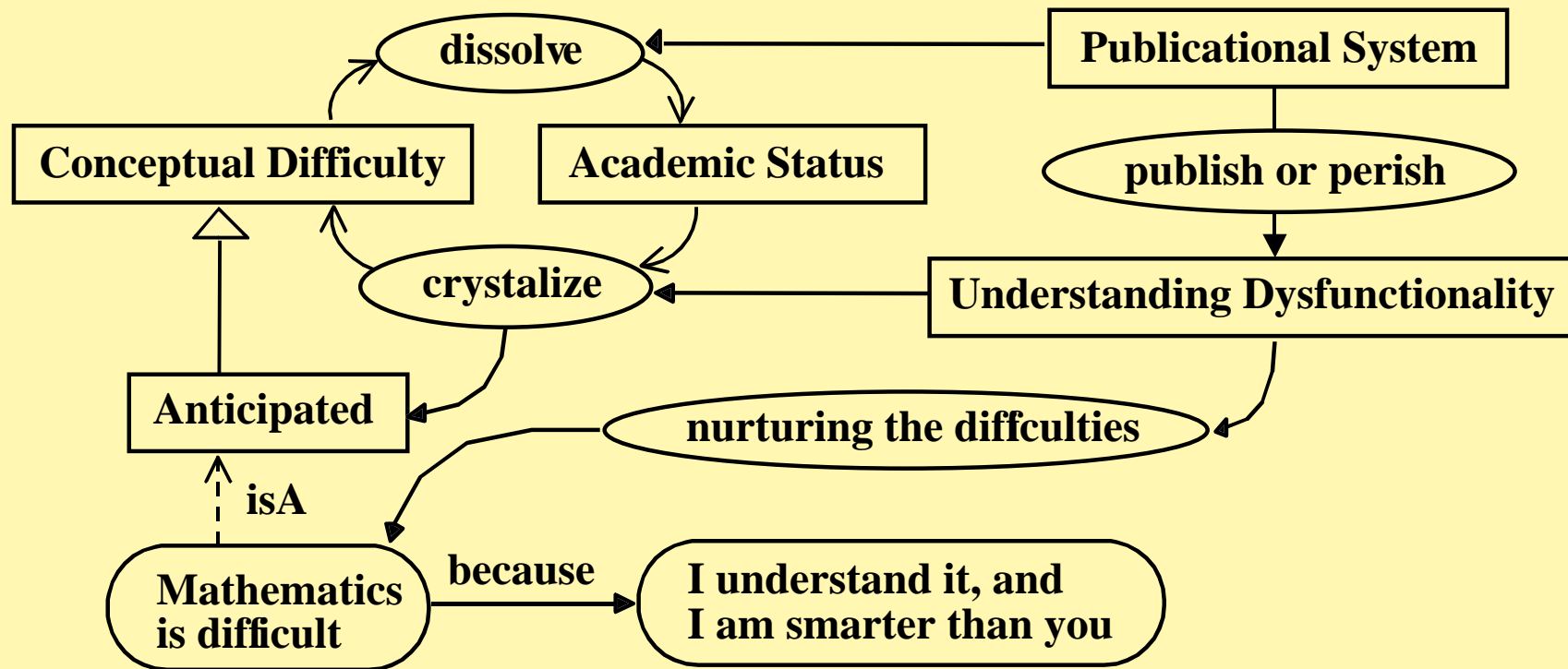
Problem / Solution applied to Crime



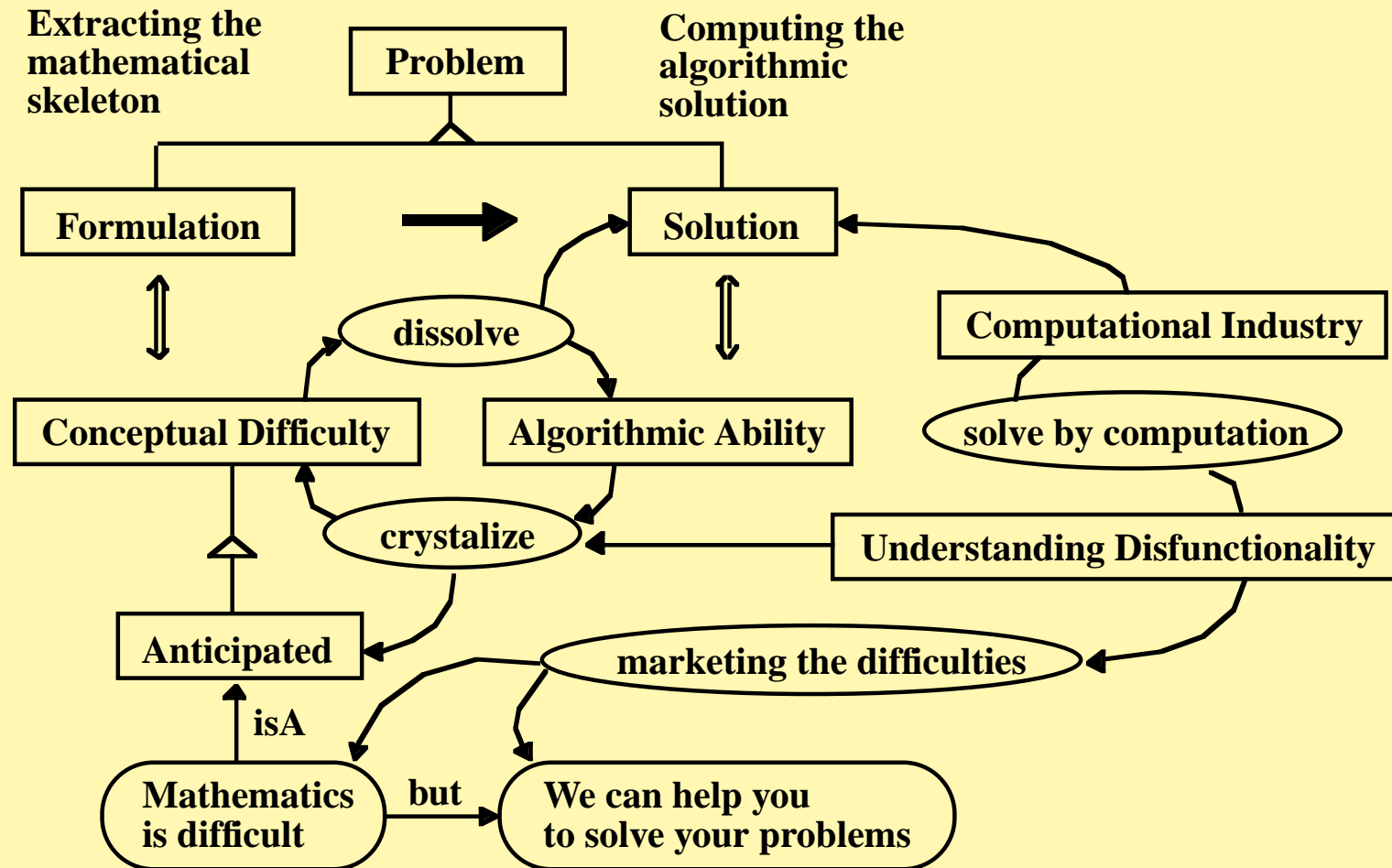
Problem/Solution applied to early math education

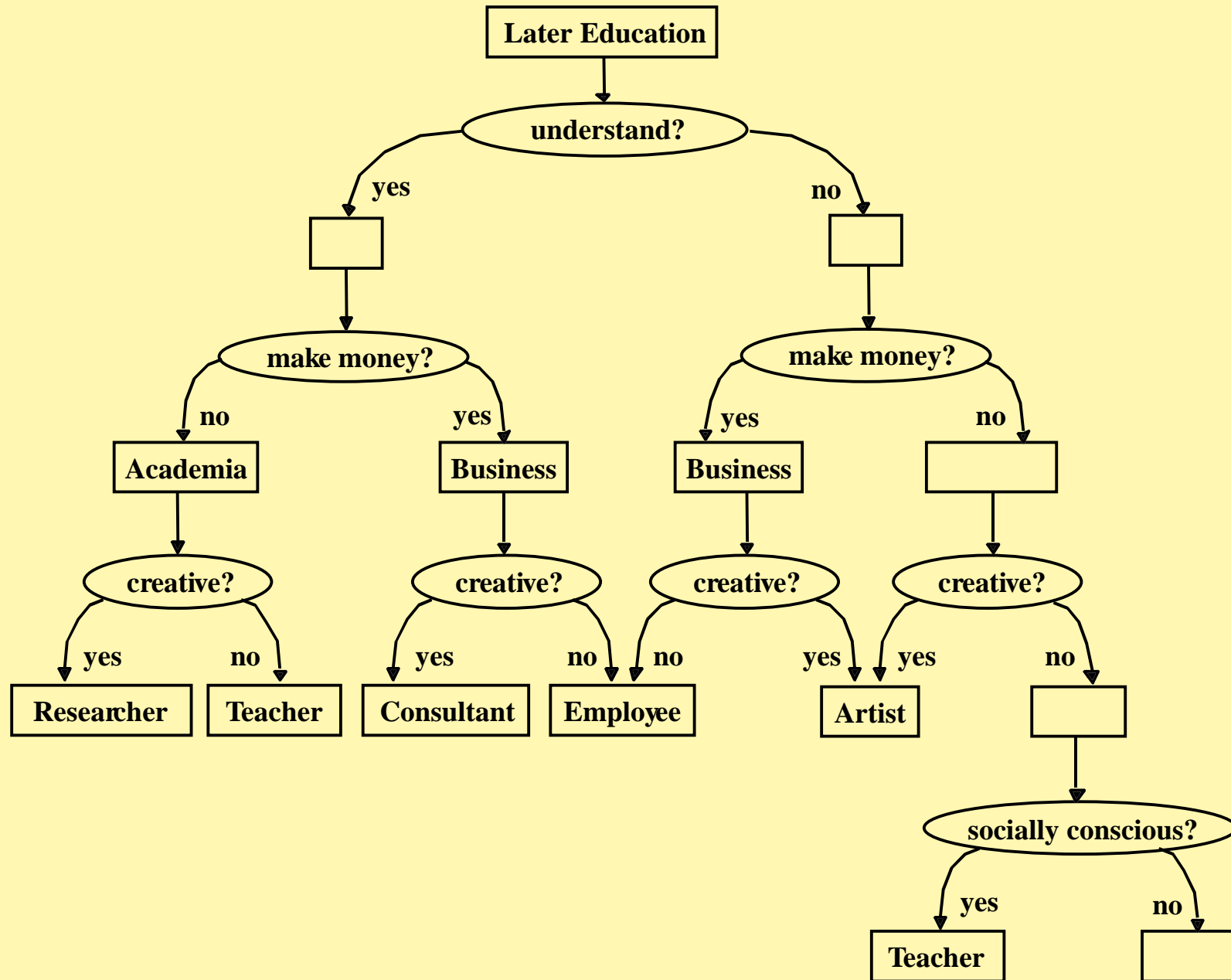


Problem/Solution applied to late math education

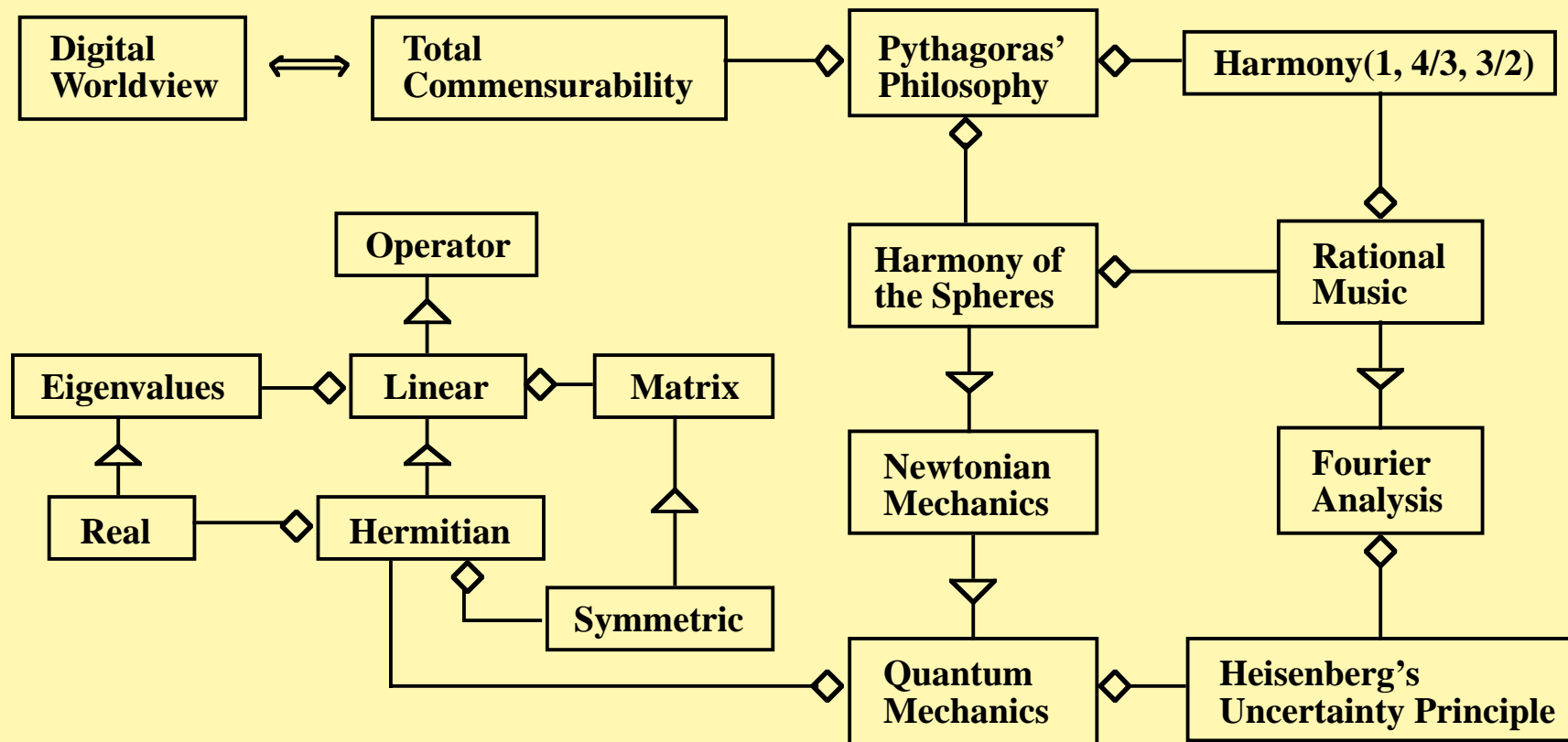


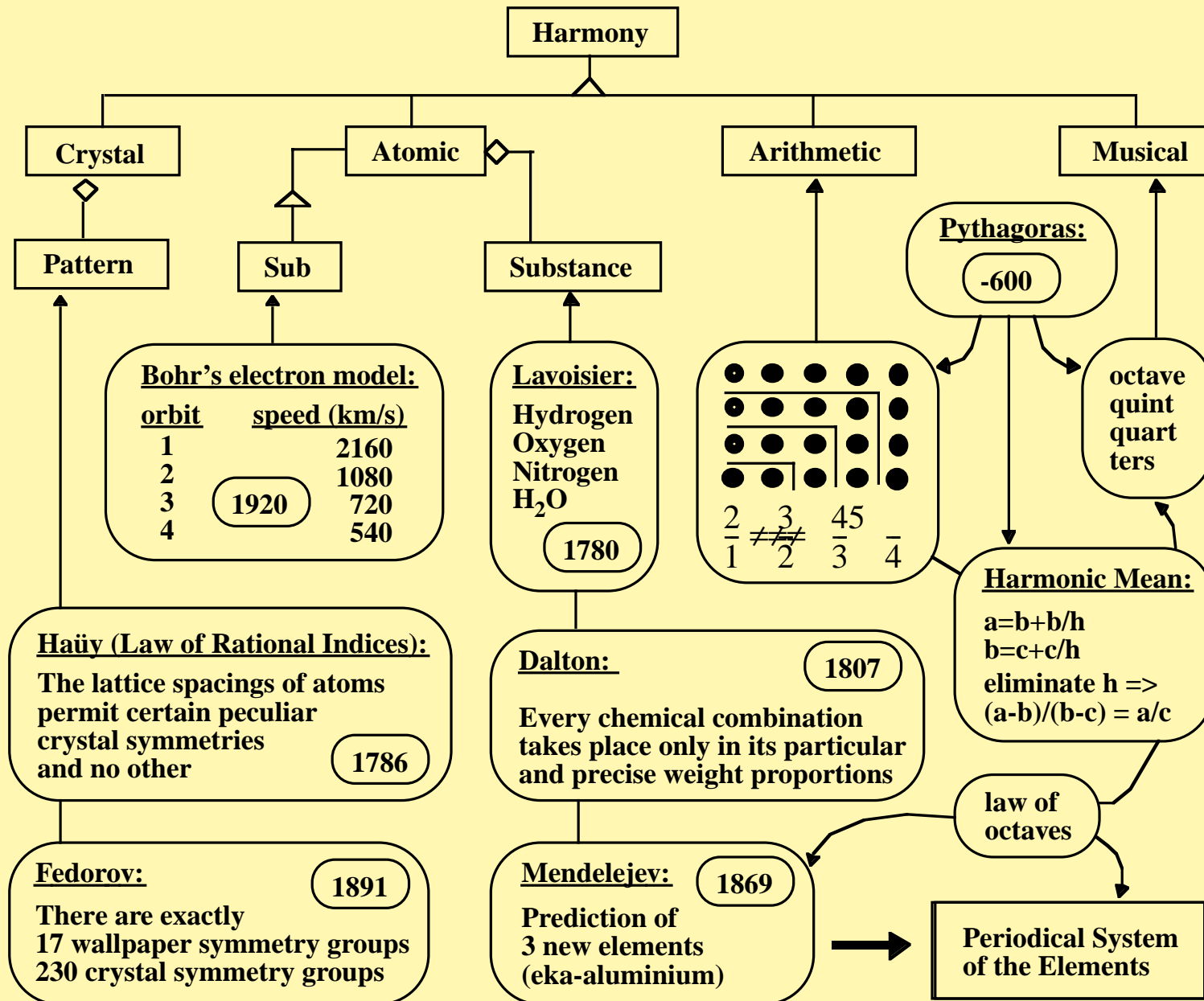
Problem/Solution applied to calculator industry

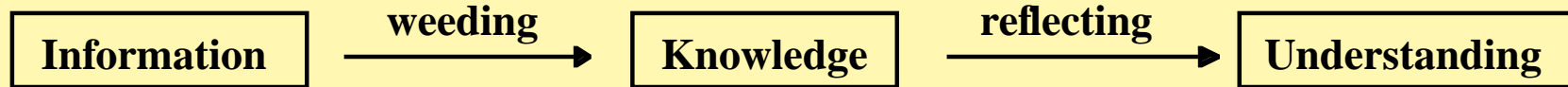


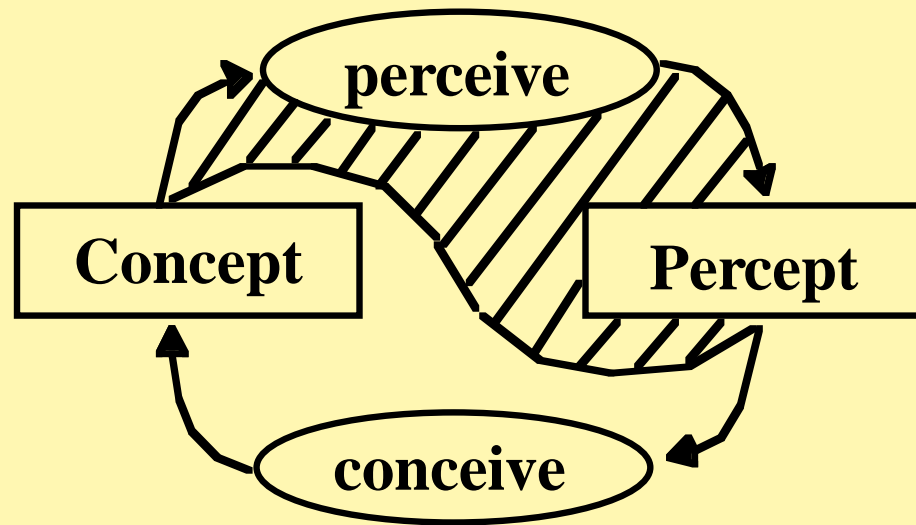


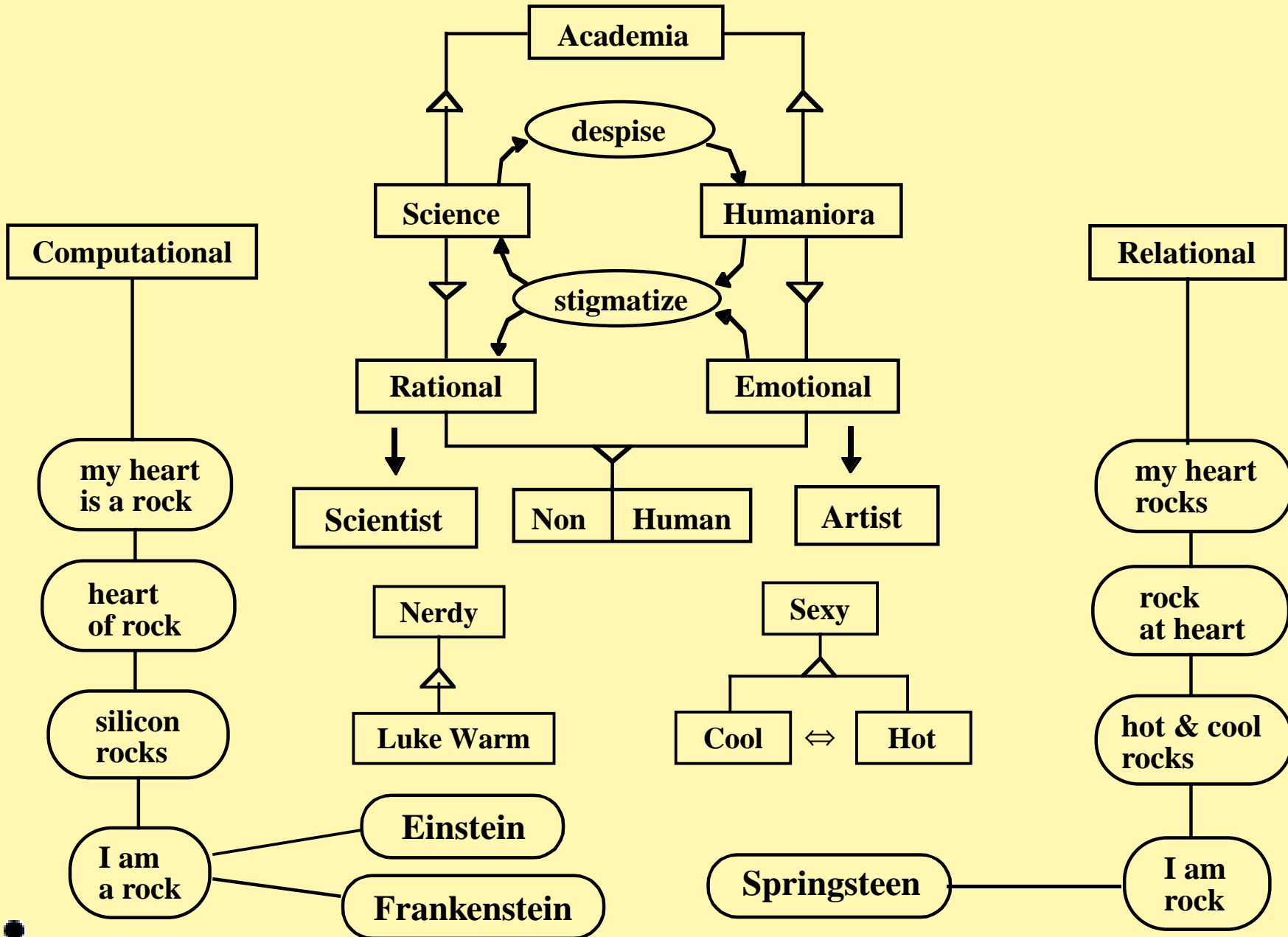
The digital view - from Pythagoras to Heisenberg

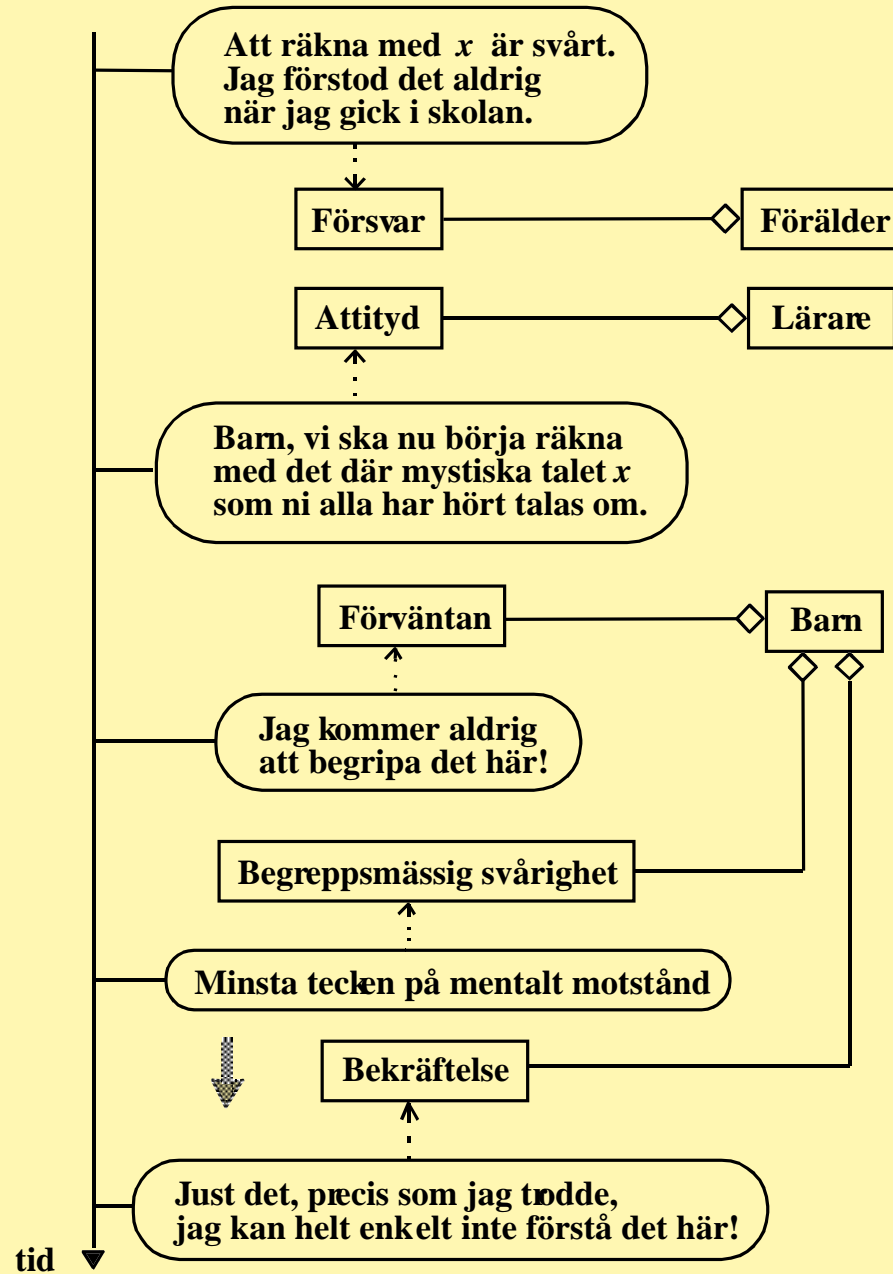




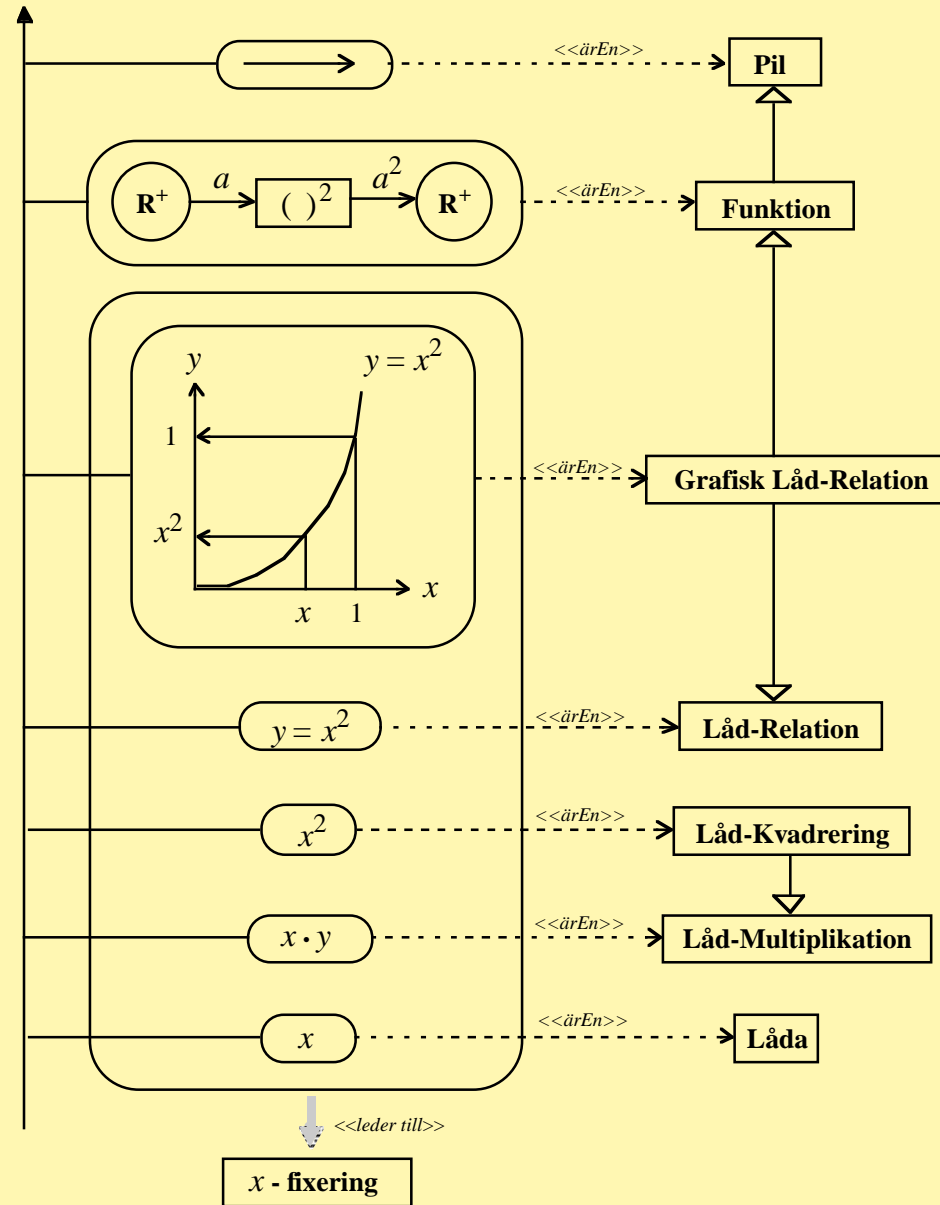








inlärningsordning



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- [Naeve, A.](#), *The Garden of Knowledge as a Knowledge Manifold - a conceptual framework for computer supported subjective education*, CID-17, NADA/KTH, 1997.
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- [Naeve, A.](#), *Conceptual Navigation and Multiple Scale Narration in a Knowledge Manifold*, CID-52, NADA/KTH, 1999.
- [Naeve, A.](#), *Begreppsmodellering och matematik*, CID-109, NADA/KTH, 2001.
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