

Institute of Education, HSE Summer School 2018

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National Research University HSE, Institute of Education, Moscow



HSE-Summer School Lectures

Consist of two connected topics:

Development and enhancement of thinking, educational assessments with examples of PISA and Timms and key competencies (July 3 2018)

Learning to learn as a goal of education and as an issue in assessment and evaluation (July 4 2018)

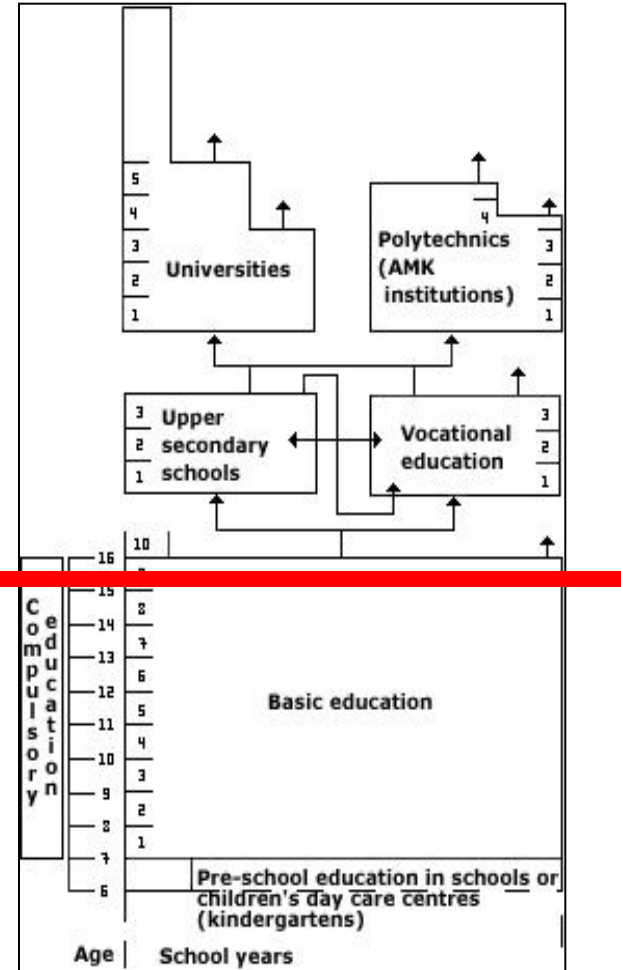
The main line: **Will we be smart enough? Cognitive demands on the incoming work force.**



The Finnish Education System

- **Basic education** still mostly divided to two separate entities of grades 1–6 and grades 7-9
- **Age-cohort 60 000**, together 540 000 students
- About 3000 schools
- Average expenses 7000 e/student

PISA assessment point/position



Learning to learn, L2L Studies: EPISTEMIC MENTALITY

Mastery of Thinking

= a general competence

Perspective of Hope

= a scholastic attitude

Cohort, cross-sectional studies, replicated

1. classes

3. classes

6. classes

9. classes

"11th" classes

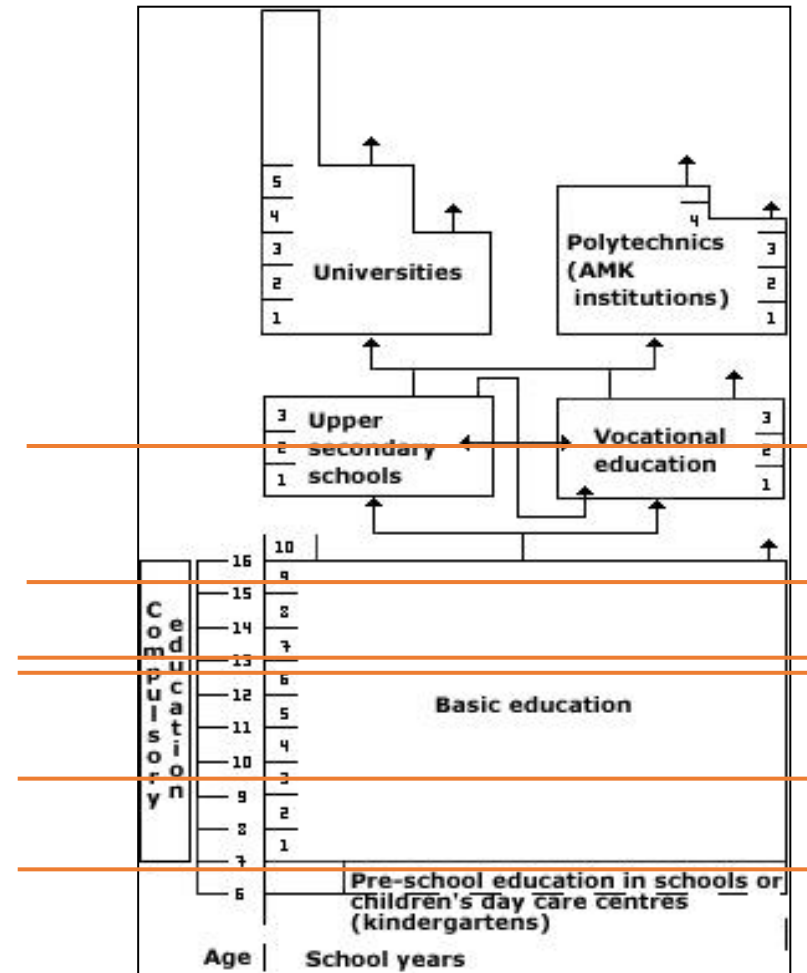
Longitudinal studies

1>3>6>9; 3>6>9>12; 6> adults

Cross-sectional sequences

1>3>6>9>

1>3>6>9>12

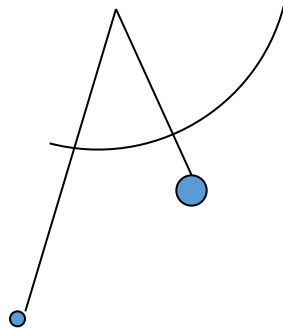


Piaget's pendulum

Based on the schema of *Control of Variables*, from Shayer's Science Reasoning Tasks, based on the descriptions in Inhelder and Piaget's "Growth of Logical Thinking" (1958).

Pendulum:

Length (short or long) x weight (light or heavy) x push (weak or heavy)



	<u>length</u>	<u>weight</u>	<u>push</u>	<u>swings</u>
Experiment 1:	short	heavy	weak	20
Experiment 2:	long	light	weak	17

Length Has it an impact, and if, what kind?

Weight Has it an impact, and if, what kind?

Push Has it an impact, and if ,what kind?

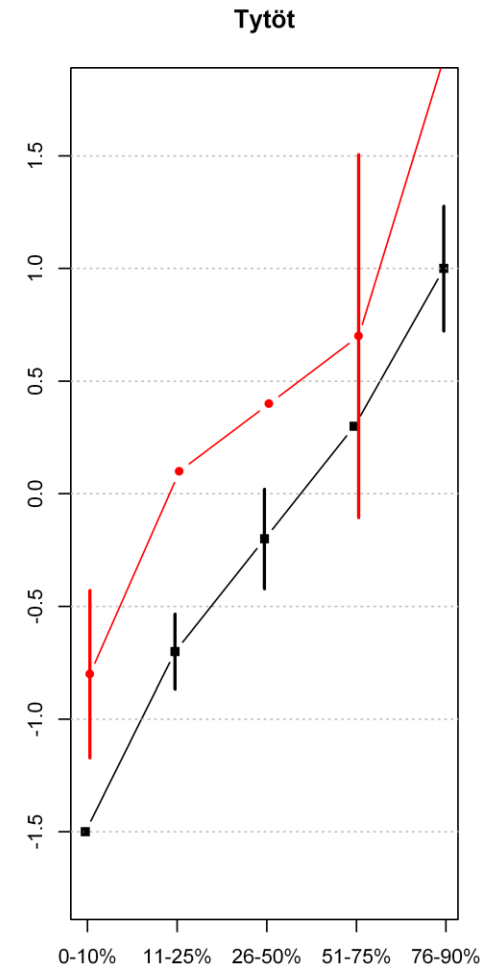
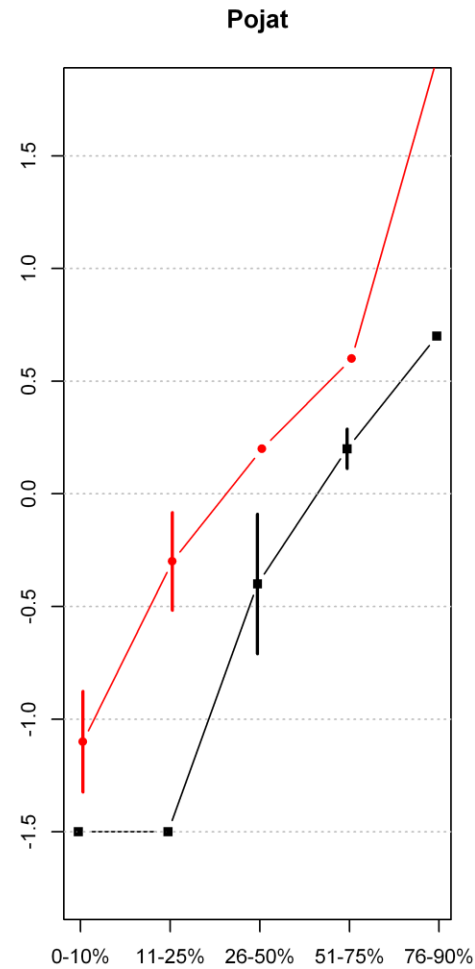
2001 > 2012

Arithmetical
operations

3 g 5 = 10 p 5

g?

p?



Complex Problem Solving, CPS, using Computer Based Assessment, Prof. Dr. Samuel Greiff, U Luxembourg

Find out about the relationships and plot them in the model! Round 5 162

Strategy A
-- - O + ++
[Slider: 1] [Graph: 0 2 3]

Strategy B
-- - O + ++
[Slider: 1] [Graph: 0 2 3]

Strategy C
-- - O + ++
[Slider: 2] [Graph: 0 2 3]

Novella
19 [Graph]

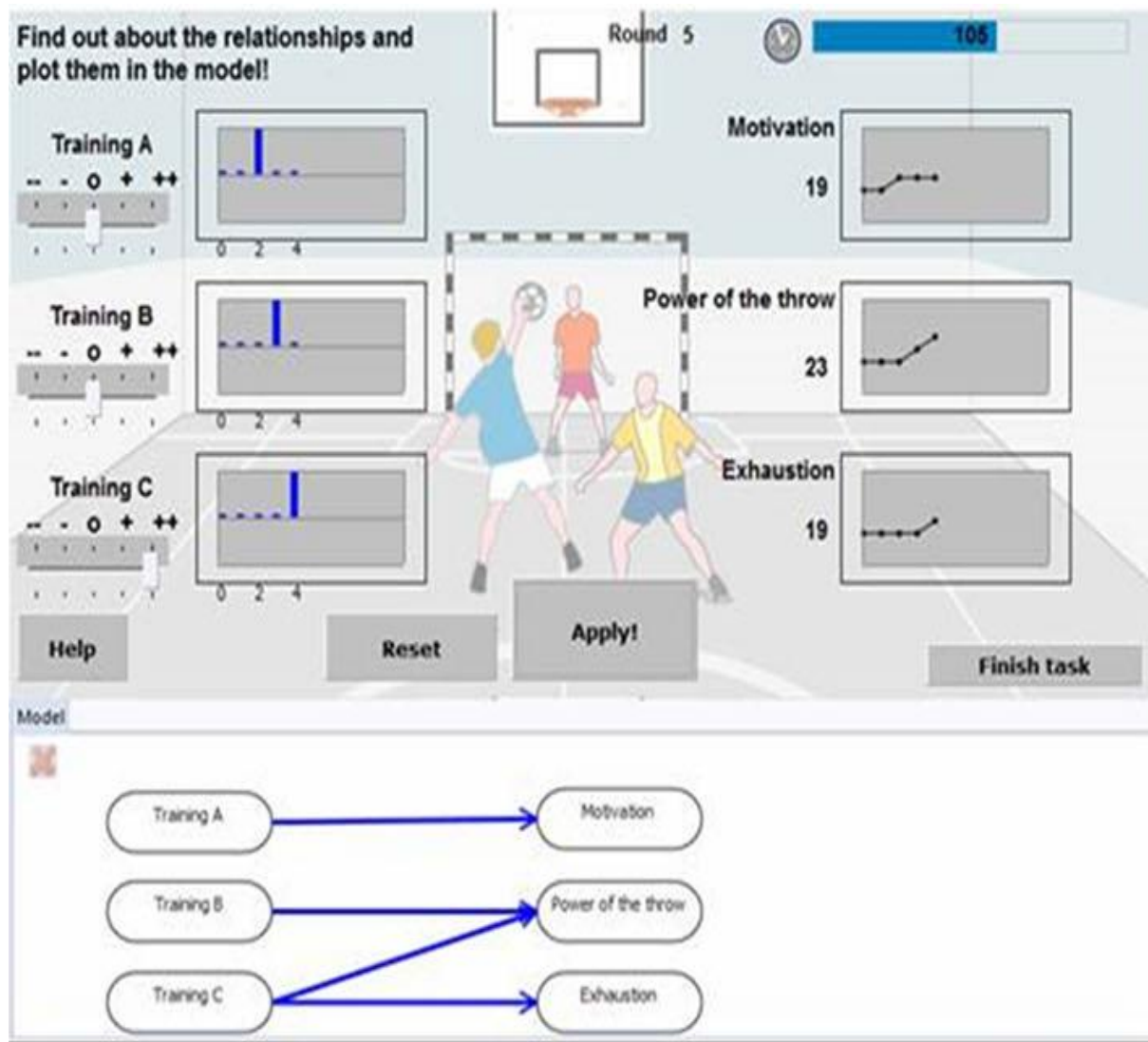
Flavanto
19 [Graph]

Marisse
19 [Graph]

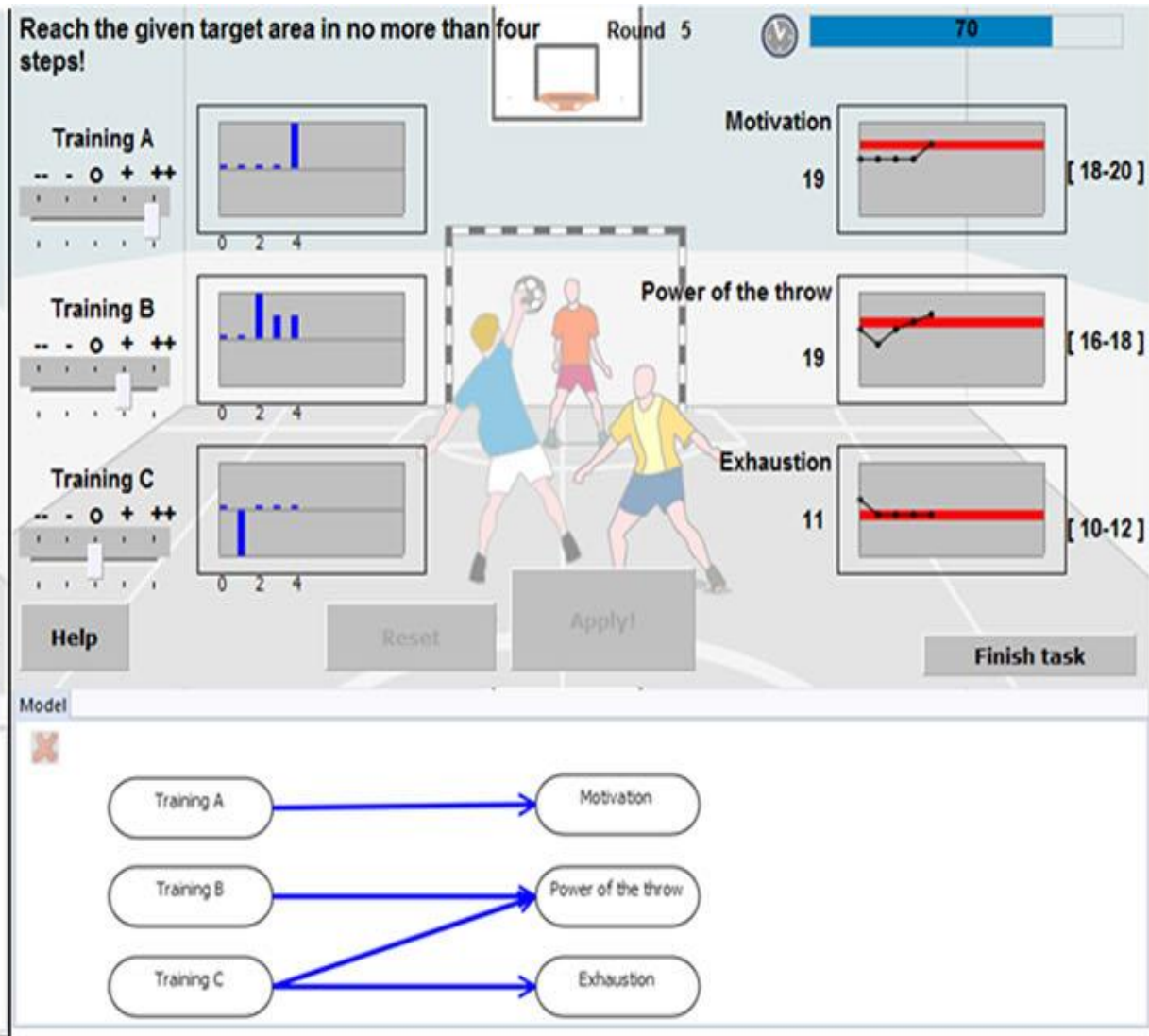
Help **Clear** **Apply!** **Finish task**

Model

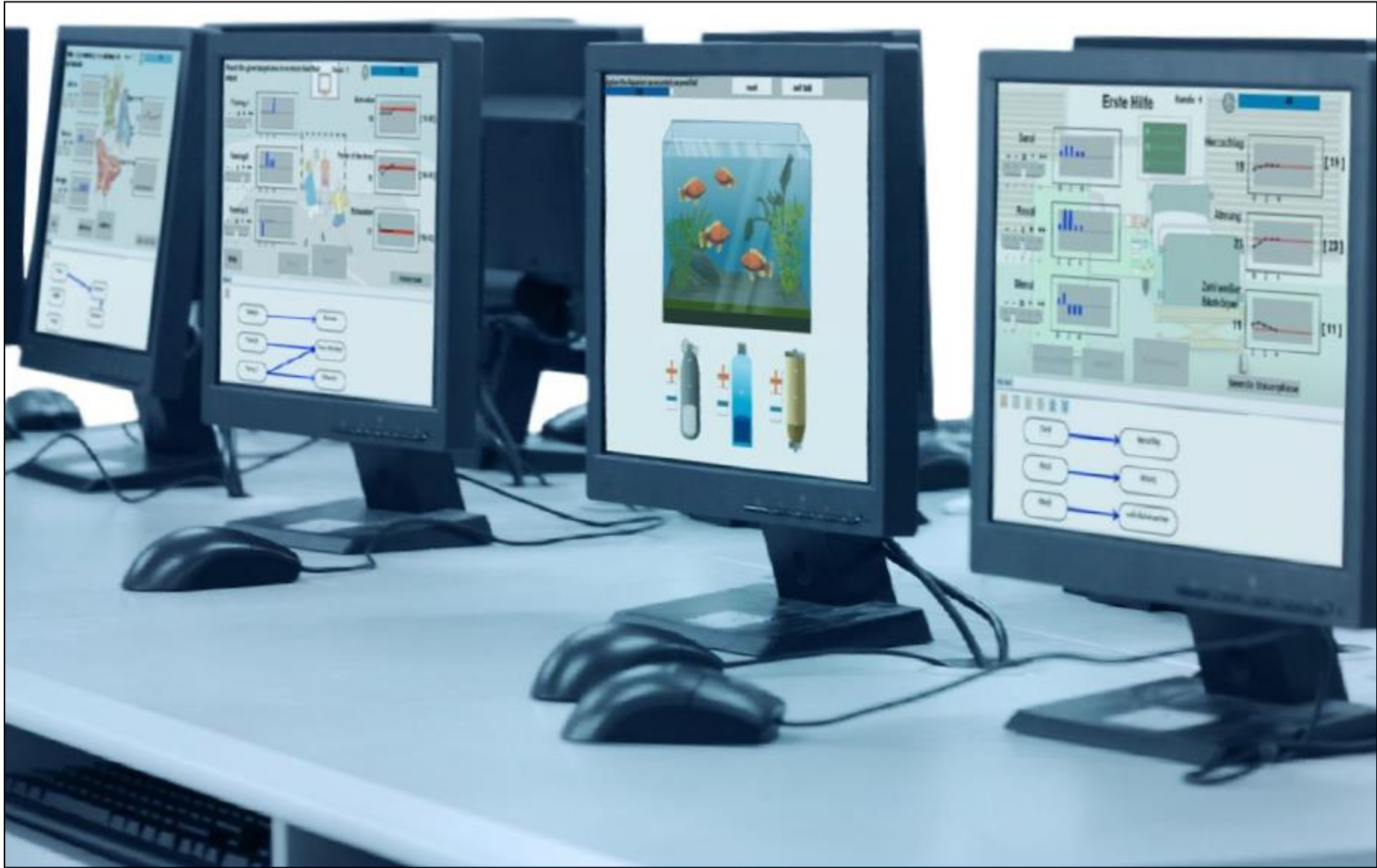
```
graph LR; S_A[Strategy A] --> N[Novella]; S_B[Strategy B] --> N; S_B --> F[Flavanto]; S_C[Strategy C] --> M[Marisse];
```



(a)



(b)



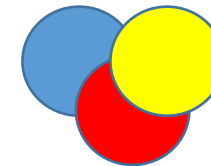
**PISA, Programme for International Student Assessment, by OECD,
since 2000, 2003 2006, 2009, 2012 and 2015**

A random sample of schools (to have at least c. 5000 students)

A random sample (up to 35) of students from the selected schools

Cross-sectional survey

**Three areas: Reading, Mathematical and Science Literacy, paper-
and-pencil data collection, a complex data analysis**



**OECD mean is set to 500 and SD is 100, and countries can be
compared in relation to 500 and to each other (< or >)**

**Sometimes also other topics: 2003 problem solving, 2015
collaborative problem solving + computer-supported data**

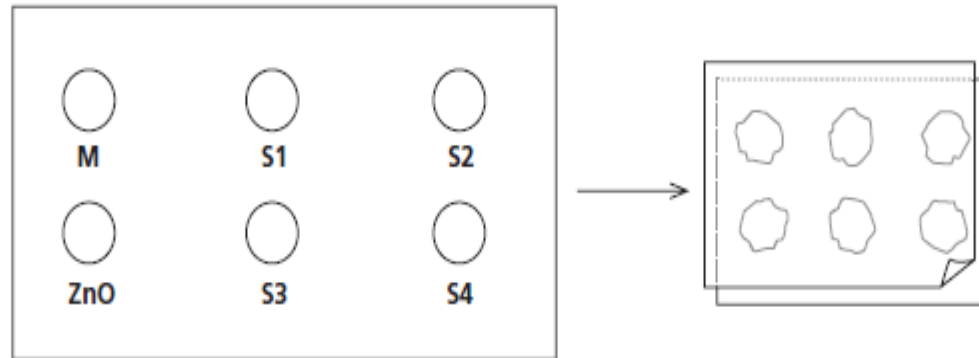
Mimi and Dean wondered which sunscreen product provides the best protection for their skin. Sunscreen products have a *Sun Protection Factor (SPF)* that shows how well each product absorbs the ultraviolet radiation component of sunlight. A high SPF sunscreen protects skin for longer than a low SPF sunscreen.

Mimi thought of a way to compare some different sunscreen products. She and Dean collected the following:

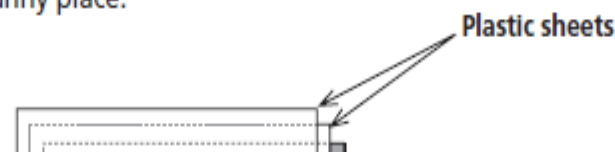
- two sheets of clear plastic that do not absorb sunlight;
- one sheet of light-sensitive paper;
- mineral oil (M) and a cream containing zinc oxide (ZnO); and
- four different sunscreens that they called S1, S2, S3, and S4.

Mimi and Dean included mineral oil because it lets most of the sunlight through, and zinc oxide because it almost completely blocks sunlight.

Dean placed a drop of each substance inside a circle marked on one sheet of plastic, then put the second plastic sheet over the top. He placed a large book on top of both sheets and pressed down.



Mimi then put the plastic sheets on top of the sheet of light-sensitive paper. Light-sensitive paper changes from dark grey to white (or very light grey), depending on how long it is exposed to sunlight. Finally, Dean placed the sheets in a sunny place.



QUESTION 8.2

Which one of these questions were Mimi and Dean trying to answer?

A. How does the protection for each sunscreen compare with the others? Score 499

B. How do sunscreens protect your skin from ultraviolet radiation?

C. Is there any sunscreen that gives less protection than mineral oil?

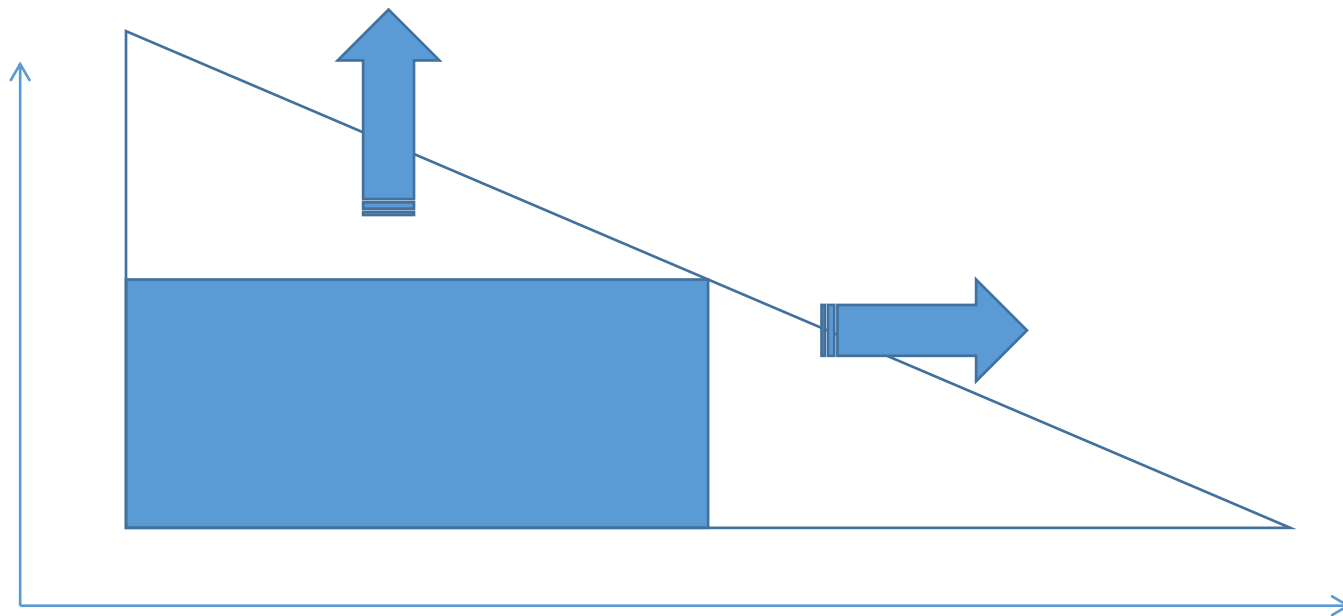
D. Is there any sunscreen that gives more protection than zinc oxide?



To begin - two ways to look
on schooling

Major Finnish Educational Expansions and Extensions, since 1948

1948 1967-72 1978 1984/5 1990 ... 2014





OPETUSHALLITUS

OPS 2016

Curriculum reform in Finland

FINNISH NATIONAL BOARD OF EDUCATION

More information:

Mrs. Irmeli Halinen, Head of Curriculum Development
irmeli.halinen@oph.fi

- **Curriculum reform 2016**
- **Renewal of the core curriculum for pre-primary and basic education**
- The national core curriculum for pre-primary and basic education was renewed in 2014. The process involved all stakeholders, particularly education providers and education personnel. The aim was to encourage also parents and pupils to participate in the process.
- The renewed core curriculum was completed by the end of 2014. New local curricula that are based on this core curriculum were implemented in schools from August 2016.
- The renewed national core curricula for pre-primary and basic education have been published in English. Printed copies can be purchased on the FNBE online bookstore (user interface only available in Finnish and Swedish) or through international bookstores. Electronic copies are available on eBooks.com, Amazon, Ingram and iTunes.
- [Brochure about the renewed core curricula \(pdf\)](#)
- [National Core Curriculum for Basic Education 2014 on the FNBE bookstore](#)
- [National Core Curriculum for Pre-Primary Education 2014 on the FNBE bookstore](#)



General education reform: Curriculum development work 2012–2017

2012 2013 2014 2015 2016 2017

NCC for pre-primary, basic and voluntary additional basic education Local curricula

NCC for general upper secondary education Local curricula

NCC Preparatory education for general upper secondary school Local curricula

NCC for basic education for adults and NCC for general upper secondary education for adults Local curricula

NCC for basic education in the arts Local curricula

NCC = National Core Curriculum



Broad-based competence in the draft core curriculum (2)

Dimensions of broad-based competence (7)

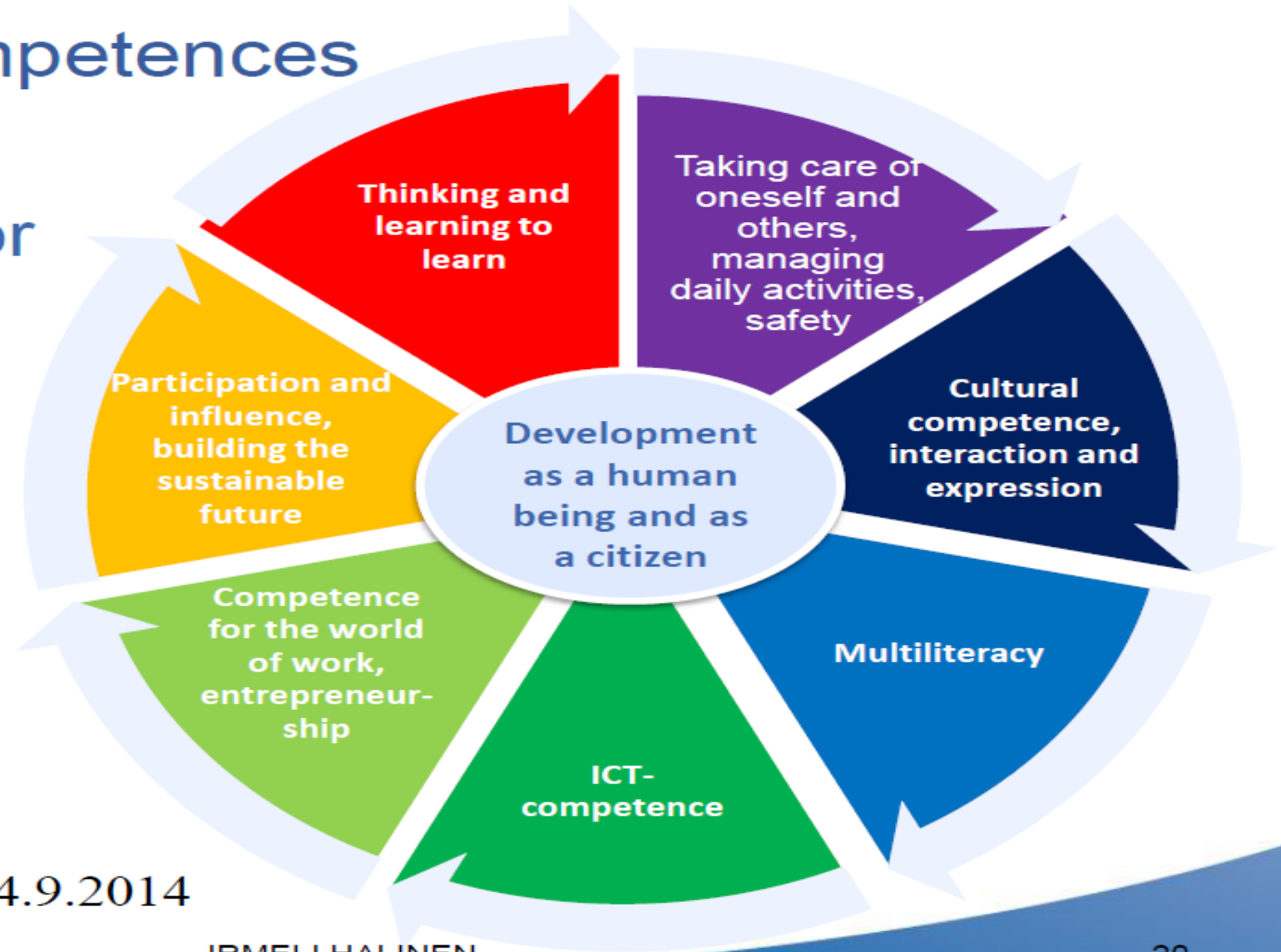
- Thinking and learning
- Cultural competence, interaction and expression
- Looking after oneself, managing daily activities, safety
- Multiliteracy
- ICT competence
- Competence required for working life and entrepreneurship
- Participation, empowerment and responsibility



Rethinking competences

National Goals for Basic Education and Transversal Competences

- knowledge
- skills
- values
- attitudes
- will



Core Curriculum Draft 14.9.2014

Learning to Learn in the Finnish Framework

Learning to learn is seen to encompass the general educational goals that are not the sole domain or responsibility of any one subject but

- ... are formed in good educational practice in the different subjects
- ... guide students' learning and are present in school achievement
- ... can be understood as a precursor to lifelong learning in indicating students' (cognitive) propensity and (affective and volitional) willingness for learning and self-development

The objects of learning to learn assessment can be divided to

- **competences (thinking skills, solving cognitive tasks)**
- **school and learning related beliefs and attitudes**

Ice smoke in Hanko by the Sea
5 | 2016



Model of Schooling 1st step



Coverage: % of the relevant age cohort
historical expansion from 1 % to 100 %;
*how to organise education for ALL
using (comprehensive vs. selective)
models for schooling*

Model of Schooling – 2nd step

Content:

the level of
the knowlegde
and skills

Defined via curriculum
goals &
leaving credentials & links
to further education

*how to tackle
the variation of
pupils & to solve
matching (demands/competence)*

**What the
civil and
economic
activities
require:
Our best
guess!**

Model of Schooling – the moral issue

*How to tackle
the variation of
pupils*

Content:

if the level is fixed to a \approx high level, does this mean that all should attain this very level?

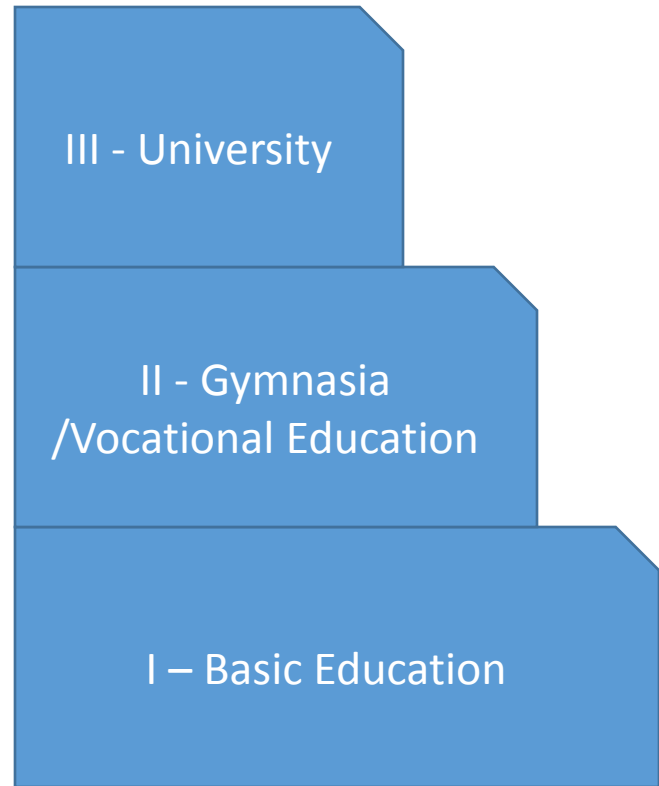
if YES, we have an educational problem,
if NO, we have a moral problem

Coverage: *using models for schooling*

Θ

Age/
or
Competence
Mastery

...

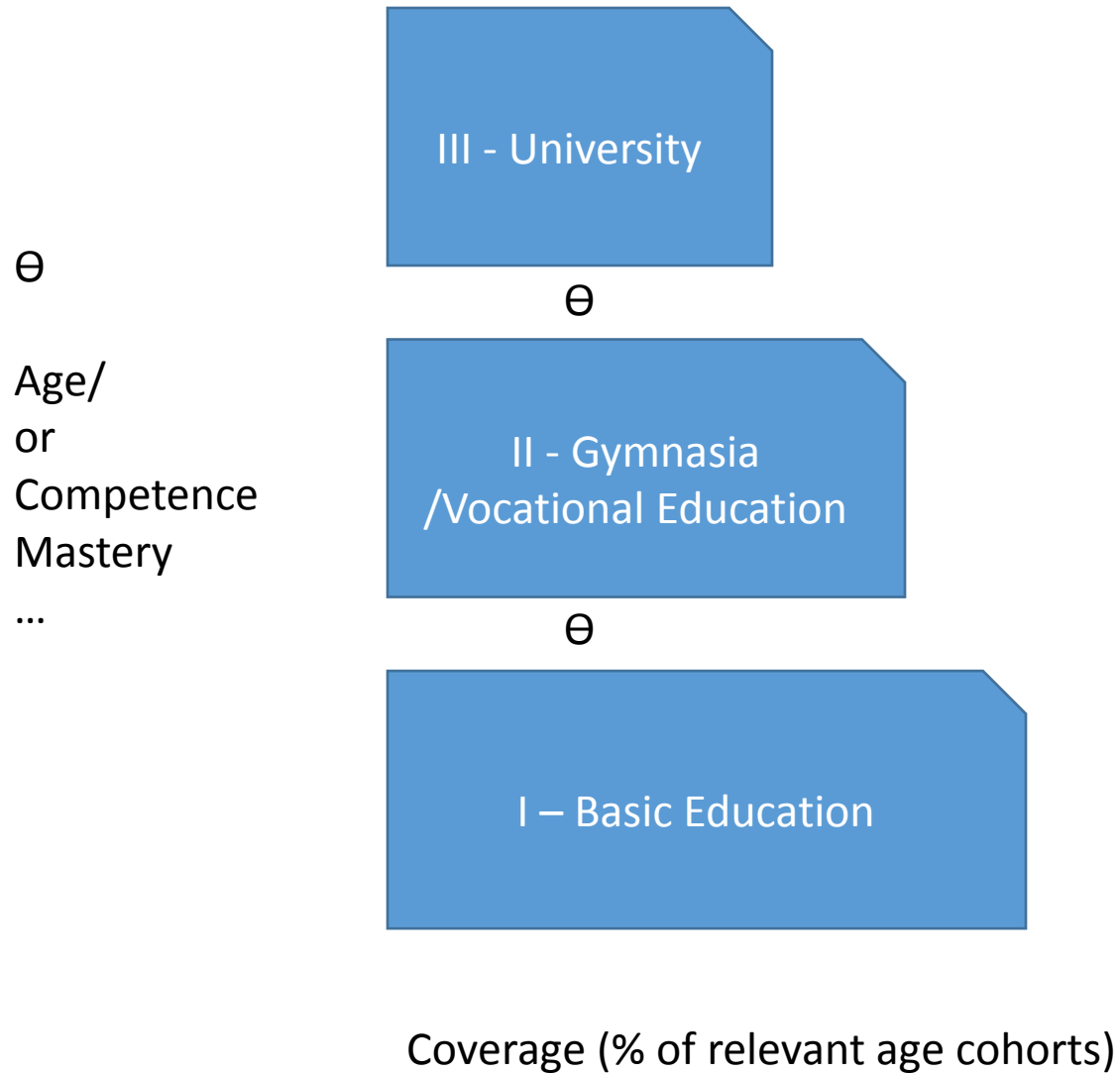


Coverage (% of relevant age cohorts)

If Θ

Is mastery, then what are the
implications?

Criteria or norms or both?



If θ
is mastery, then what are the
implications?

Criteria or norms or both?

How the schooling systems,
everywhere in the globe,
handle this way of seeing the
issue?

**How are between-student
differences, i.e. variations,
treated? And what functional
consequences or expressions
these solutions imply?**

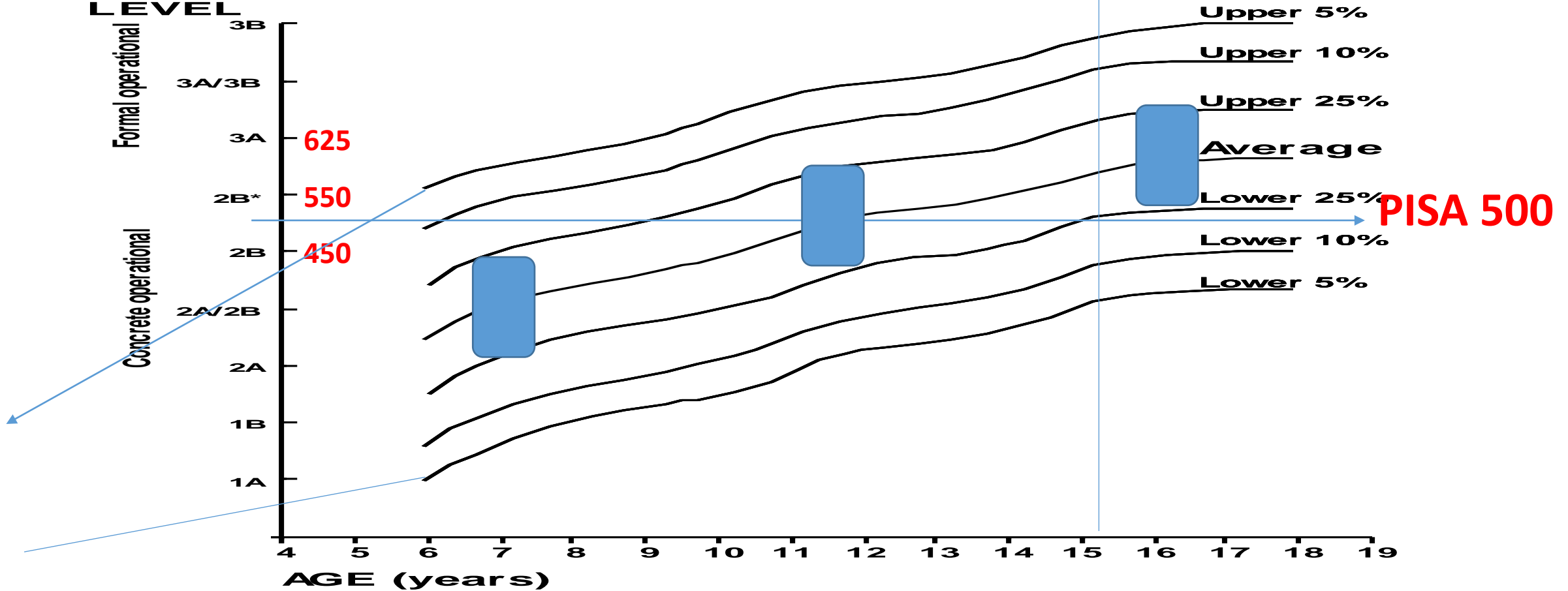
My estimation of criterion referenced level of the PISA scores in relation to the growth of logical-formal thinking



Cognitive Development

Boys; based on CSMS survey data, 1975 - 78

PIAGETIAN LEVEL



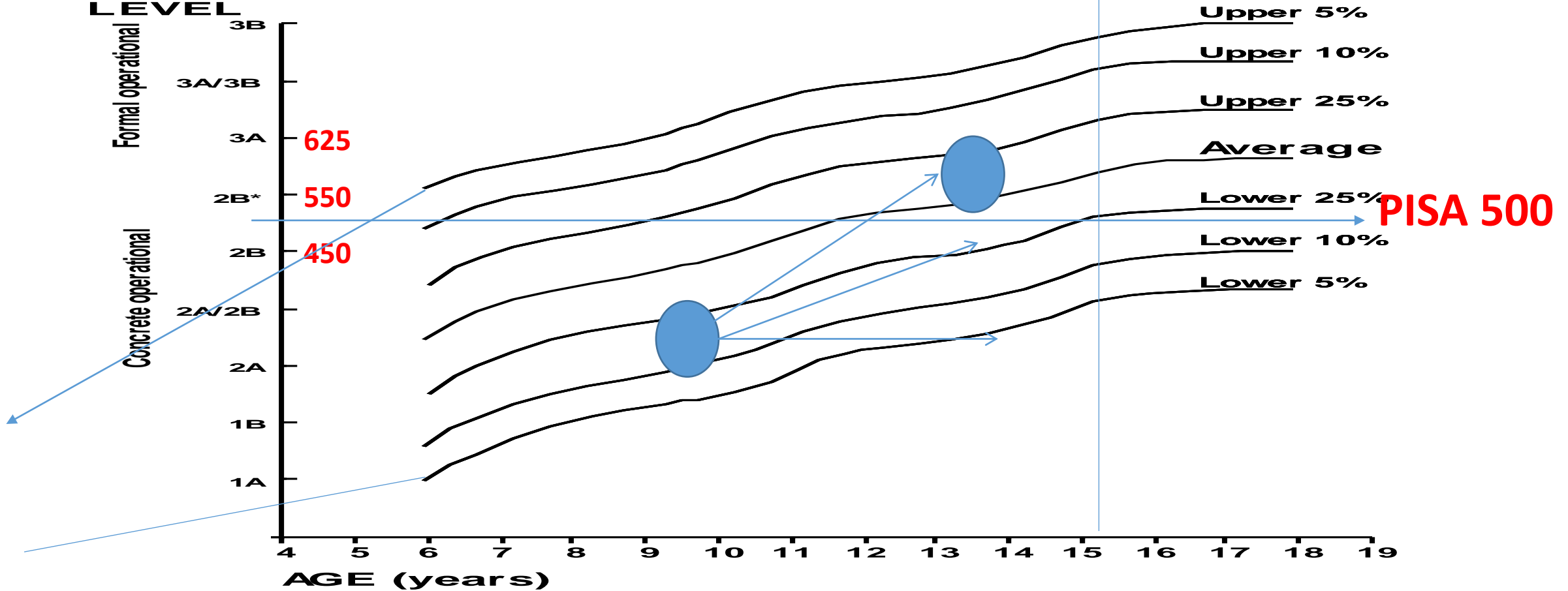
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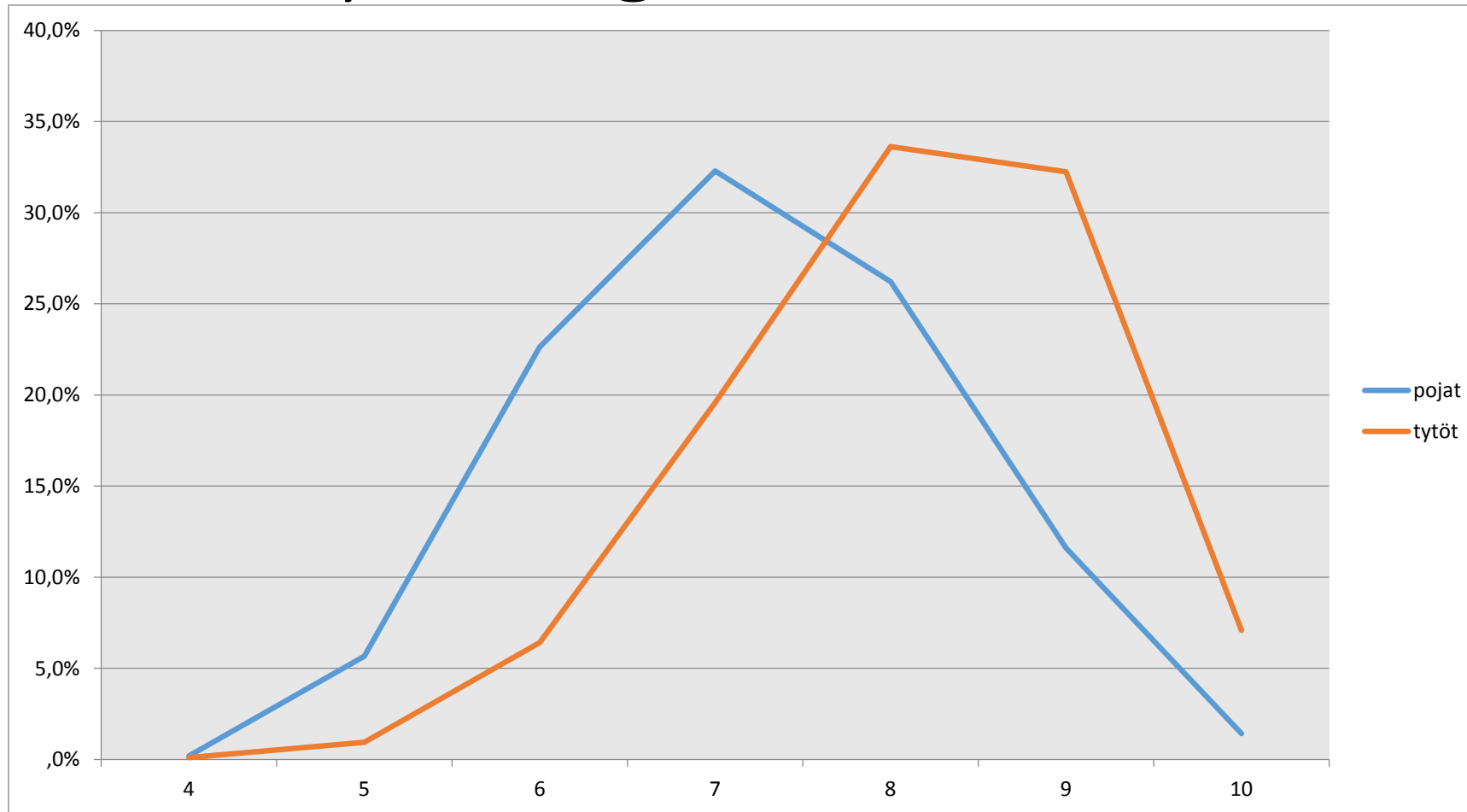
Cognitive Development

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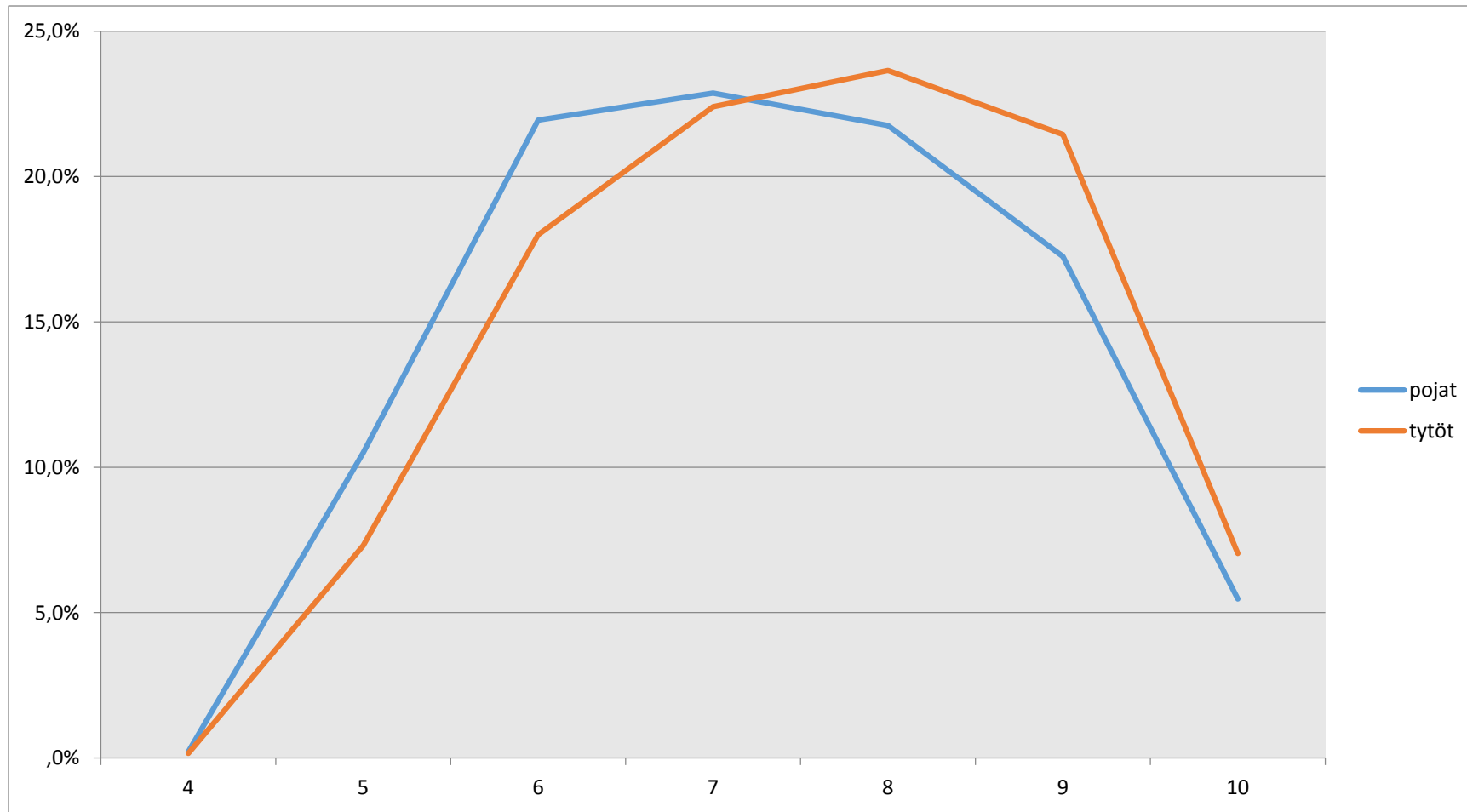
PIAGETIAN LEVEL



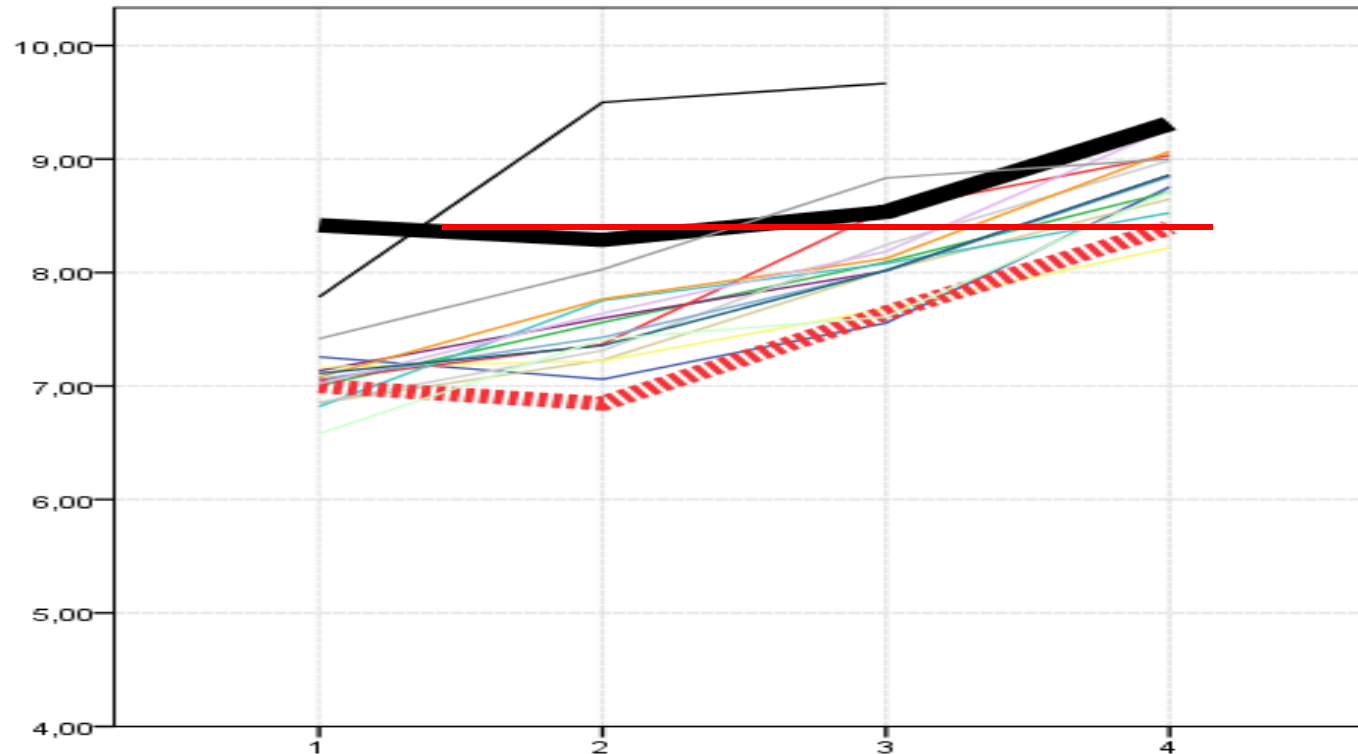
Finnish Language and Literature: School Marks for boys and girls



Mathematics: School Marks for Boys and Girls



L2L competence and GPA, 9th graders



Students have been divided into 25 % groups according to L2L cognitive test results and then GPA has been estimated for students and results are presented by schools. The results show that there are between school differences in giving schools marks, referring to a possible threat to educational equity

The moral obligation

When education is a universal benefit, and the future requires competent adults with good education, then

the school has a moral obligation to support everyone to learn

But--

Pupils have also the obligation to try to learn and to learn to commit oneself to studies

Classics on learning to learn

- [T.S.Eliot, *Modern Education and the Classics*, 1932, in Selected Essays, Faber and Faber, 3rd Enlarged Edition, 1969, p. 512
- **[No one can become really educated without having pursued some study in which he took no interest-for it is a part of education to learn to interest ourselves in subjects for which we have no aptitude.]**

The educational goal is to develop children who not only honor the rules and norms of the society,

but who are

**able to use these rules to promise themselves what they will do,
to plan ahead,
to delay gratification and
to work towards their goals and
to meet their obligations.**

In so doing they move from being controlled by others to controlling themselves, the vaunted goal of education.

(David Olson(2000). Psychological Theory and Educational Reform. Cambridge University Press)

Educational Puzzle
to be Solved
within all formal
educational
institutions



Still, the same child
should be able to handle
new **unpredictable**
situations;
where they can expect
guiding,
only from their willingness
to think and learn.



ADAPTIVE SCHOOL

Co-operation between
institutions (school, family,
protection,
social work)
loosening the borders

THINKING SCHOOL

Cultivates and
forms thinking
creating
the mastery of thinking

OPEN SCHOOL

Co-operation within school
(teachers, special teachers,
psychologist, ...)
*redefining the internal
borders*

MORAL SCHOOL

Cultivates
the humanistic values
creating
the perspective
of
hope

4 Schools

Cultivates and forms thinking creating *the mastery of thinking*

Thinking School

2 Content Schools

Cultivates the moral values creating **the perspective of hope**

Moral School

2 Structural schools

Open school

Adaptive School

Co-operation between institutions (school, family, protection, social work)
loosening the borders

Co-operation within school (teachers, special teachers, psychologist, ...)
redefining the internal borders



When the future is getting more unpredictable, leading to present situation, where

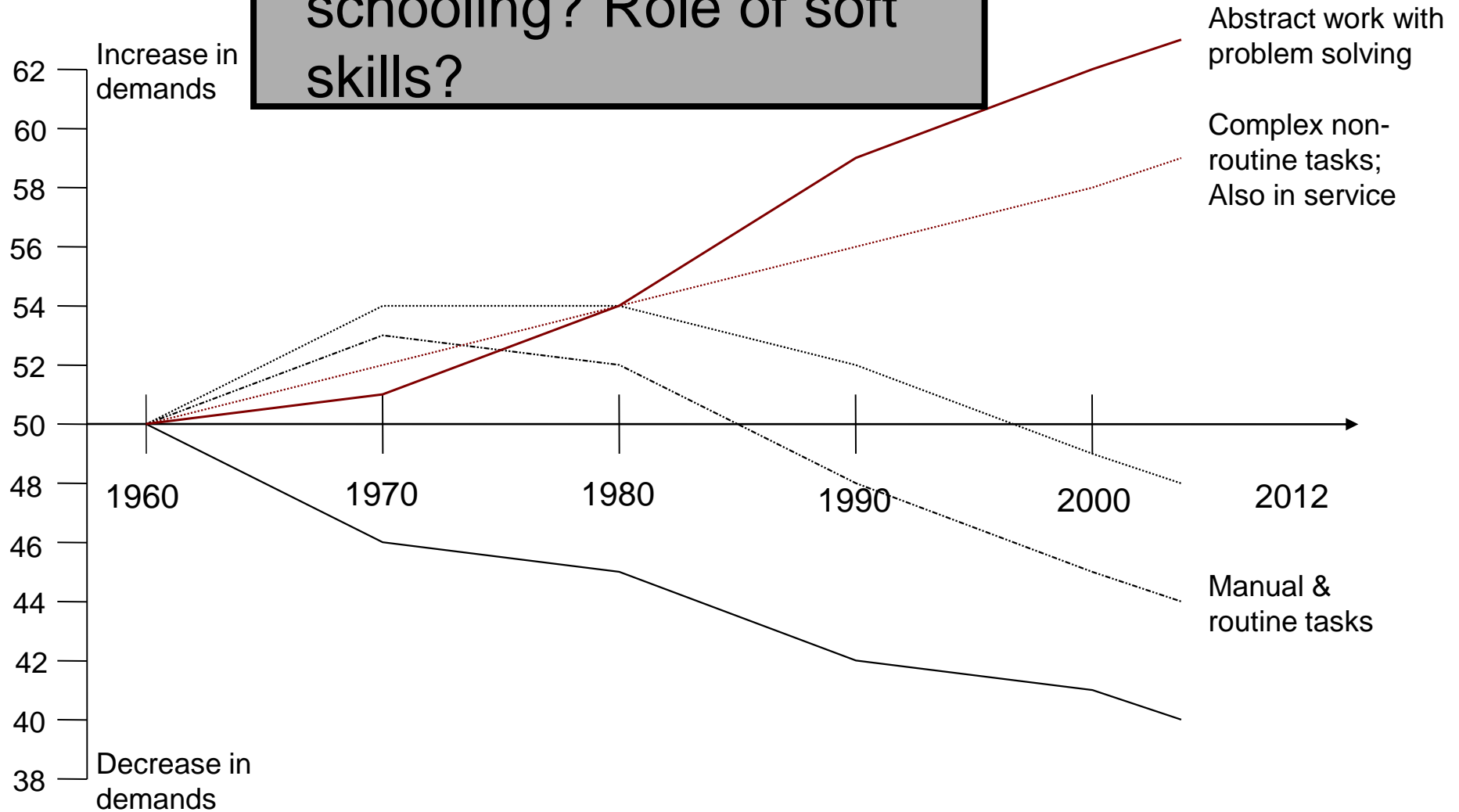
**SOCIAL and ECONOMIC VOLATILITY
CREATES A SOCIAL ENVIRONMENT THAT IS
ADVERSE TO LEARNING
(Joseph Stiglitz Thesis)**

the more we need to adapt the present educational systems to support the growth of thinking and self-systems, given that most educational systems work below best practices.

A need for rethinking in-and-of education, but this is also a task for international and multidisciplinary studies.



How to model the best survivors in relation to schooling? Role of soft skills?



Autor, Levy, & Murnane (2003)

How to model the best survivors in relation to schooling?

Role of soft skills and/or social competence and/or social and emotional skills, and their cumulative formation during schooling, from primary via secondary thru tertiary education, and during working life.

Are the certificates and diplomas enough, from the point-of-view of European labour area, in relation to international mobility and global labour markets? If not, how to solve the true formation of these things in formal education, or can it be done at all in formal institutions?

? Describe educational goals in terms of competencies, not in traditional academic terms in 3rd degree education?

Judt, T. with Snyder, T. (2012). *Thinking the twentieth century*. London: Heinemann.

A dialogue on gambling (pp366-9) And, as my comments, on risks (cf. Risk Society and Learning Society)

S: This coincides with the legitimization of gambling as such. (Which, by the way, strikes me as one of the terms which needs to be preserved, because those who are behind gambling would like to call it 'gaming' and make it into something harmless and normal.) But also what happened seems to have required Americans not to understand math. It seems to have required a certain amount of magical thinking about numbers...

J: I wish I could agree with you about the correlation between American secondary educational incompetence in mathematics and economic illusions. But I think that what really it demonstrates is this: **the vast majority of human beings today are simply not competent to protect their own interests**. Curiously, this was not at all the case back in the nineteenth century. The kinds of mistakes that people might make to their own detriment were both more straightforward and thus more readily avoided. Assuming you were prudent enough to keep clear of snake-oil salesmen and the outright crook, then the rules about borrowing were so draconian (if only on religious grounds) that many of today's indulgences were simply not available to the common man. ...

S: Is modern life really so complicated? ... **The best defence of the working class in general is arithmetic**. And that therefore social policy, just looking at it this way, has to include making sure that people can do their own math. ...

J: ... But even a well-educated citizenry is not a sufficient against an abusive political economy. There has to be a third actor there, beyond **the citizen** and **the economy**, which is the [legitimate] **government**.... *In your own interest and for the common good*. [Then follows a discussion of possibility of social democracy]

Wittgenstein on learning to look for things and learning how to ask questions.

Sentence 315: ...

It would be as if someone were looking for some object in a room; he opens a drawer and doesn't see it there; then he closes it again, waits, and opens it once more to see if perhaps it isn't there now, and keeps on like that. He has not learned to look for things. *And in the same way this pupil has not learned how to ask questions. He has not learned the game that we are trying to teach him.*

Ludwig Wittgenstein: *On Certainty (Uber Gewissheit)*. Eds. G.E.M. Anscombe and G.H. von Wright, Translated by Denis Paul and G.E.M. Anscombe. Basil Blackwell, Oxford 1969-1975.

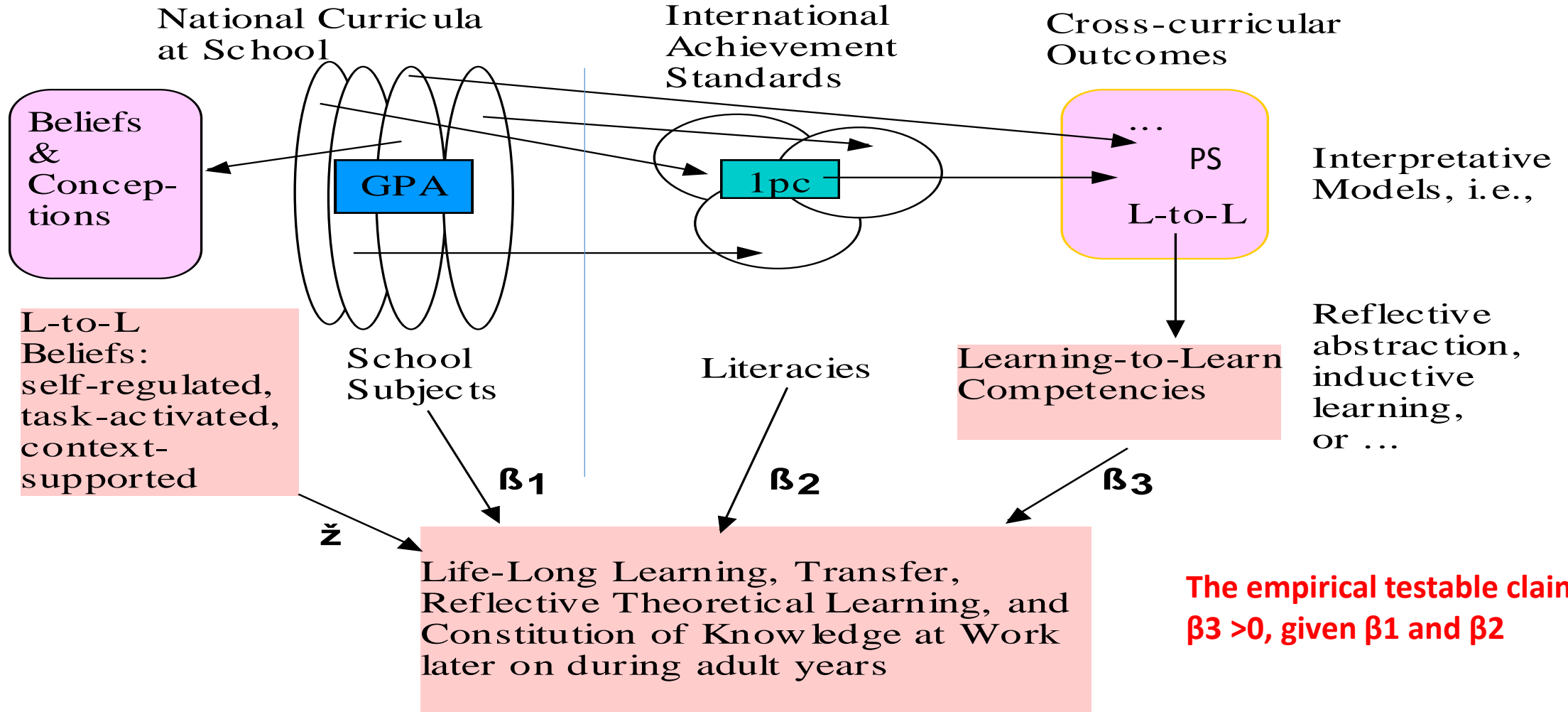
Linking complex problem solving to opportunity identification competence within the context of entrepreneurship

[Yvette Baggen^{a*}](#), [Jakob Mainert^b](#), [Thomas Lans^a](#), [Harm J. A. Biemans^a](#), [Samuel Greiff^b](#) & [Martin Mulder^a](#)

International Journal of Lifelong Education [Volume 34](#), [Issue 4](#), 2015 [Special Issue: Problem Solving – Facilitating the Utilization of a Concept towards Lifelong Education](#)

Today's working life is increasingly characterized by entrepreneurial challenges. Entrepreneurial challenges start at an individual level with the identification of entrepreneurial opportunities. Since the identification of entrepreneurial opportunities relies heavily on the **opportunity identification** competence (OIC) of individuals, understanding the meaning of OIC is relevant. In this paper, we review the link between OIC and CPS by comparing the cognitive and entrepreneurship research fields. We argue that those who excel in identifying opportunities share core characteristics with **high-level complex problem-solvers**.

School subjects, literacies and cross-curricular (key; 21st century) competencies



C. Baraldi & G. Corsi (2017). Niklas Luhmann: Education as a Social System. Springer. Pp. 88

Three main issues led to the development of pedagogy over the past centuries (Luhmann & Schorr, 1979): 2000 Introduction):

- (1) The autonomy of the education system, which requires reflection on its differentiation as a subsystem of the functionally differentiated society:
- (2) The control over the effects of education which requires a specific technology and its application in educational practices, and
- (3) The social consequences of education, which raise the issue of educational responsibility for the process of social selection.

C. Baraldi & G. Corsi (2017). Niklas Luhmann: **Education as a Social System.** Springer. Pp. 88

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The dilemmas for the reform along 21st century

- (A) Work is another functional system, which cannot directly change educational system, leading to need to understand the globalisation of education and reform theories, and terms like competencies, literacies, ...
- (B) From the perspective of work, the credentials (school leaving certificates) seem to lose their informative value, with the expressed needs to complement the information (with thinking and soft skills, ... digital literacy, ...)
- (C) The welfare society and the learning society and the world society are facing increasing difficulties to support the life courses of her citizens (employability and entrepreneurship)

Russia vs Finland PISA 2009

Some comparative data

mean read is a mean of 15 plausible values for reading

mean math is a mean of 15 plausible values for math

mean science is a mean of 15 plausible values for science

I have calculated two values for certain analysis

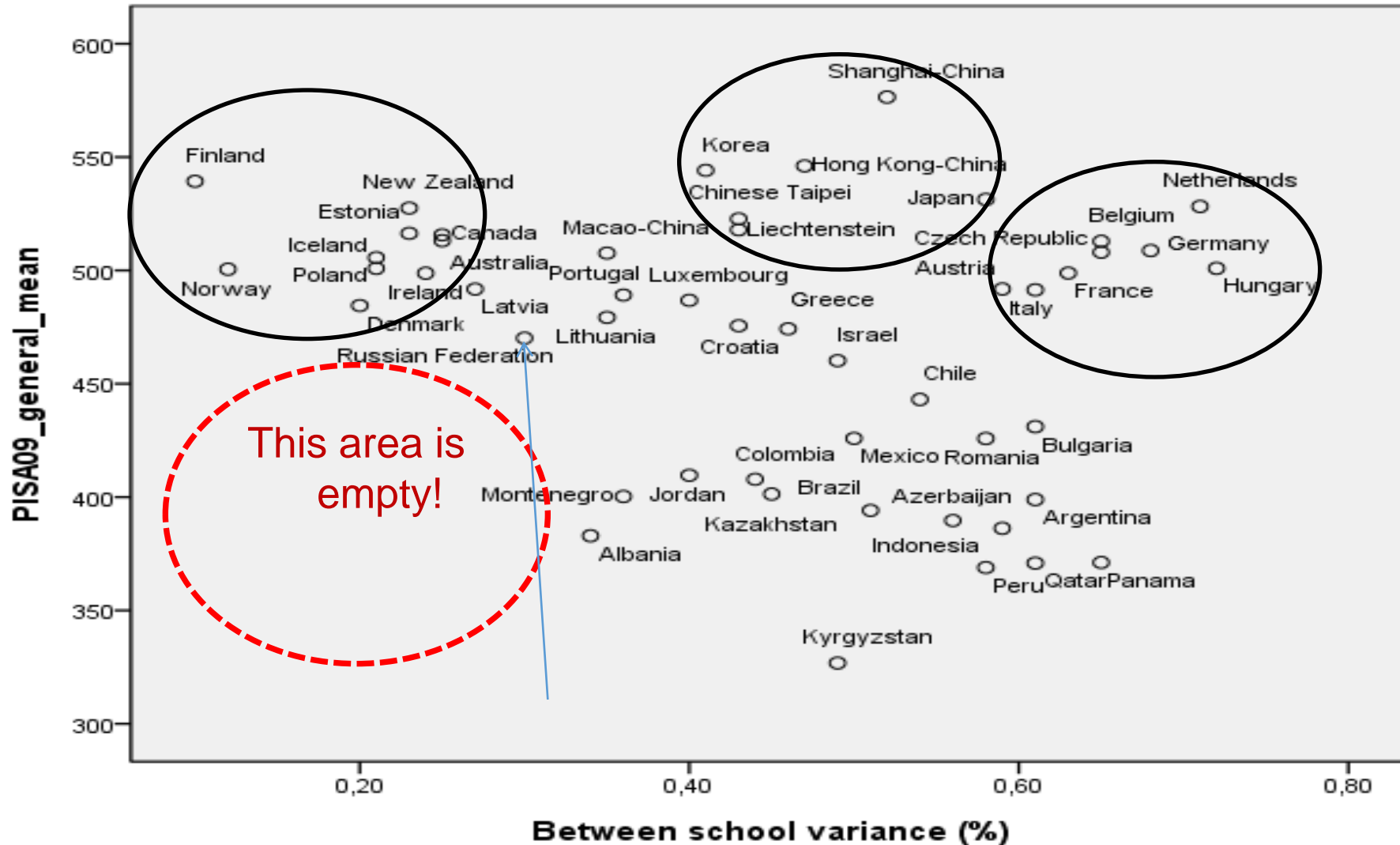
level 3 is the 1st principal component of reading, math and science scores

balance is the 2nd principal component which tell the **tilting of the profile**,

positive values meaning reading score > math score, and negative values

mean that reading score of an individual is lower than his/her math score

Variance components: Between School Variation (2009)



- Scandinavian (comprehensive school) model,
- Asian model,
- Central European model.

Reading

■ Total between-school ■ Total within-school

Expressed as a percentage of the average variance in student performance in OECD countries



Descriptive Statistics FINLAND

	N	Min	Max	Mean	SD
mean read	5810	184	744	531	83
mean math	5810	210	783	537	76
mean science	5810	218	799	549	84
Level 3	5810	-2,52	3,04	,73	,80
Balance	5810	-2,82	4,38	,09	,94

Descriptive Statistics RUSSIA

	N	Min	Max	Mean	SD
mean read	5308	124	750	462	86
mean math	5308	191	797	469	80
mean science	5308	133	796	480	85
Level 3	5308	-3,09	3,12	,03	,83
Balance	5308	-3,22	3,89	,12	,94

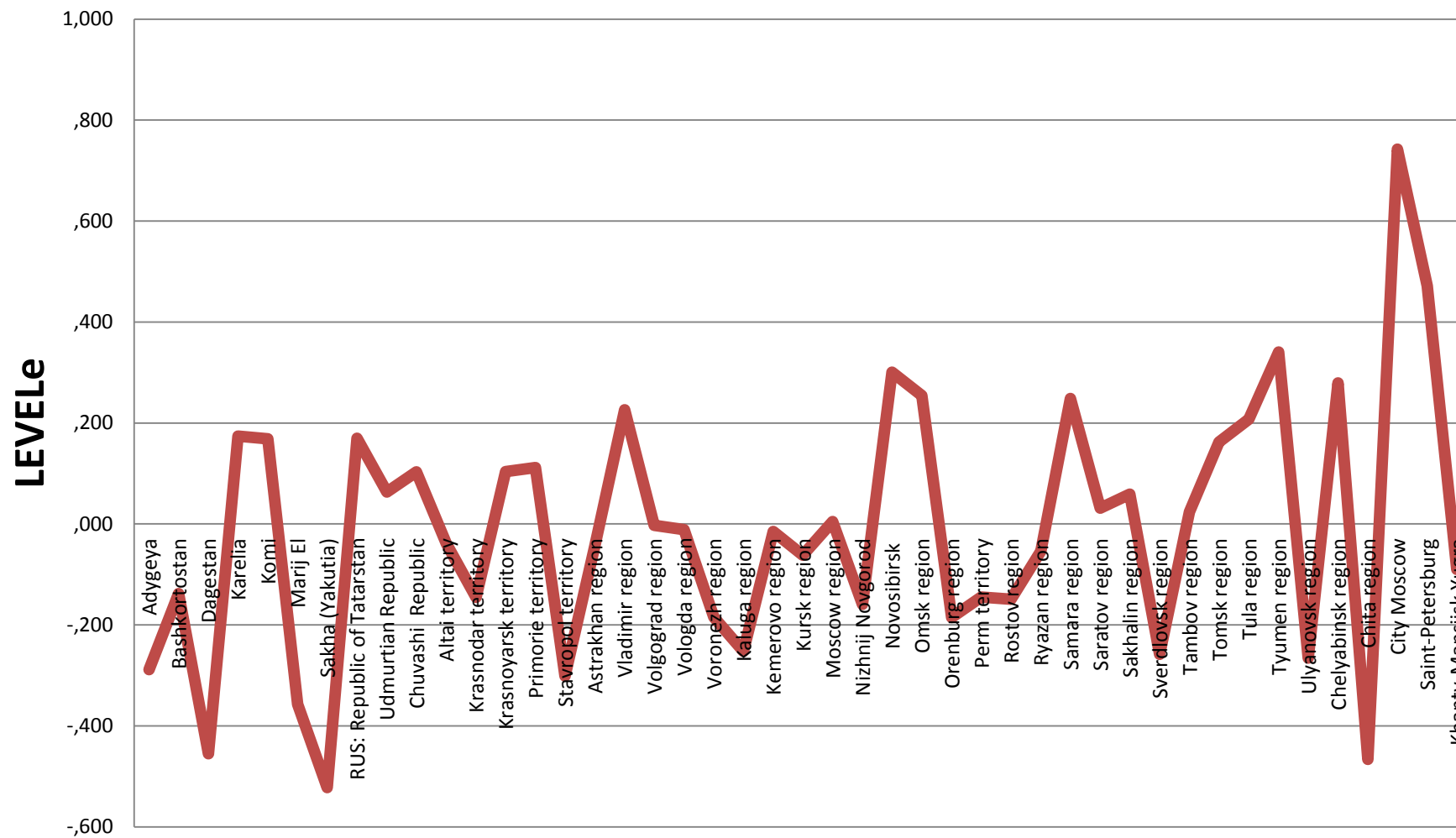
Regional differences in Finland and Russia, PISA 2009 data

Anova, SPSS

Finland,	F (11/5809)= 14.23	2,6 %
Russia,	F (44/5307) = 15,7	11,6 %

If rounded, in Russia the regional differences are 4 times larger (3 vs 12) than in Finland

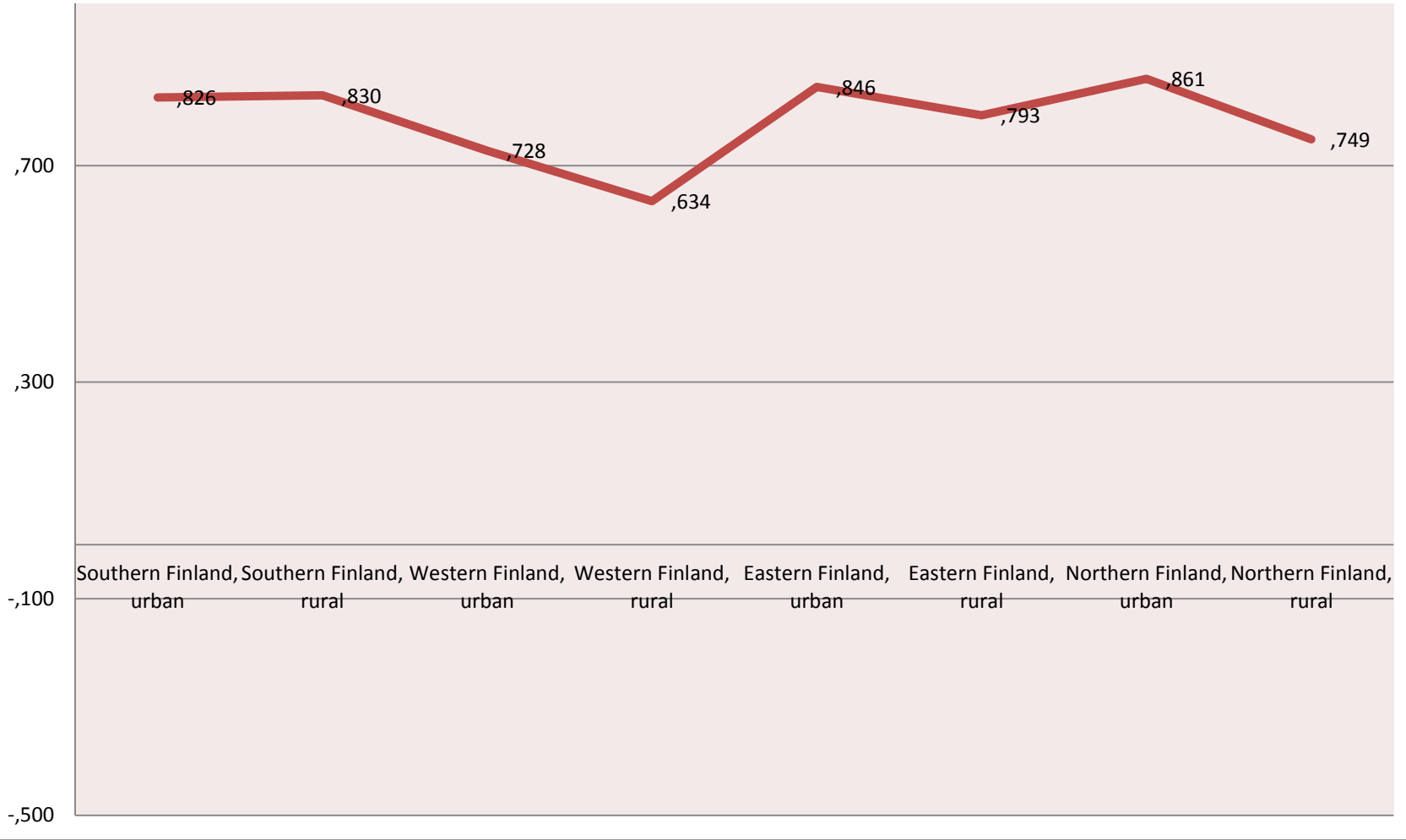
Russian Regions /Stratum/Level indicator



Stratum	Level
Adygeya	-,288
Bashkortostan	-,138
Dagestan	-,455
Karelia	,174
Komi	,169
Marij El	-,357
Sakha (Yakutia)	-,522
Tatarstan	,170
Udmurtian	,063
Chuvashi	,103
Altai territory	-,038
Krasnodar	-,145
Krasnoyarsk	,104
Primorie territory	,111
Stavropol	-,301
Astrakhan region	-,044
Vladimir region	,226
Volgograd region	-,003
Vologda region	-,011
Voronezh region	-,185
Kaluga region	-,252
Kemerovo region	-,015

Kursk region	-,062
Moscow region	,005
Nizhnij Novgorod	-,159
Novosibirsk	,301
Omsk region	,255
Orenburg region	-,185
Perm territory	-,145
Rostov region	-,149
Ryazan region	-,054
Samara region	,249
Saratov region	,031
Sakhalin region	,059
Sverdlovsk region	-,258
Tambov region	,024
Tomsk region	,162
Tula region	,208
Tyumen region	,341
Ulyanovsk region	-,266
Chelyabinsk region	,279
Chita region	-,467
City Moscow	,742
Saint-Petersburg	,472
Khanty-Mansijsk	-,090

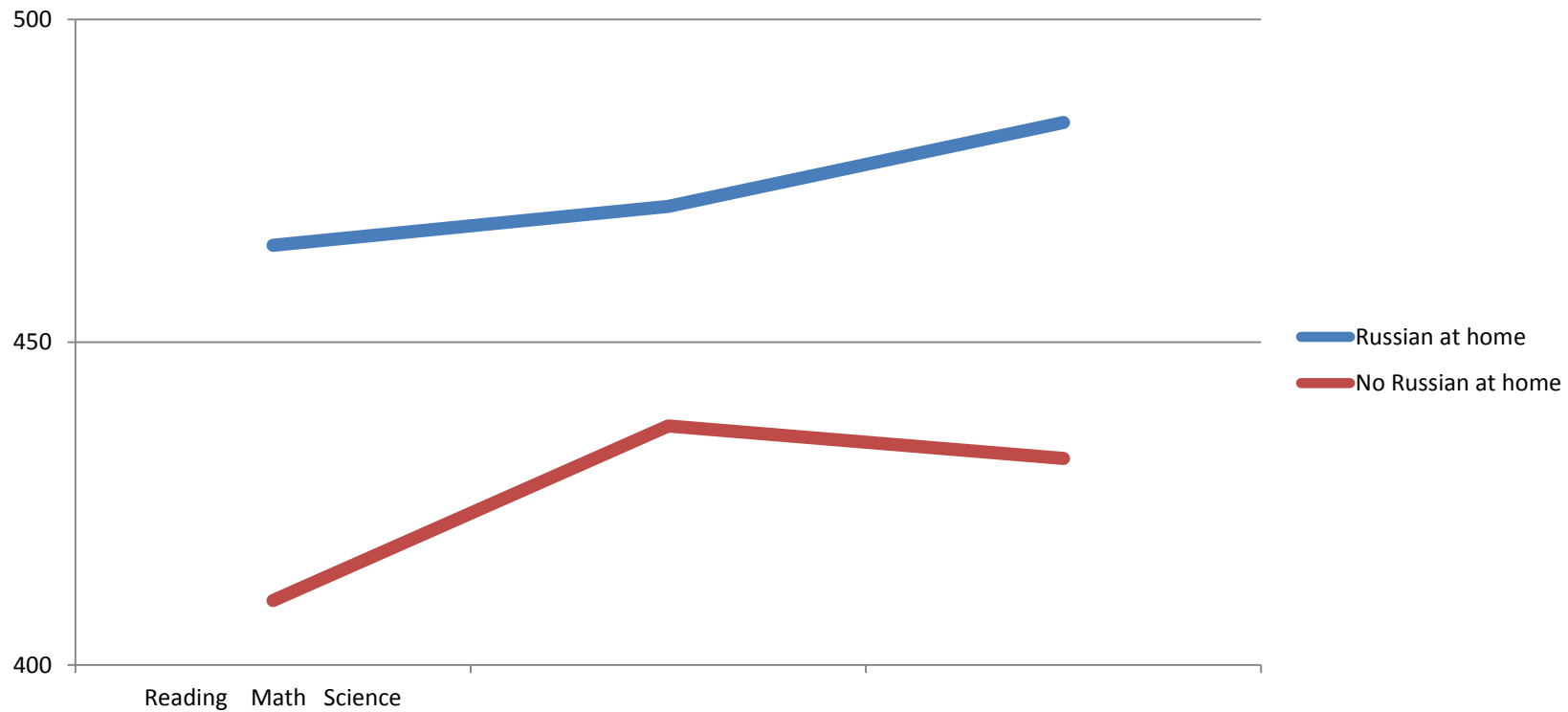
Finnish Regions /Stratum/ level

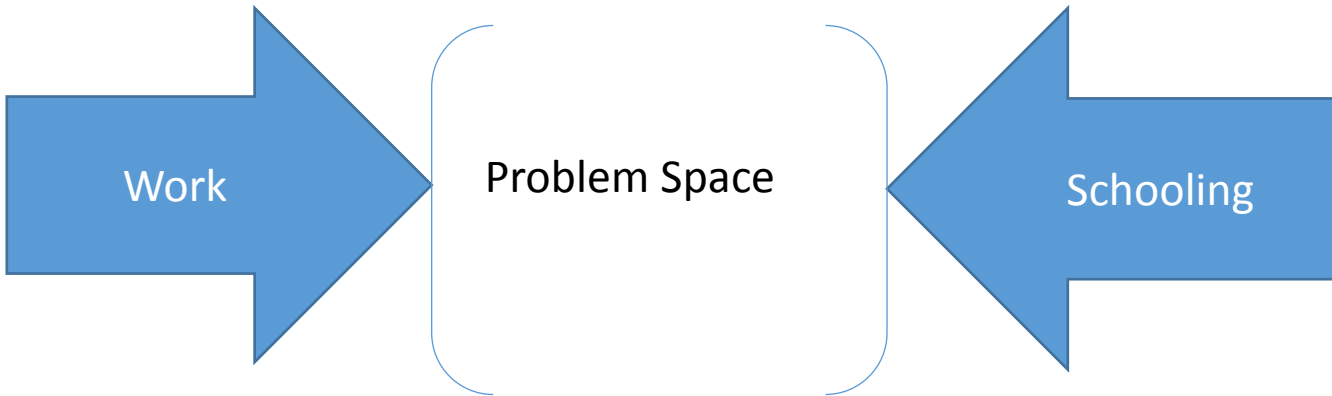


Finnish Regions + Moscow + S. Petersburg



Home Language /Russian Data





Changes

Science

Technology

Economy

Justice

Politics

Changes

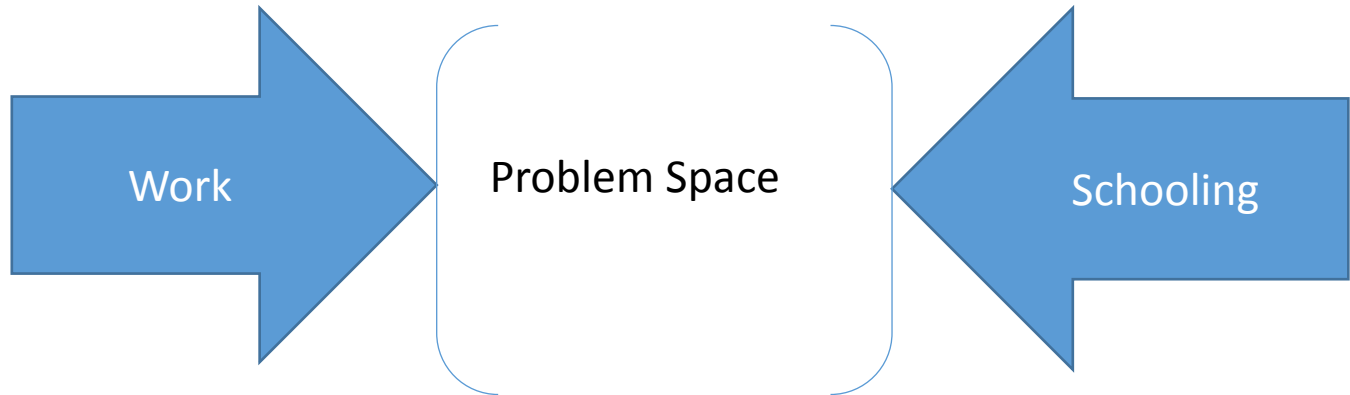
Methods

Contents

Curriculum

**Assessment &
Evaluation**

Management



Changes

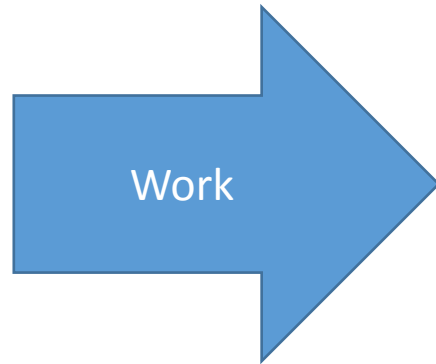
Science

Technology

Economy

Justice

Politics



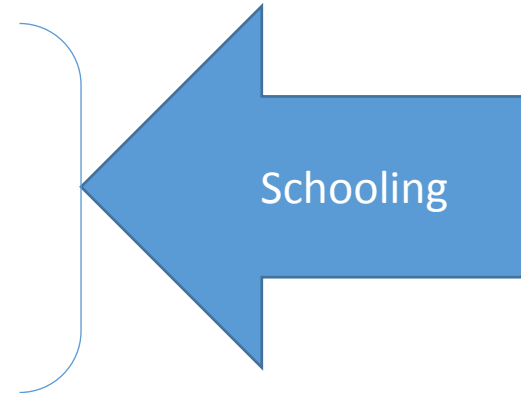
Employability

Competence
Formula:

Demand/
Supply

Credentials as
Information/
Promise

Few/Many
Ok/-OK



Changes

Methods

Contents

Curriculum

**Assessment &
Evaluation**

Management

Changes

Science

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Justice

Politics

New Work Demands Problem Solving of complicated tasks in dynamic contexts within organisations, with Habits, Manners and – Suitable – experiences, and with new types of tools provided by development of science systems, including computer-supported technicalities like AI (info) and Robots (labor)

Changes

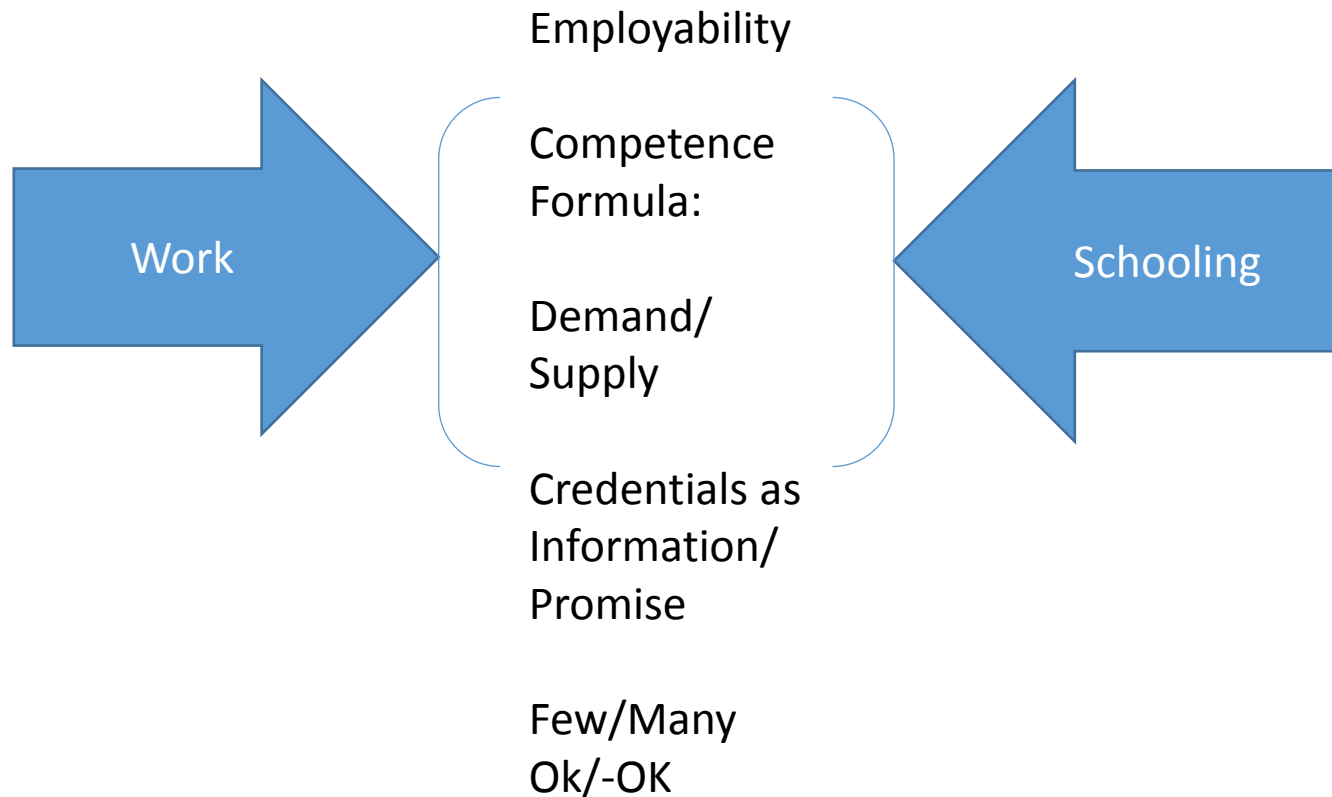
Methods

Contents

Curriculum

Assessment & Evaluation

Management of Educational institutions



Changes

New Work Demands Problem Solving of complicated tasks in dynamic contexts within organisations, with Habits, Manners and – Suitable – experiences, and with new types of tools provided by development of science systems, including computer-supported technicalities like AI (info) and Robots (labor)

Science

Changes

Technology

Methods

Economy

Contents

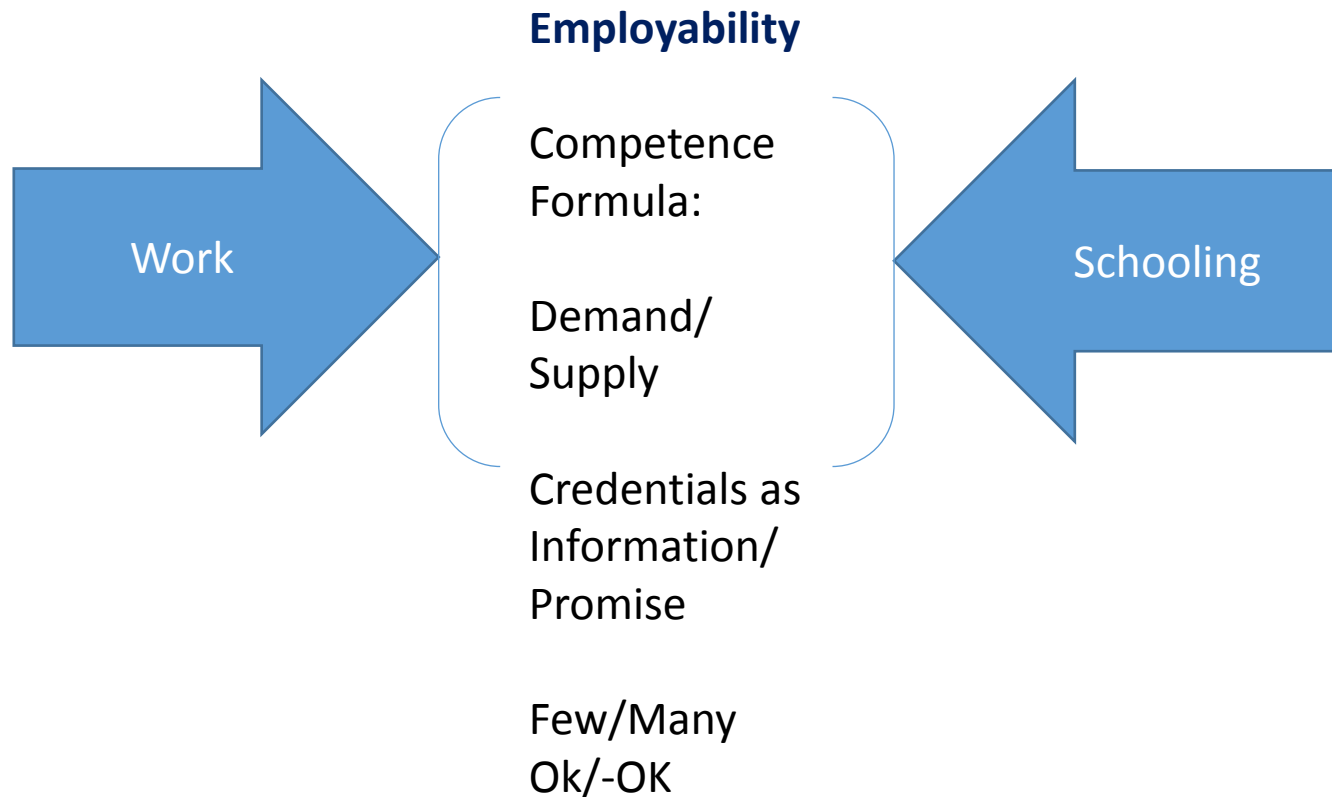
Justice

Curriculum

Politics

Assessment & Evaluation

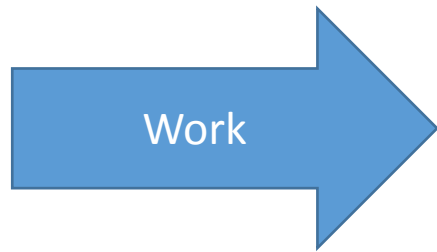
Management of Educational institutions



New Work Demands Problem Solving of complicated tasks in dynamic contexts within organisations, with Habits, Manners and –Suitable – experiences, and with new types of tools provided by development of science systems, including computer-supported technicalities like AI (info) and Robots (labor)

Changes

**Methods
Contents**



Employability

Demand for Problem Solving /
Supply thru Credentials /Contents of Curricula
thru Academic Disciplines

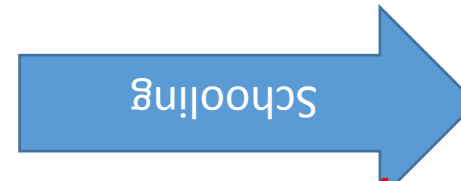
**Credentials as providing /holding
Information needed /Given Promise**

Few competent/Many Unsuitable

Diplomas give relevant info / are not deep
informative

**Thinking and Learning to Learn as a
Contingency formula**, to open news ways to
introduce changes in schools subjects, didactics
(pedagogy) and class/school evaluations,

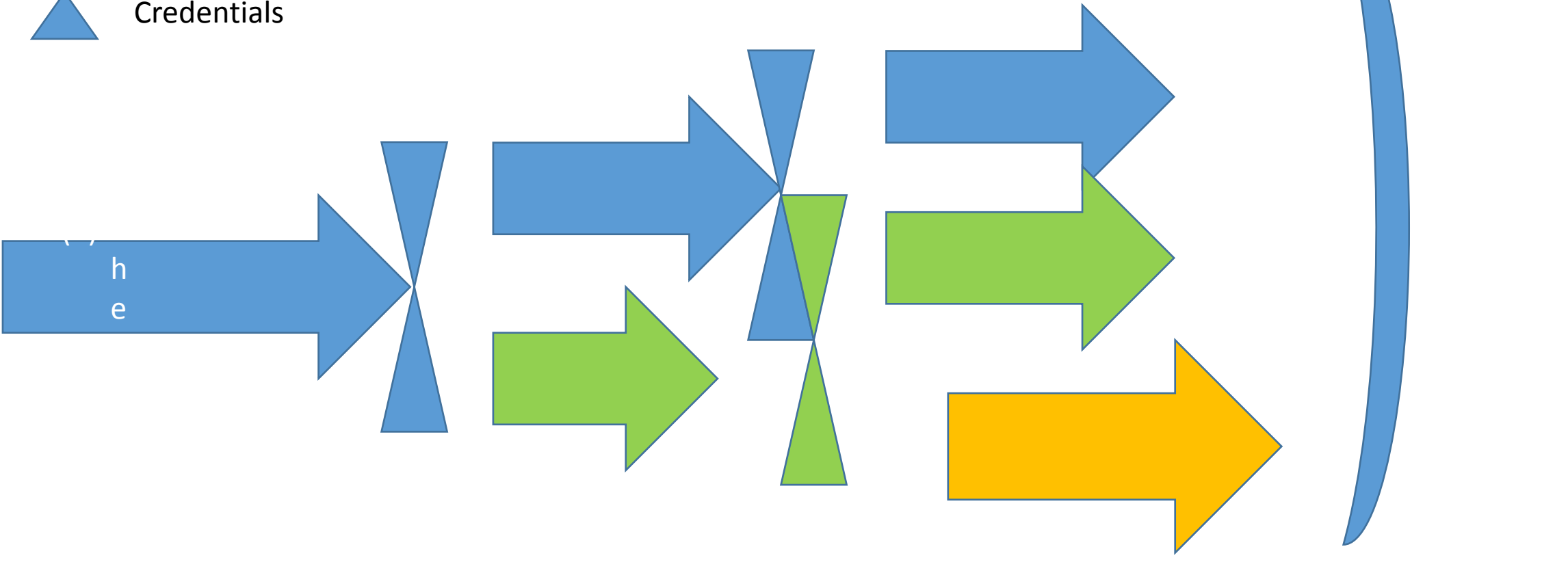
Literacies



**Curriculum
Assessment &
Evaluation**

**Management
(Decision Making) in
Educational
institutions**

 Transitions
Credentials



Education as a functional system

Economy as a functional system

New Technologies are Emerging and Needed (Digitalisation, ..)

Employability and Entrepreneurship

Labour force

Disciplines

Complexity

Competencies

Literacies

Occupations/Vocations

What Do I Do, in Assessment?

Before the Digital Age

The Plan

Before Digital Age

paper-and-pencil

- here we are

Using Digital Devices

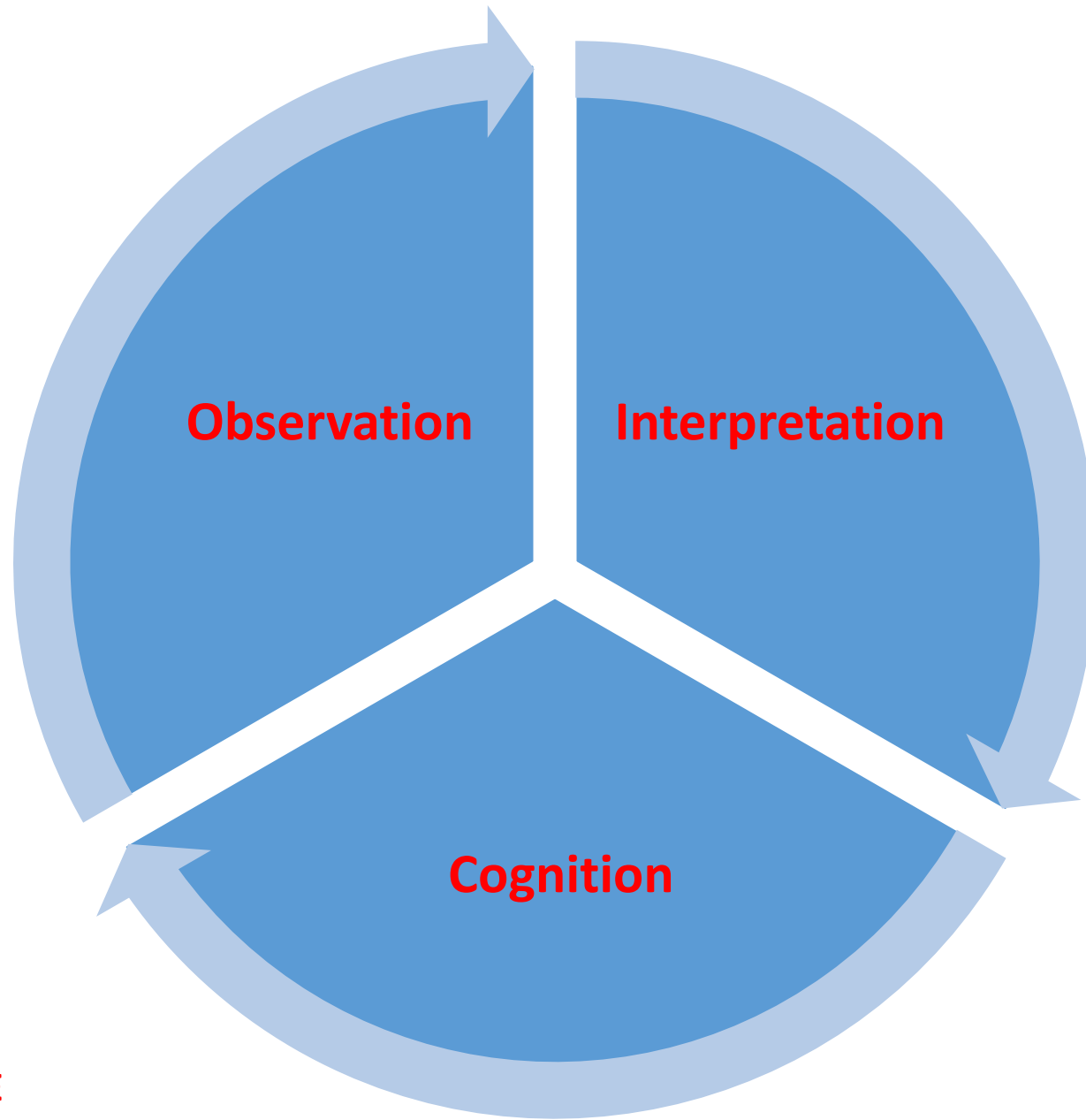
problem solving

- here we are moving

Digital Thinking and Net-Working

tasks and/forms?

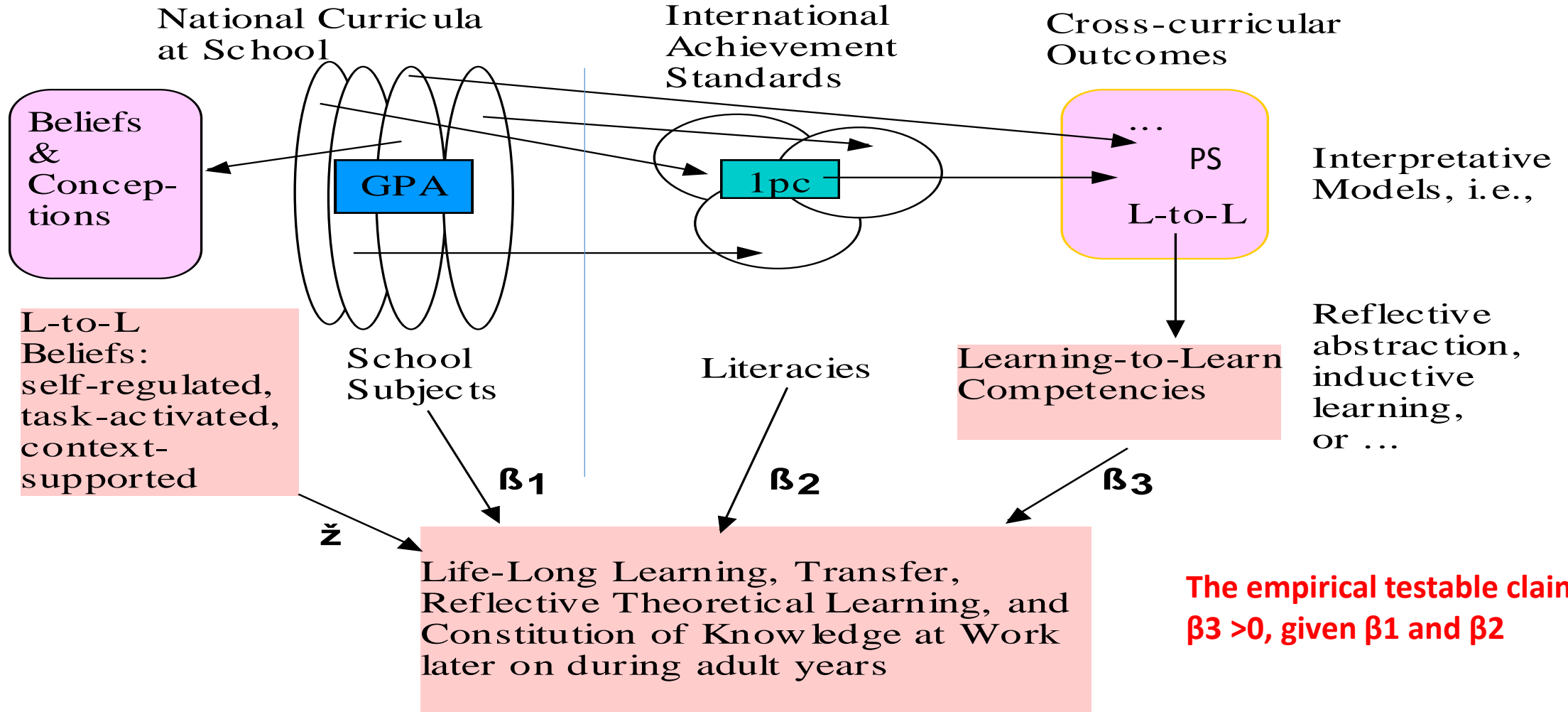
- **there** we may/should/go



ASSESSMENT TRIANGLE

Knowing what students know. The science and design of educational assessment. 2001

School subjects, literacies and cross-curricular (key; 21st century) competencies



Knowledge acquisition: generally

$$A_{i,j,k,t} = g_{t-1} (\mathbf{F}_{i,j,k,t}, \mathbf{S}_{i,j,k,t}, \mu_{i,j,0}, \varepsilon_{i,j,k,t}, \mathbf{U}_{i,j,k,t})$$

A [Marks; PISA; L2L; GPS; ...] scores

F History of parental inputs

S History of school inputs

μ Mental capacity of student at birth

ε History of student inputs in the knowledge acquisition process

U error term

g 'developmental function'

$$A_{i,j,k,t} = g_{t-1} (F_{i,j,k,t}, S_{i,j,k,t}, \mu_{i,j,0}, \varepsilon_{i,j,k,t}, U_{i,j,k,t})$$

A [PISA] scores

F History of parental inputs

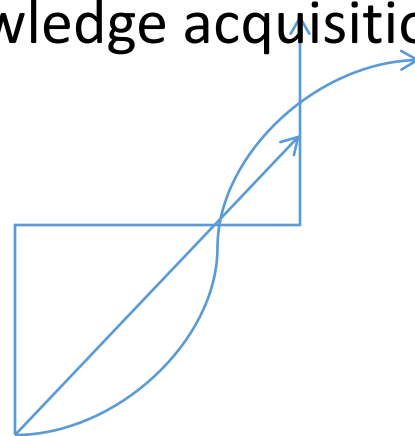
S History of school inputs

μ Mental capacity of student at birth

ε History of student inputs in the knowledge acquisition process

U error term

g 'developmental function'



True measurement model in PISA

$$A_{i,j,k,t} = g_{t-1} (F_{i,j,k,t}, S_{i,j,k,t}, \mu_{i,j,0}, \varepsilon_{i,j,k,t}, u_{i,j,k,t})$$

- A testipistemäärä
- F vanhempien vaikutuksen historia
- S koulun vaikutusten historia
- μ kognitiivinen kapasiteetti, saatu syntymässä
- ε oppilaan oppimisen historia
- u virhetermi
- g on 'vaikutusfunktio' ja sen muoto

IS SIGNICANTLY MORE SIMPLE

$$A_{i,j,k,2006} = g_{2006}(\alpha_j, \gamma_k, F_{i,j,k,2006}, S_{i,j,k,2006}) + u_{i,j,k,t}$$

Parental inputs /Hisei...

School inputs

PISA Model

$$A_{i,j,k,t} = g_{t-1} (F_{i,j,k,t}, S_{i,j,k,t}, \mu_{i,j,0}, \varepsilon_{i,j,k,t}, U_{i,j,k,t})$$

- A PISA scores
- F History of parental inputs
- S History of school inputs
- μ Mental capacity of student at birth
- ε History of student inputs
- g 'developmental function'

$$A_{i,j,k,2006} = g_{2006}(\alpha_j, \gamma_k, F_{i,j,k,2006}, S_{i,j,k,2006}) + U_{i,j,k,t}$$

α is a country-specific index for the **effects of institutional factors on the use of cognition**

γ is an index for self-efficacy and motivation, which affects the interpretation of **the measurement occasion** (low vs high stakes)

Eq. (1) shows how an outcome at age a , T_a , which is the performance on a task, depends on cognition C_a , personality P_a , other acquired skills such as education and job training K_a , and **the effort allocated** to the task e_{T_a} :

$$\underbrace{T_a}_{\text{Outcome on a task at age } a} = \phi_a \left(\underbrace{C_a}_{\text{Cognition}}, \underbrace{P_a}_{\text{Personality}}, \underbrace{K_a}_{\text{Other acquired skills}}, \underbrace{e_{T_a}}_{\text{Effort devoted to task}} \right), a=1, \dots, A.$$

Heckman, J. & Kautz. T. Hard Evidence on Soft Skills. Labour Econ. 2012 August 1; 19(4): 451–464.

Eq. (2) shows how the effort allocated to task T_a depends on cognition C_a , personality P_a , other acquired skills K_a , incentives R_{T_a} , and preferences γ_a

$$e_{T_a} = \psi_{T_a} \left(C_a, P_a, K_a, \underbrace{R_{T_a}}_{\text{Incentives to perform on task}}, \underbrace{\gamma_a}_{\text{Preferences}} \right).$$

The traits and other acquired skills evolve over time through investment and habituation.

Eq. (3) shows that traits at age $a+1$ are age-dependent functions of cognitive ability, personality traits, other acquired skills, and investment I_a at age a .

$$(C_{a+1}, P_{a+1}, K_{a+1}) = \eta_a \left(C_a, P_a, K_a, \underbrace{I_a}_{\text{Investment and experience}} \right), a=1, \dots, A.$$

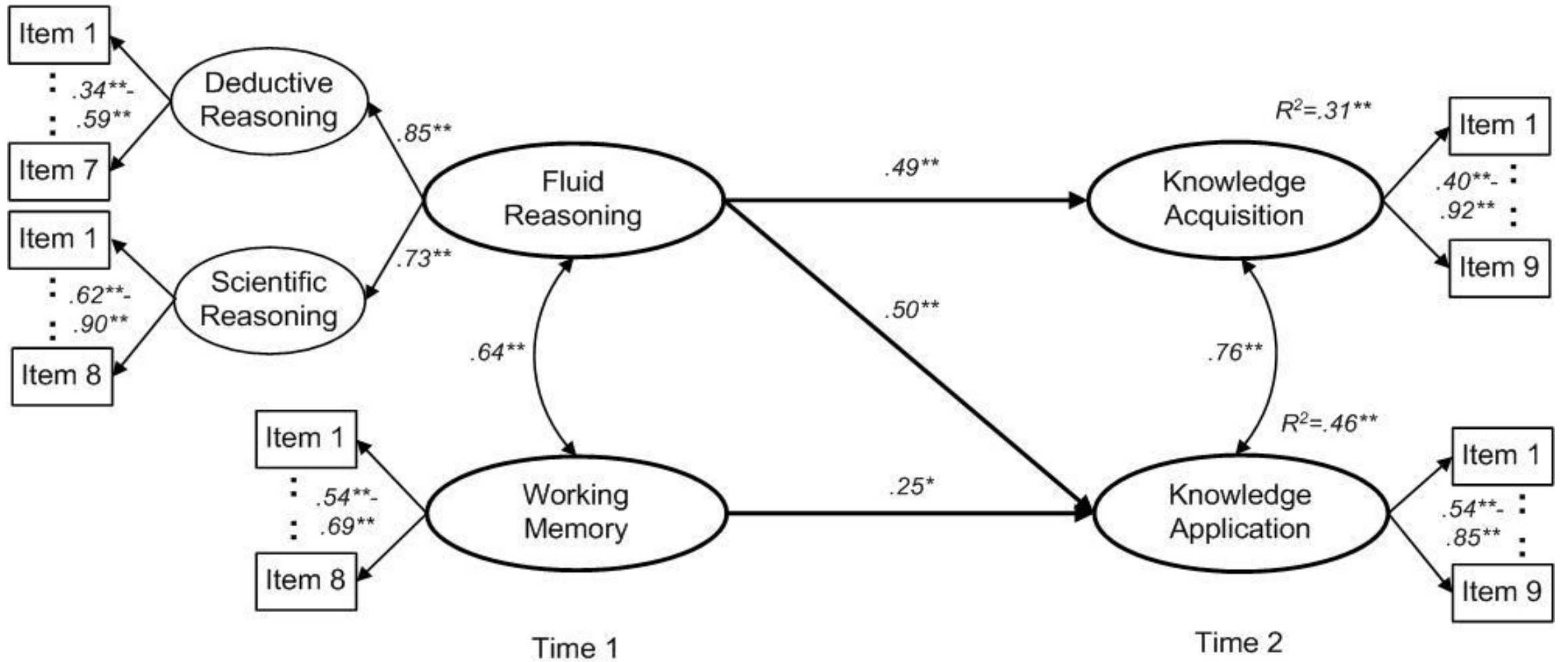


Figure 2. The longitudinal prediction of CPS knowledge acquisition and CPS knowledge application by fluid reasoning and working memory (Model A). * $p < .05$. ** $p < .001$.

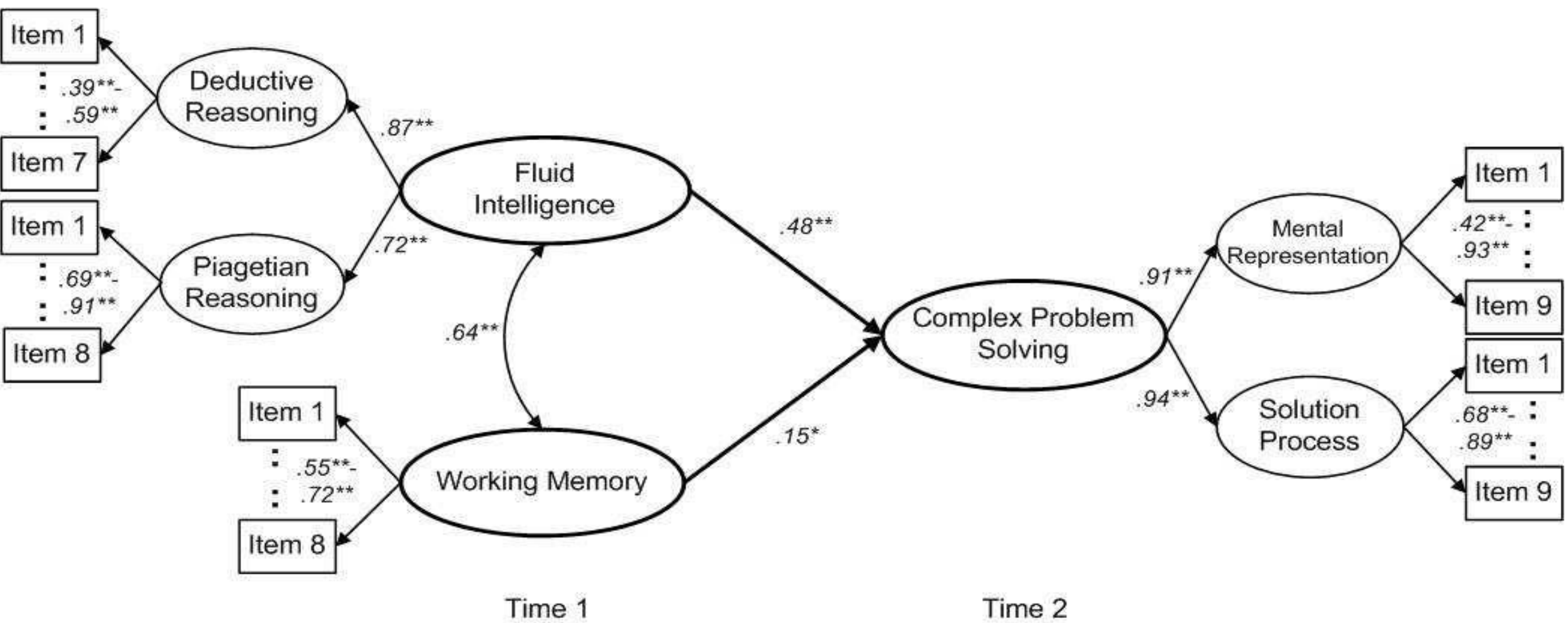


Fig. 1. The cascade model. Ellipses represent latent constructs; rectangles, measured variables. Numbers adjacent to paths are standardized coefficients. Weighted least squares means and variance adjusted (WLSMV) estimation was used for parameter estimation.
 *p < .05. **p < .001.

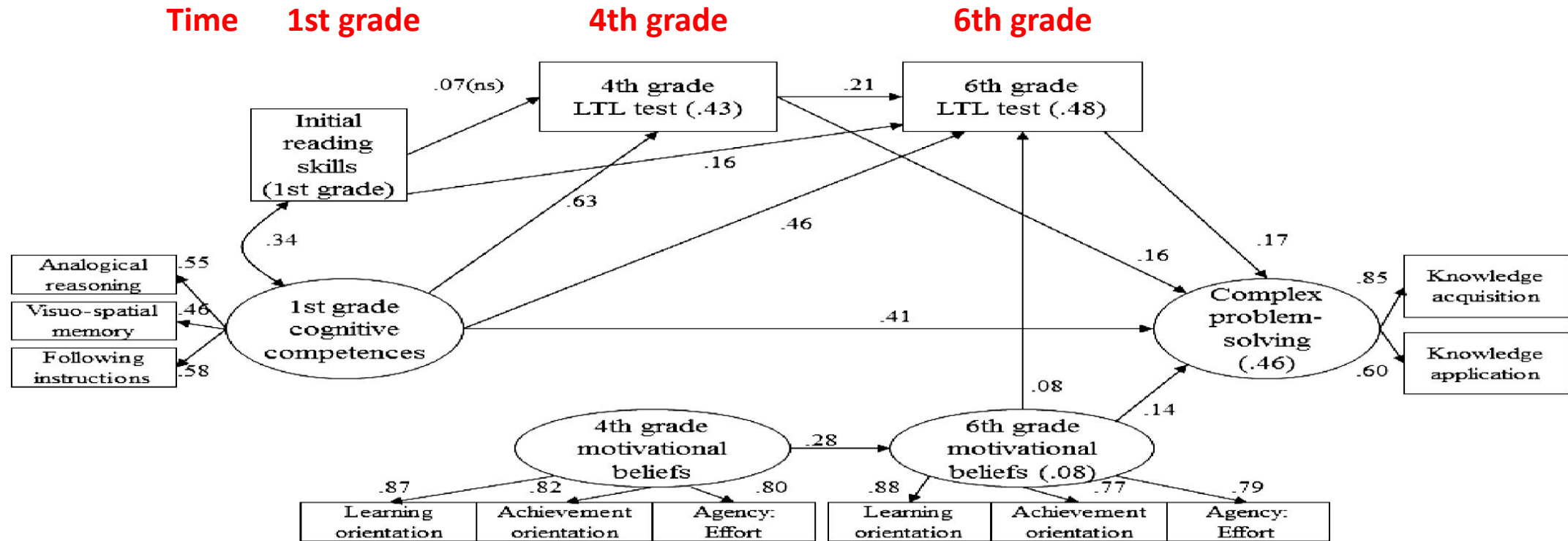


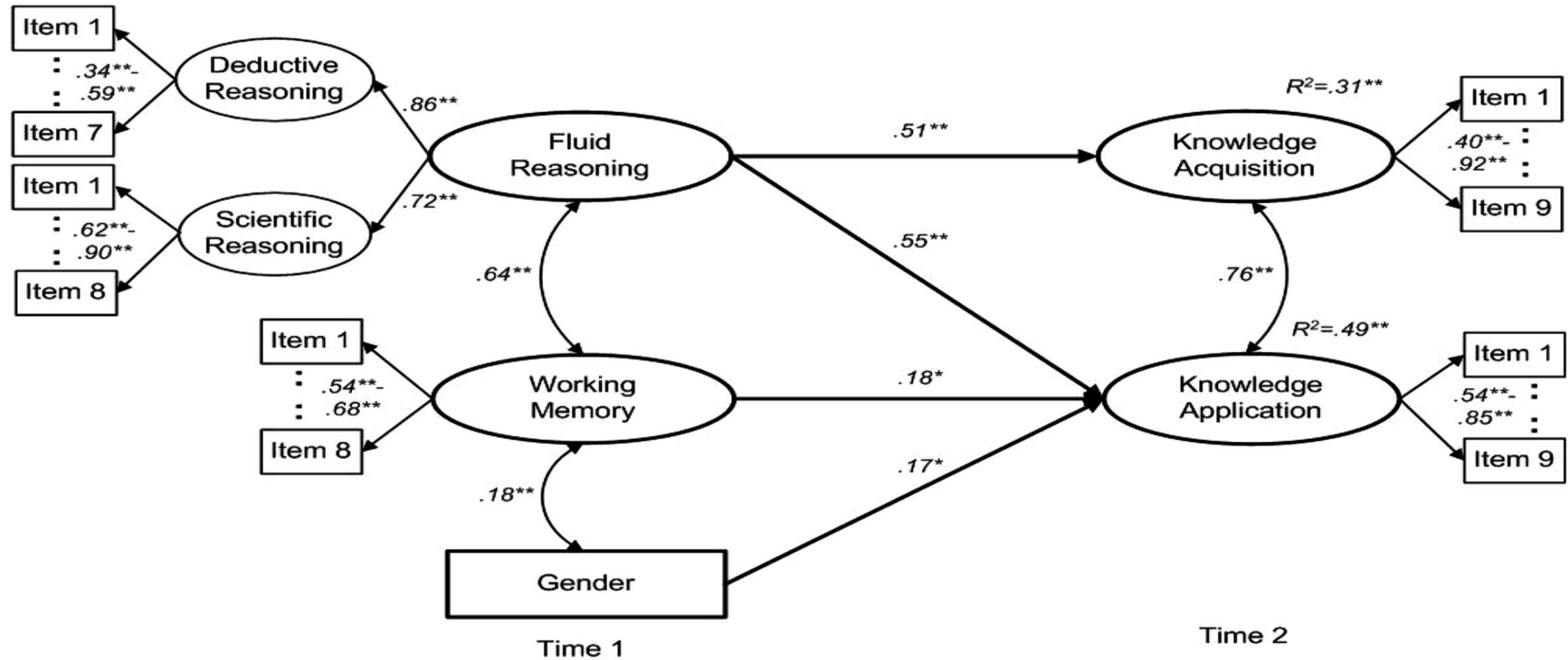
Figure 1. The final model for predicting performance in cognitive LTL tasks and complex problem solving. The only non-significant path from initial reading skills to fourth-grade LTL test is marked with (ns). Numbers in brackets indicate the variance accounted for

FIGURE 2 | The longitudinal prediction of CPS **knowledge acquisition** and CPS **knowledge application** by fluid reasoning (FR) and working memory (measured with L2L scales)
 Greiff et al, 2015, Frontiers of Psychology, July 2015, Article 1060.

N= 1696, Vantaa longitudinal L2L study

Time 1 = 12 year-old

Time 2 = 15 year-old



How we think - Digital Media and Contemporary Technogenesis

M.K.Hayles, 2012, p. 93

- "I actually did the work in the **Inter_net**," someone said.
- "Well," JH said, "the work was done in your individual heads, but the record of it is here."
- "No. It is not a *record*, not really. It's *working*. You have to work in the net, and this is the **present** outcome of also my workings. Okay?"

IS also the COGNITION of the Assessment Triangle changing, when new tools for mediating activities emerge? This is the Question for Media Studies to answer.

HSE has presented the **topics for discussions**:

Focus on the main "take-aways" from the <Finnish> case:

the key ingredients of success / failure;

what practices can be planted in a different setting and what should be the minimal viable scale of this grain, would a practice work if adopted by a single teacher?

a school? an area? a network of teachers? a country?

HSE has presented **the tone of discussions**:

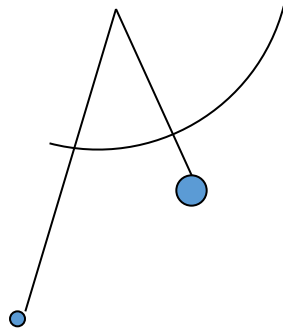
be flexible. Emphasis on conversation and clarity+consensus of conclusions, and less time to presentations.

Piaget's pendulum

Based on the schema of *Control of Variables*, from Shayer's Science Reasoning Tasks, based on the descriptions in Inhelder and Piaget's "Growth of Logical Thinking" (1958).

Pendulum:

Length (short or long) x weight (light or heavy) x push (weak or heavy)



	<u>length</u>	<u>weight</u>	<u>push</u>	<u>swings</u>
Experiment 1:	short	heavy	weak	20
Experiment 2:	long	light	weak	17

Length Has it an impact, and if, what kind?

Weight Has it an impact, and if, what kind?

Push Has it an impact, and if, what kind?

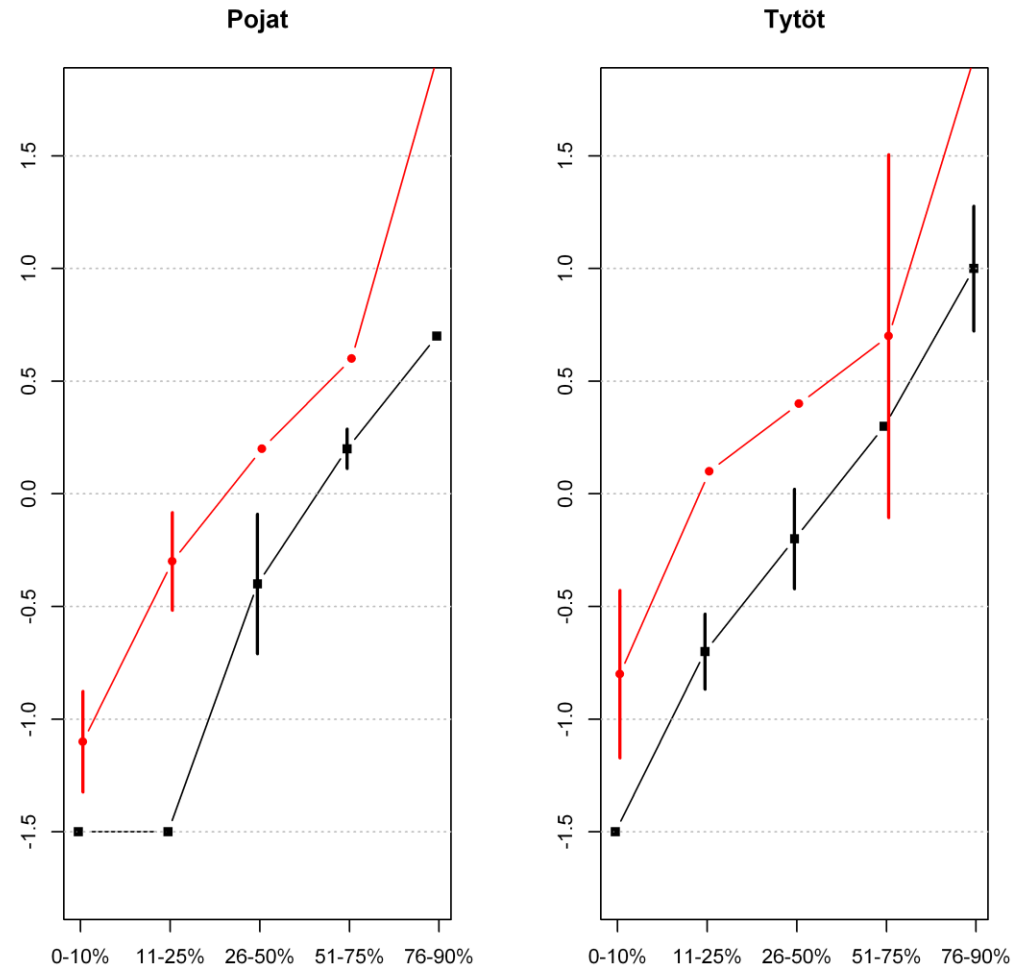
2001 > 2012

Arithmetical
operations

3 g 5 = 10 p 5

g?

p?



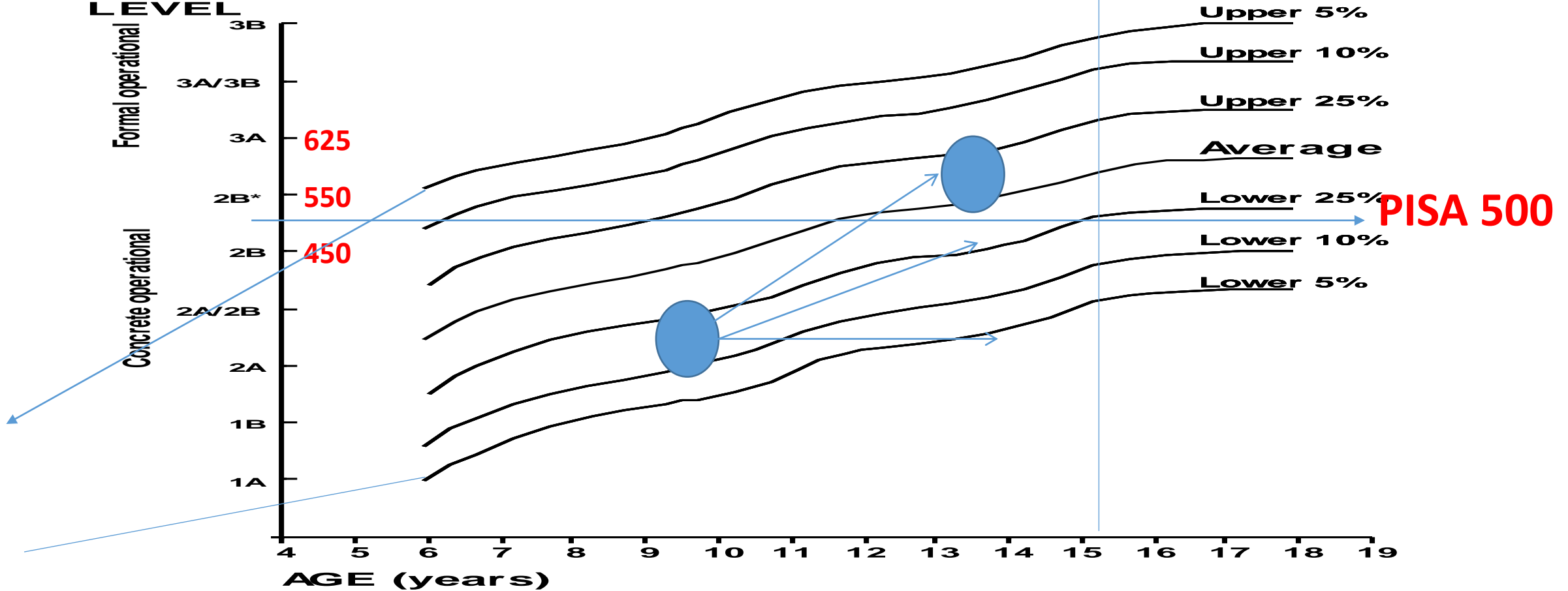
My estimation of criterion referenced level of the PISA scores in relation to the growth of logical-formal thinking



Cognitive Development

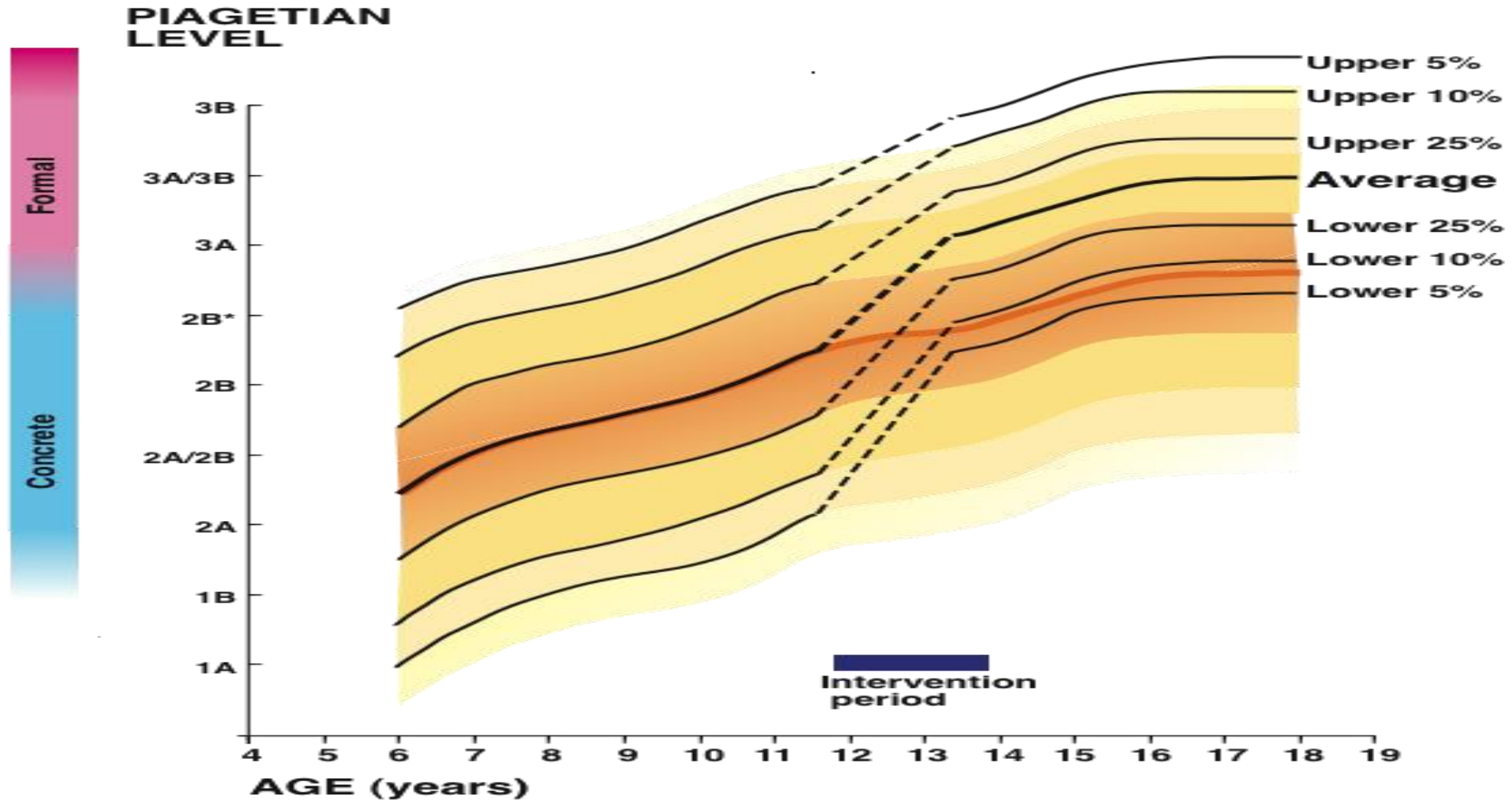
Boys; based on CSMS survey data, 1975 - 78

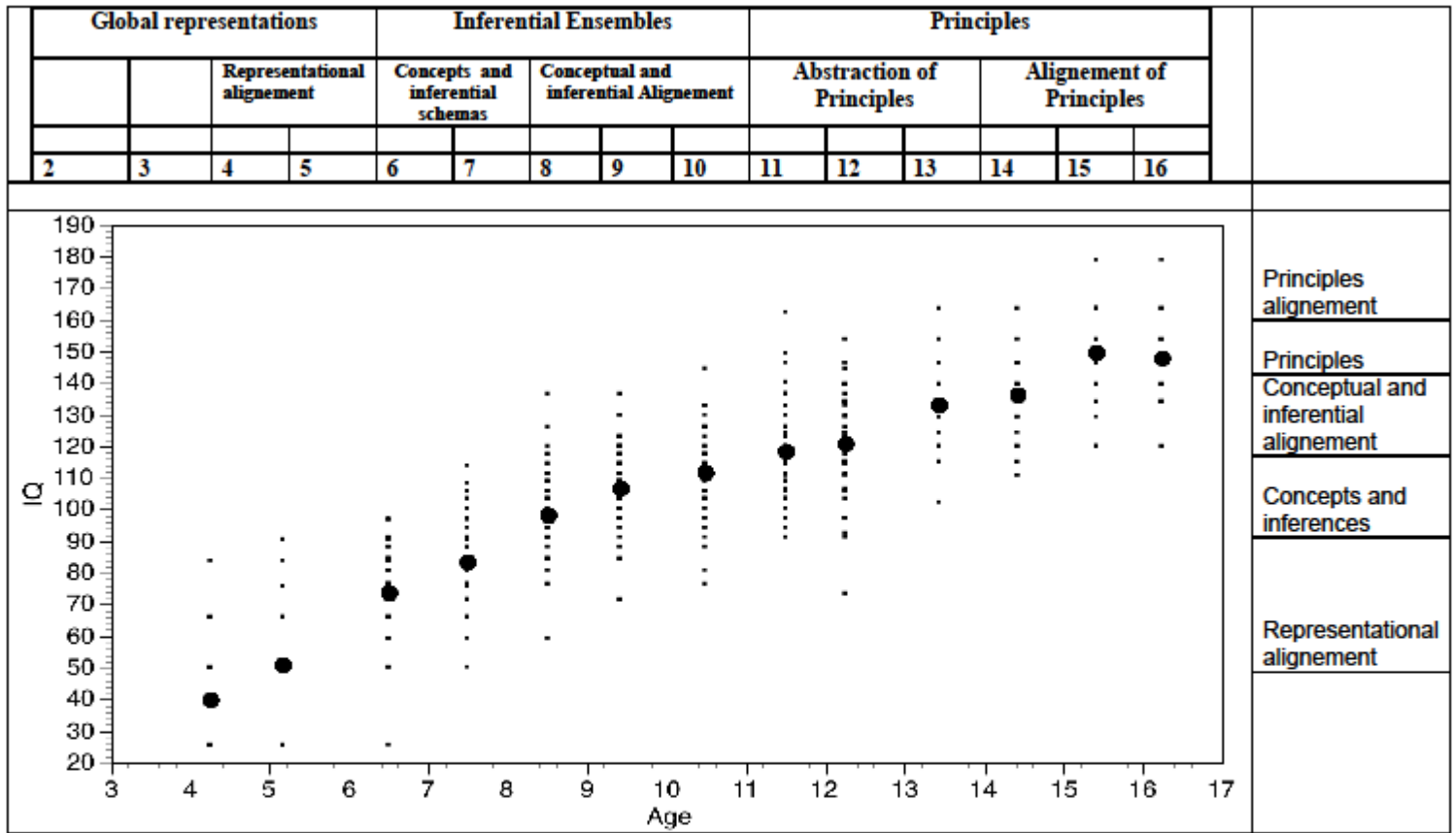
PIAGETIAN LEVEL



Cognitive Development and Intervention:

based on CSMS survey data 1975-77





The IQ in the figure is not the conventional one. Instead it represents an absolute scale of the whole developmental process so that, in Piagetian terms, '100' represents something around the 2B* level, achieved by the average child between 9 and 10, with the mean and range plotted at each year. 'Concepts' roughly parallels Concrete operations, and 'Principles' Formal operations. The range at 12 years probably indicates the range that would be found in a larger sample at 15/16.

The essential features of any programme designed to promote higher order thinking:

- **Concrete preparation** to introduce the necessary vocabulary and clarify the terms in which a problem /a task/ is to be set
- **Cognitive conflict** at a level to set the students' minds a puzzle which is interesting and attainable
- **Construction zone activity** in which the conflict is at least partially resolved as students' minds go beyond their previous thinking capability
- **Metacognition** in the sense of conscious reflection on the problem solving process and naming of reasoning patterns developed for the future use.
- **Bridging** of these reasoning patterns to new contexts in order to generalise them and consolidate their use.

References:

Adey, P. & Shayer, M. (1994). Really Raising Standards: Cognitive intervention and Academic Achievement. London: Routledge.

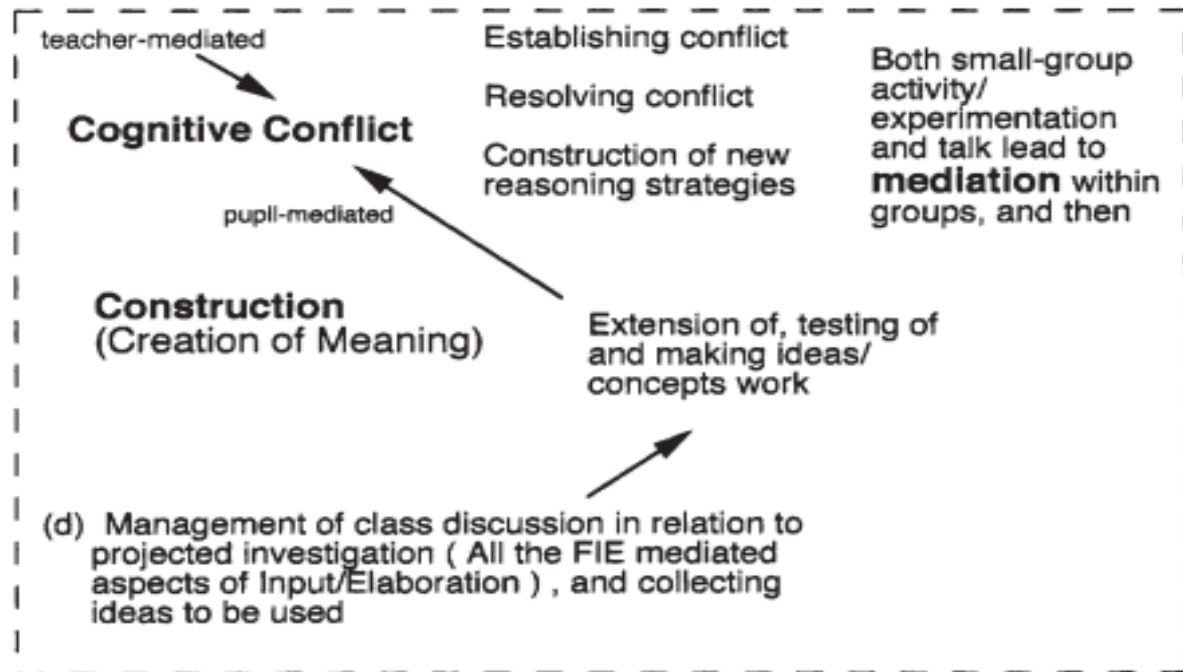
Halinen, I. & al (2017). Ajattelun taidot ja oppiminen. Jyväskylä: PS-Kustannus.

Kuusela, J. (2000). Tieteellisen paradigman mukaisen ajattelun kehittyminen peruskoulussa. Tutkimuksia 221. Helsinki: Helsingin yliopiston opettajankoulutuslaitos.

Shayer, M. & Beasley, F. (1987). Does Instrumental Enrichment Work? British Educational Research Journal, 13, 101-119.

Construction Zone Activity (CZA)

Act 2



These apply to TS lessons where pupils are asked to *go beyond* their present thinking

Concrete Preparation

These apply to introductory TS lessons in each Reasoning Pattern strand

Act 1

- (c) Selection of relevant verbal tools
- (b) Establishment of confidence (at Concrete level) in using new technical vocabulary
- (a) Providing new technical vocabulary which *subsequently* will be used to develop formal models

Backward to new CZA in new TS activity

Act 4

Bridging

Forward to other areas of science or mathematics

To planning of (mainly) instructional science lessons

Act 3

Whole-class sharing of results and experience of CZA ideas
 AND
 questioning of pupils by pupils to clarify results results in
 —further **Mediation**
 (pupils *internalise* Constructions which have occurred during Act 2, but shared with all in Act 3)

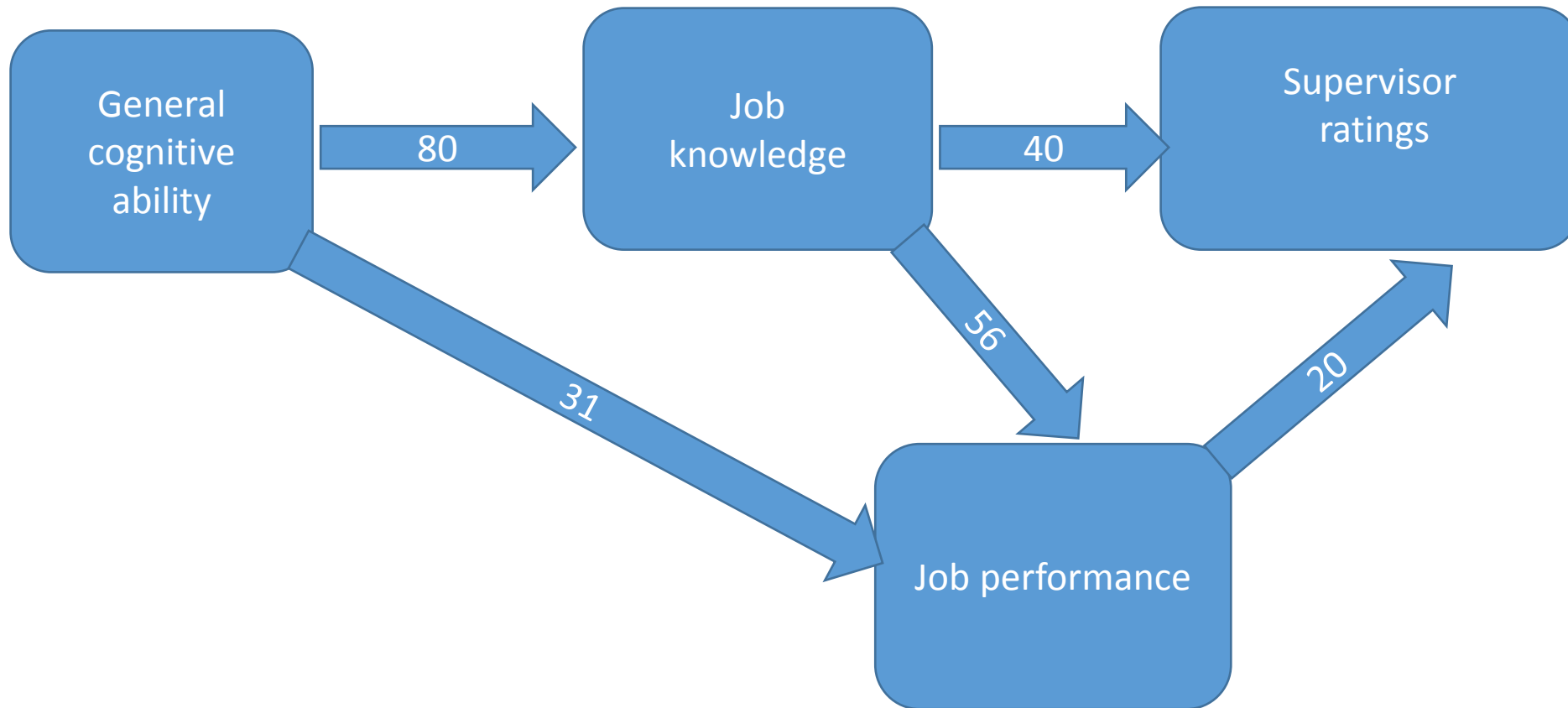
This should be followed by

Metacognition

Conscious summary by pupils of of strategies successfully applied, and **FINDING GOOD NAMES** for verbal/maths tools used

1

- 1.1 Several people working together generate more insights than on their own.
- 1.2 Children vary enormously in their levels of thinking.
- 1.3 Learning tasks in mathematics vary enormously in levels of difficulty.
- 1.4 A teacher needs to bear in mind all of the above to manage learning effectively.



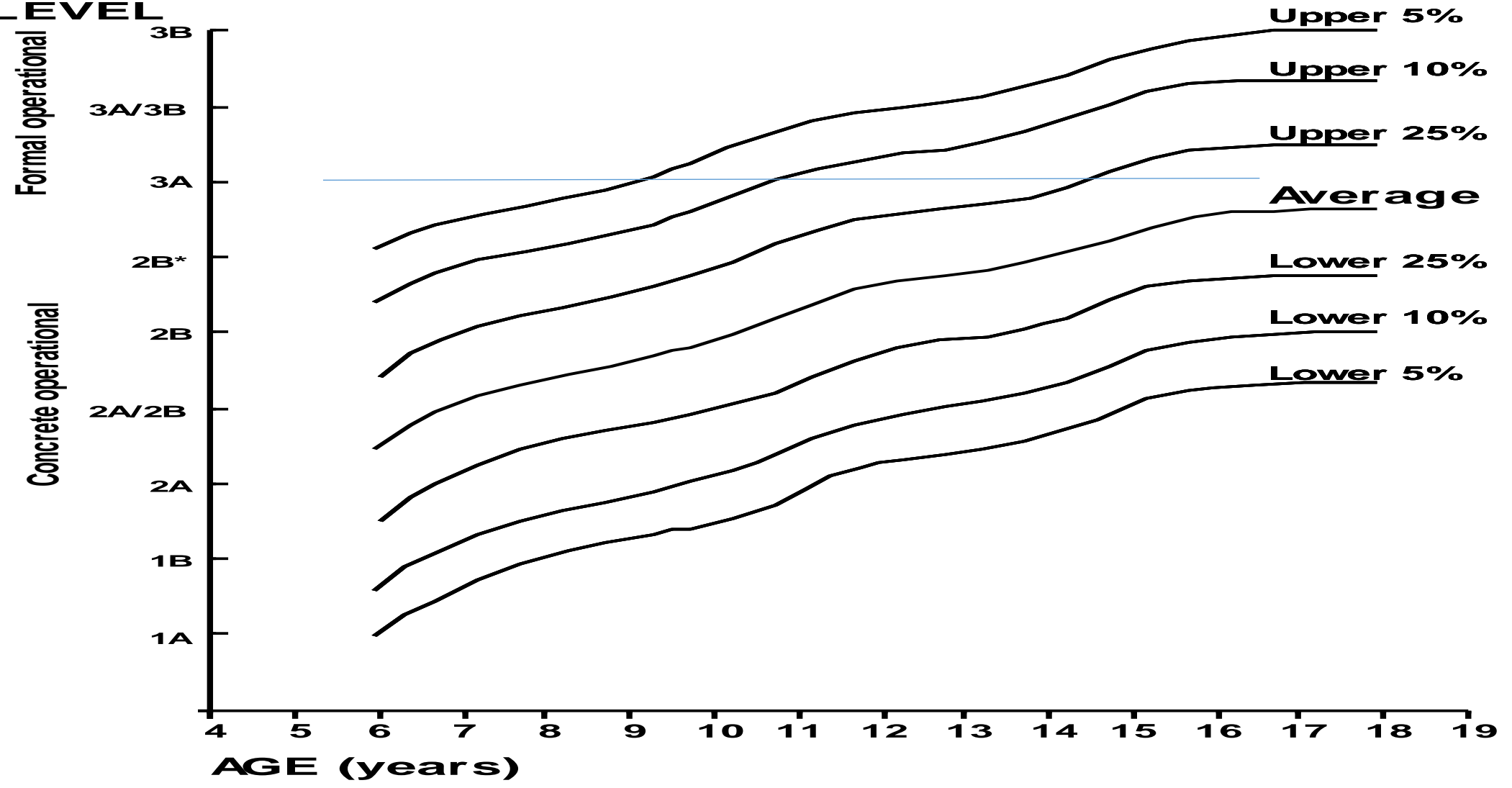
Cognitive abilities and aptitudes and estimated job performance (in the 70's, but...)



Cognitive Development

Boys; based on CSMS survey data, 1975 - 78

PIAGETIAN LEVEL



General developmental course in school:

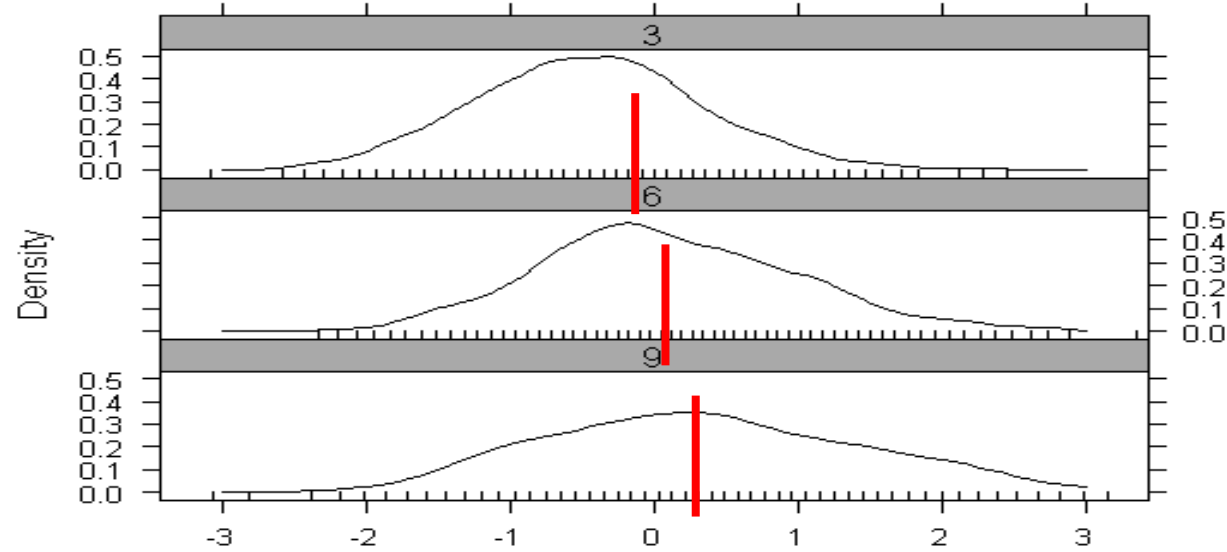
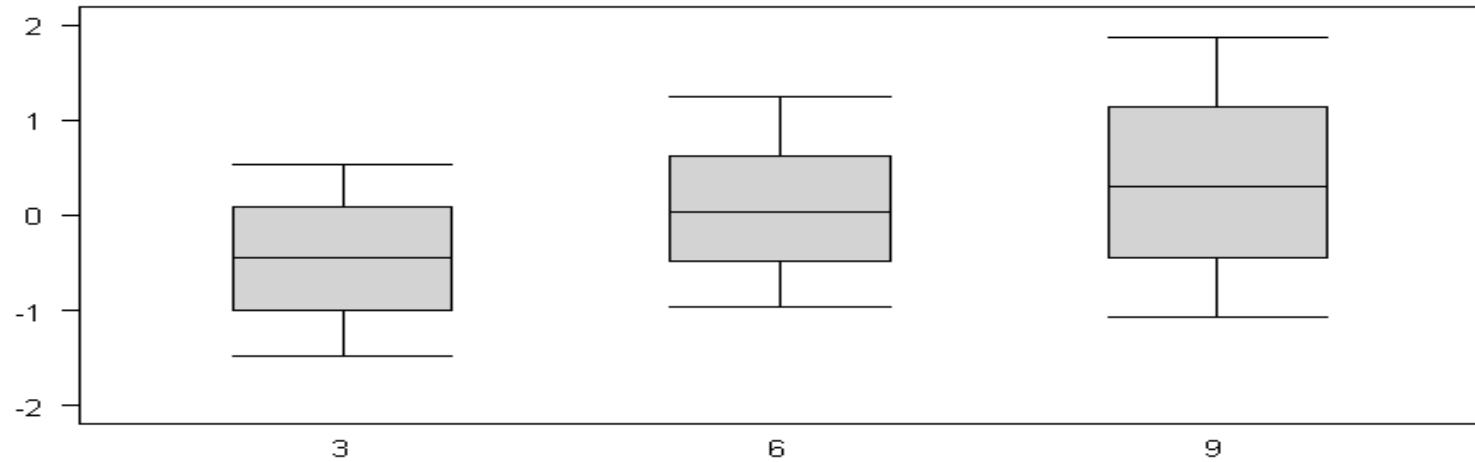
a) competencies increase slowly

b) attitudes decrease (=self-reflection increases)

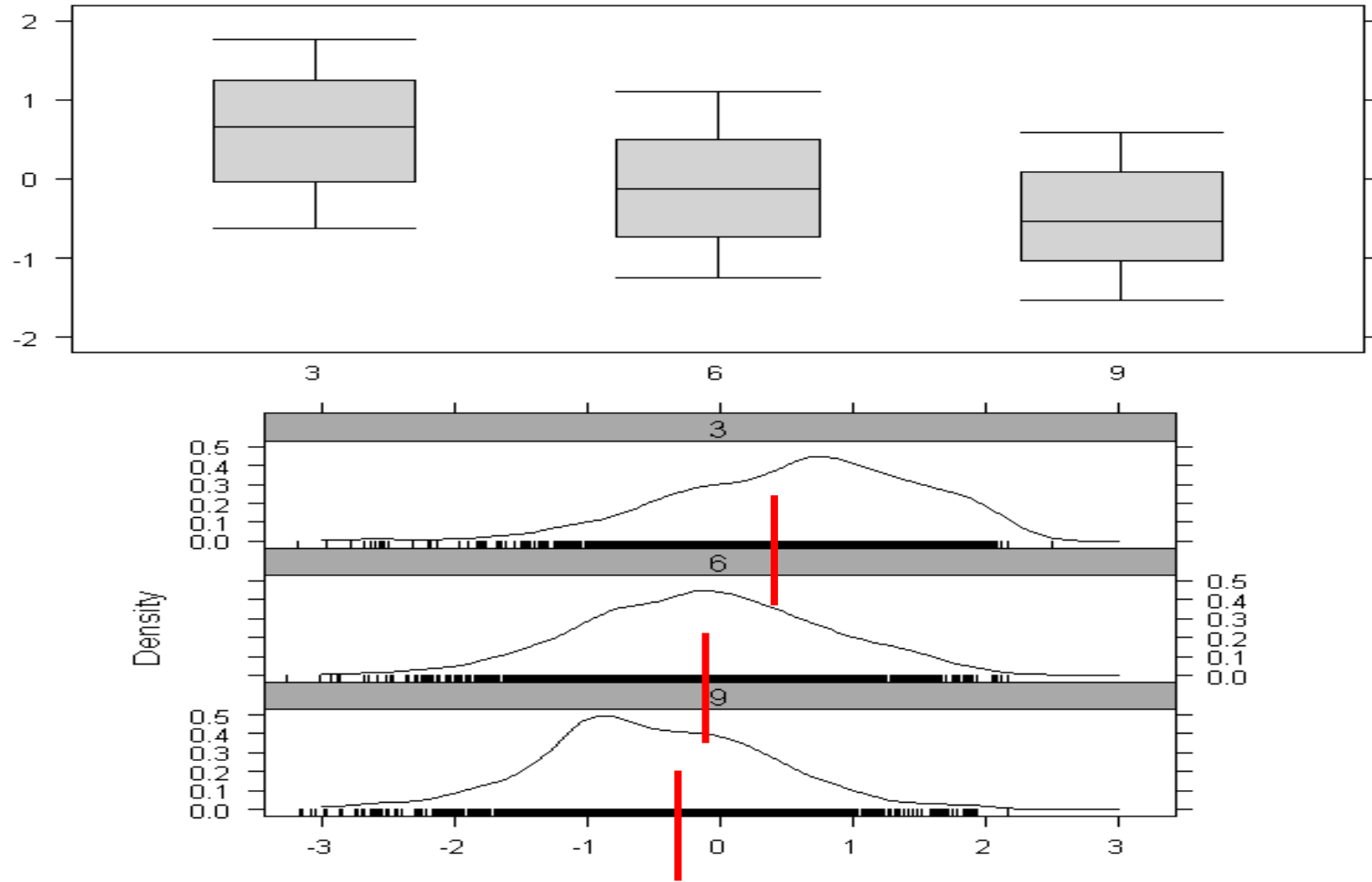
c) structuration of competencies and attitudes takes place;

all thru public feedback as diplomas and test results

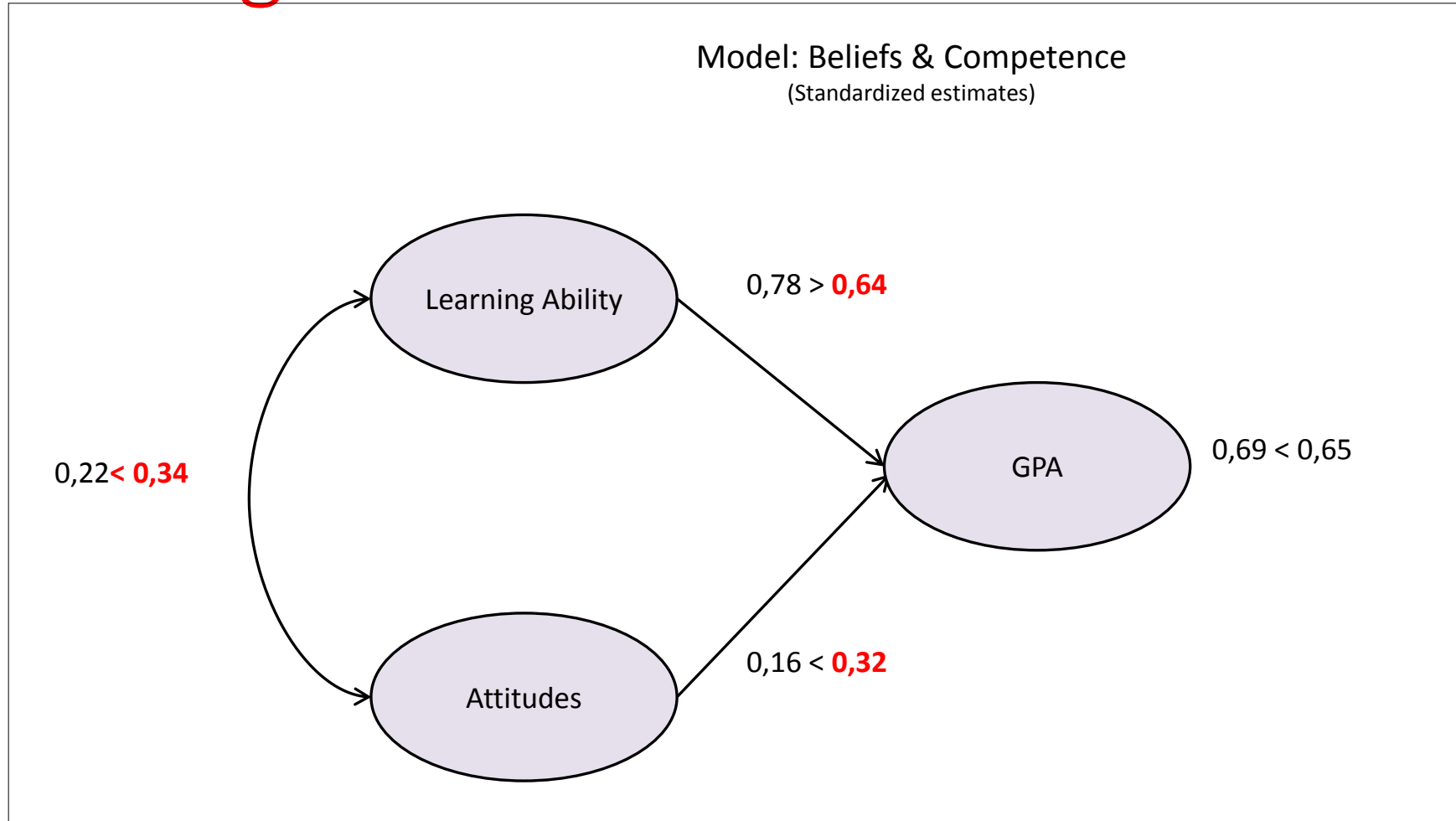
Growth of Thinking 3th – 6th – 9th grade (15 y)

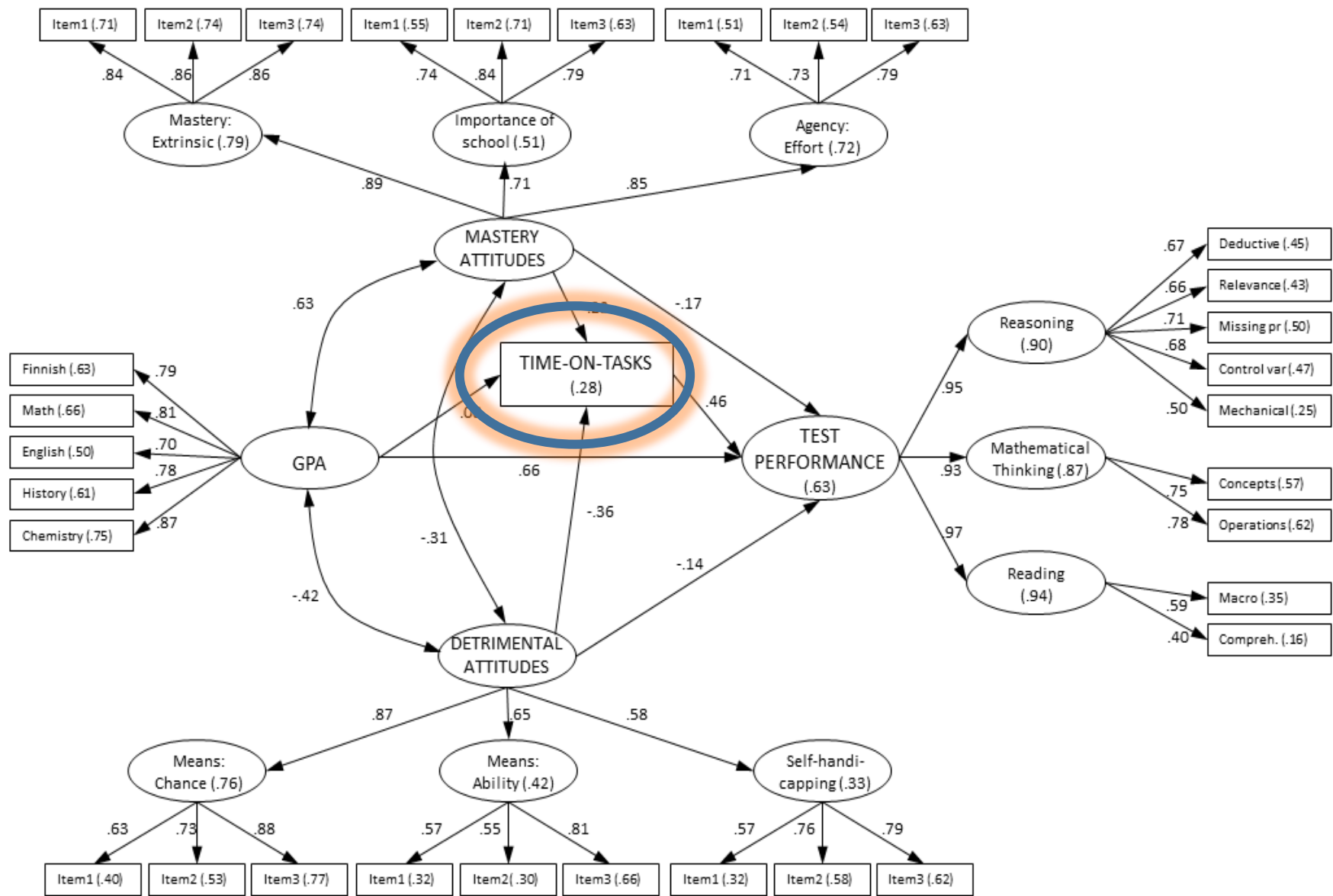


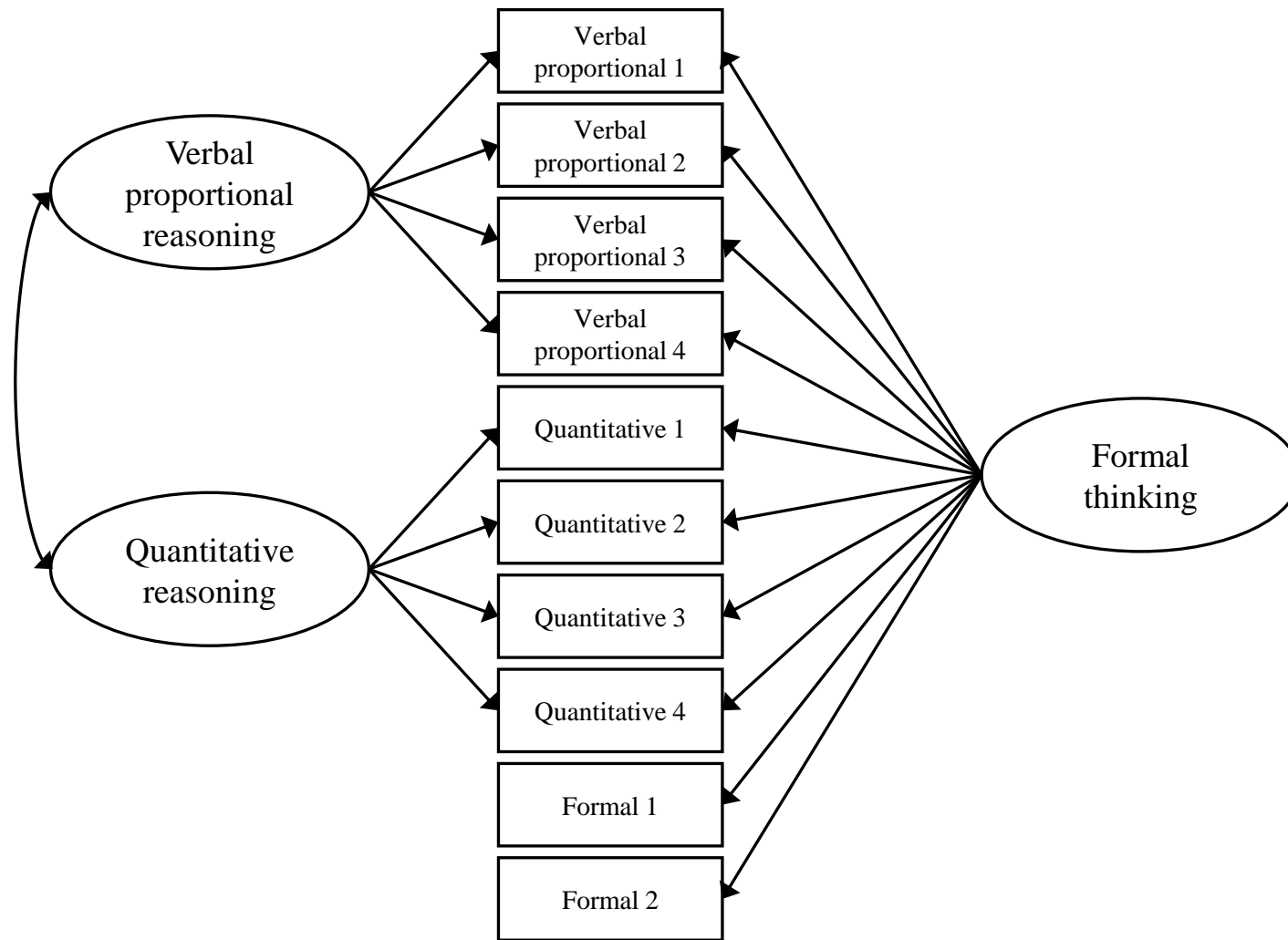
Changes in attitudes: 3 – 6 – 9



Structuration (correlations higher) from 6th to 9th grades



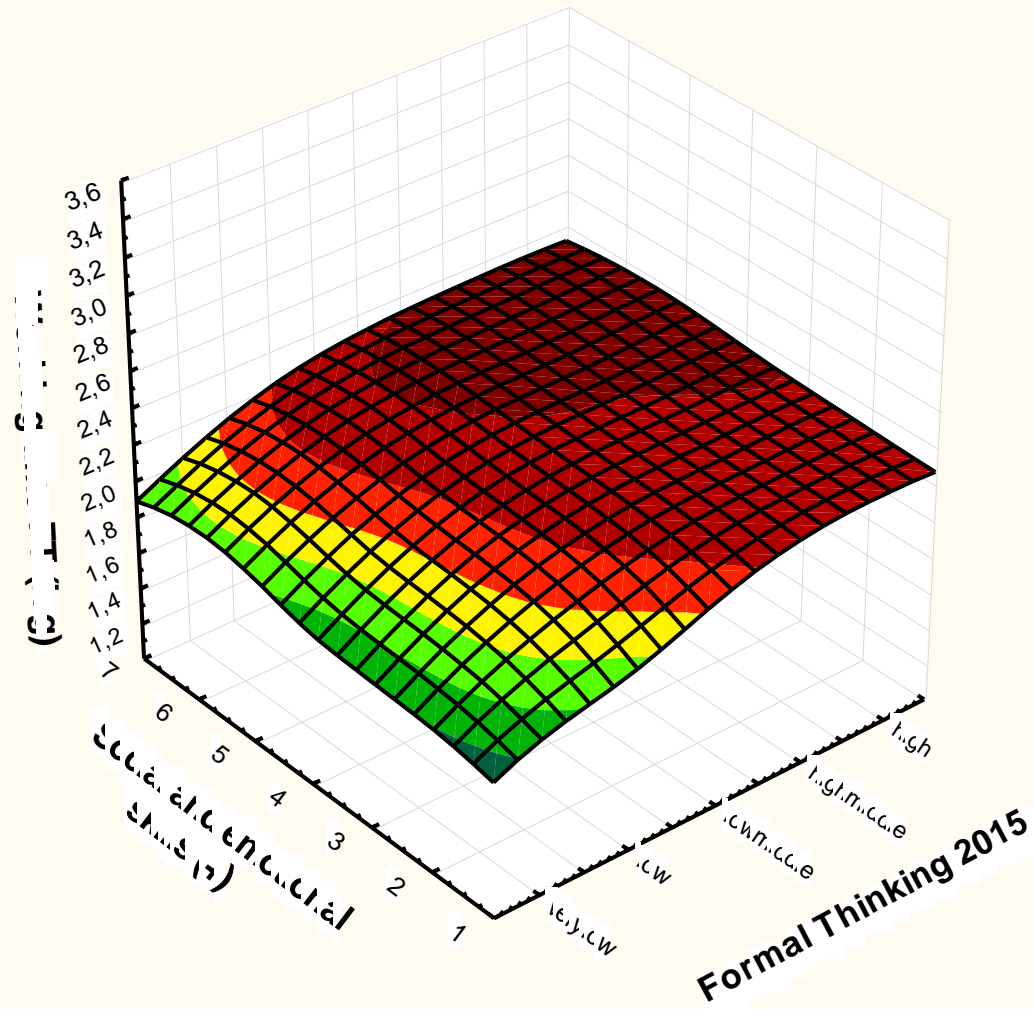




Vainikainen, Hautamäki & al (2015) General and specific thinking skills and schooling: preparing the mind for new learning. Thinking Skills and Creativity, 2015.

MetrOP_2011-2014_Short.sta 374v*6750c

FormTime2014Log = Distance Weighted Least Squares



MetrOP_2011-2014_Short.sta 374v*6750c
LUKKA_14 = Distance Weighted Least Squares

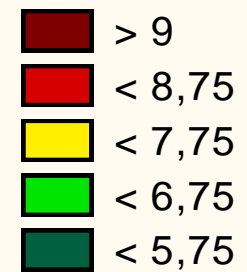
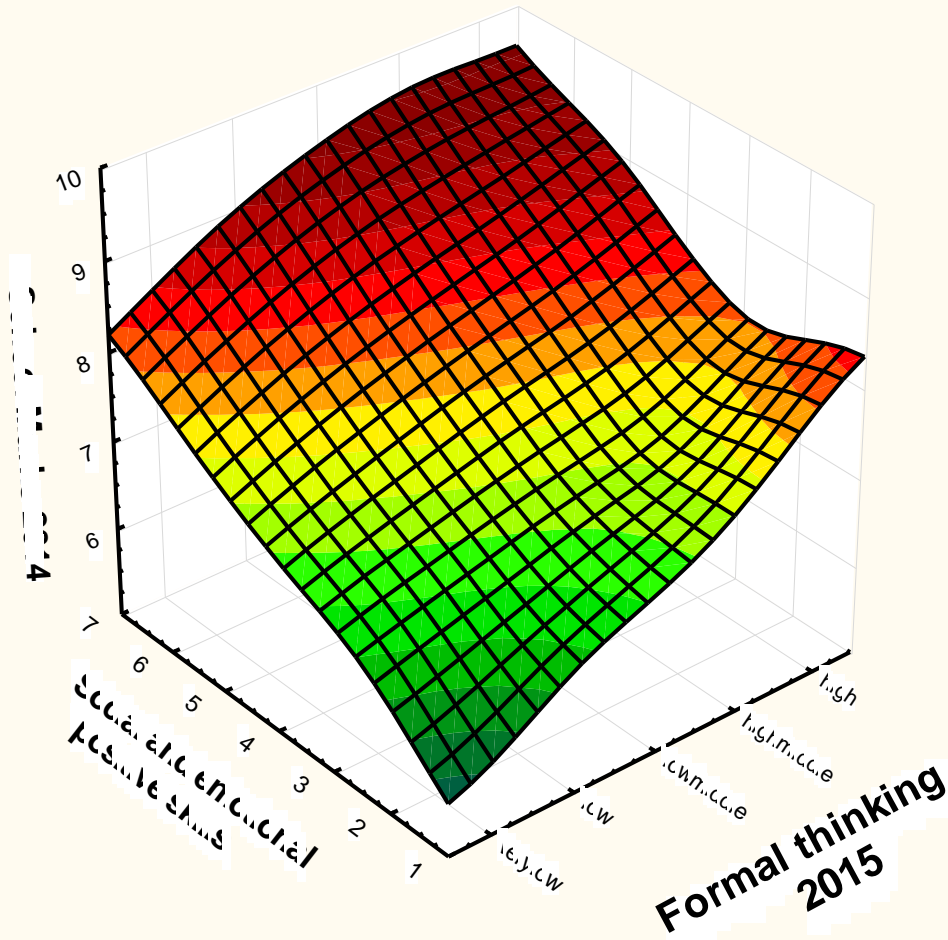
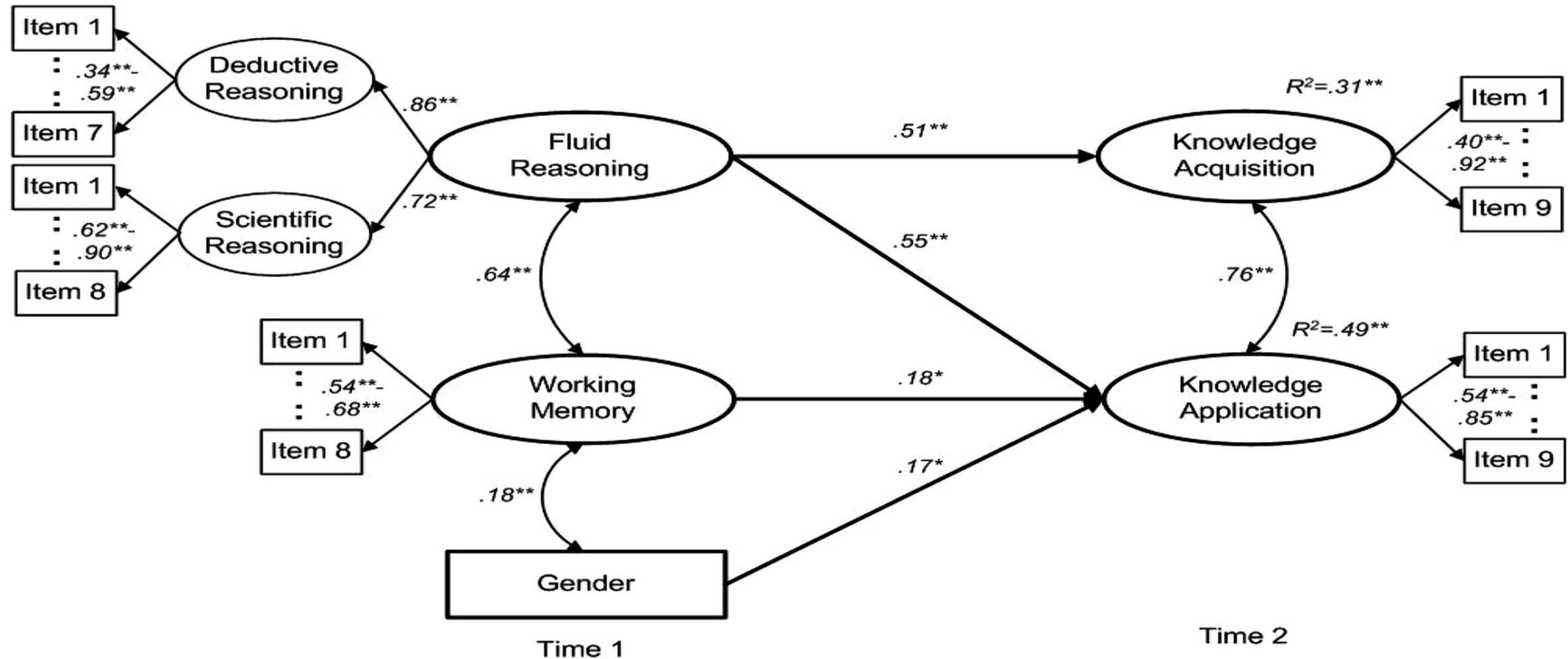


FIGURE 2 | The longitudinal prediction of CPS knowledge acquisition and CPS knowledge application by fluid reasoning (FR) and working memory.

Greiff et al, 2015, Frontiers of Psychology, July 2015, Article 1060.

N= 1696, Vantaa longitudinal L2L study,

Time 1= 12 yr, Time 2 = 15 yr



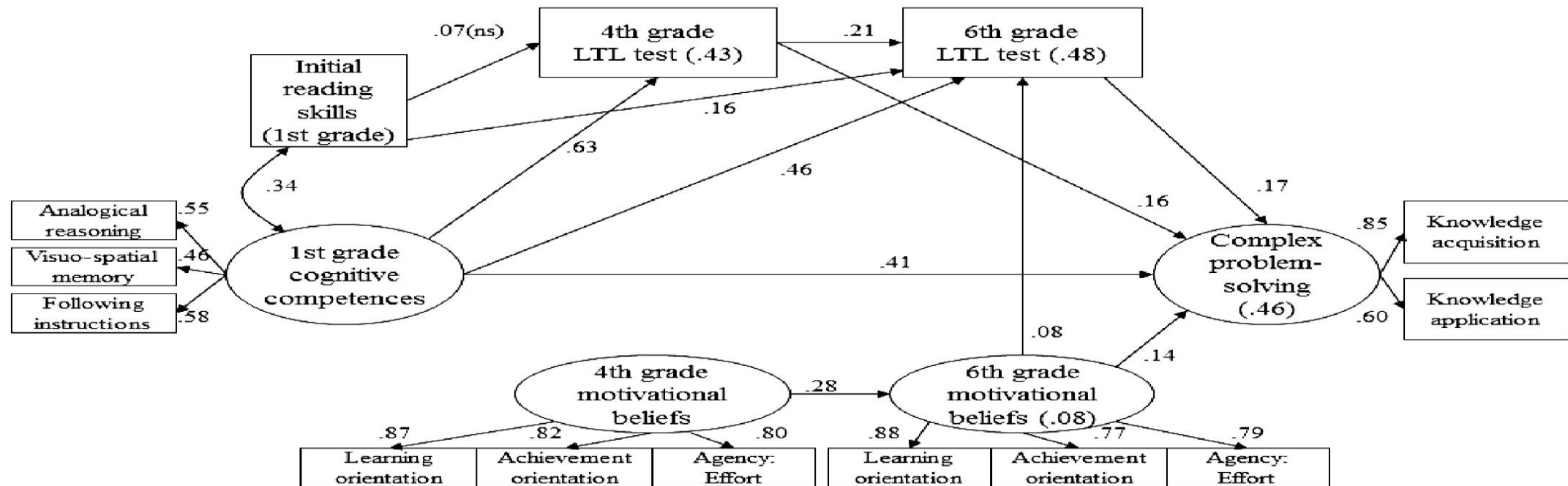


Figure 1. The final model for predicting performance in cognitive LTL tasks and complex problem solving. The only non-significant path from initial reading skills to fourth-grade LTL test is marked with (ns). Numbers in brackets indicate the variance accounted for

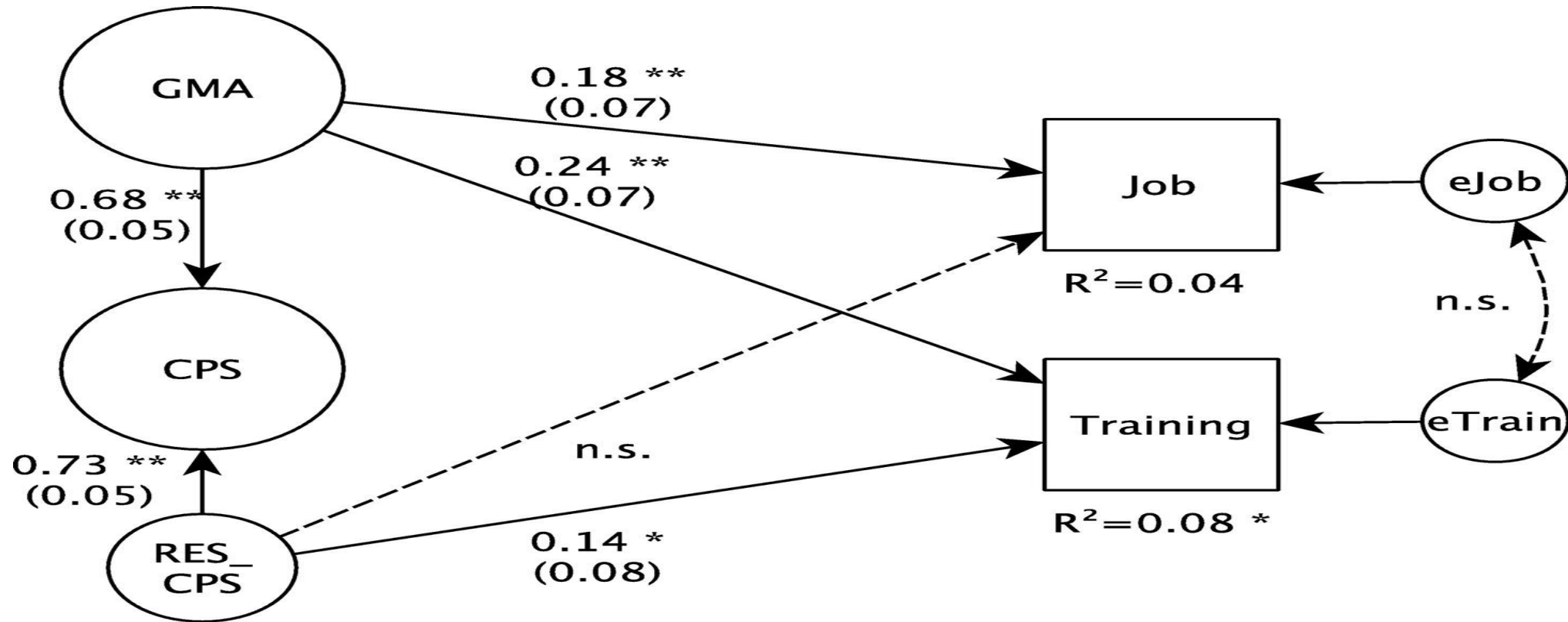


Figure 2. Model 2 for H2. CPS was regressed on GMA. The CPS residuals (RES_CPS) in this regression as well as GMA were used to predict job level (Job) and number of professional trainings (Trainings). eJob and eTrain are the uncorrelated residuals of Job and Training. The numbers in parentheses are the standard errors (SE; e.g. SE = .08 for $\beta = .14^*$ between RES_CPS and number of professional trainings). * $p < .05$; ** $p < .01$

Linking complex problem solving to opportunity identification competence within the context of entrepreneurship

[Yvette Baggen](#)^{a*}, [Jakob Mainert](#)^b, [Thomas Lans](#)^a, [Harm J. A. Biemans](#)^a, [Samuel Greiff](#)^b & [Martin Mulder](#)^a

International Journal of Lifelong Education [Volume 34](#), [Issue 4](#), 2015 [Special Issue: Problem Solving – Facilitating the Utilization of a Concept towards Lifelong Education](#)

Today's working life is increasingly characterized by entrepreneurial challenges. Entrepreneurial challenges start at an individual level with the identification of entrepreneurial opportunities. Since the identification of entrepreneurial opportunities relies heavily on the **opportunity identification** competence (OIC) of individuals, understanding the meaning of OIC is relevant. In this paper, we review the link between OIC and CPS by comparing the cognitive and entrepreneurship research fields. We argue that those who excel in identifying opportunities share core characteristics with **high-level complex problem-solvers**.

Special Education in Finland: Present service model

Jarkko Hautamäki & Laura Saarelma

University Helsinki Training School (Helsingin Normaalikoulu)

The NEED
Great and difficult to serve

Small and standard

SUPPORT
Special

2 %

5-7 %

Intensive

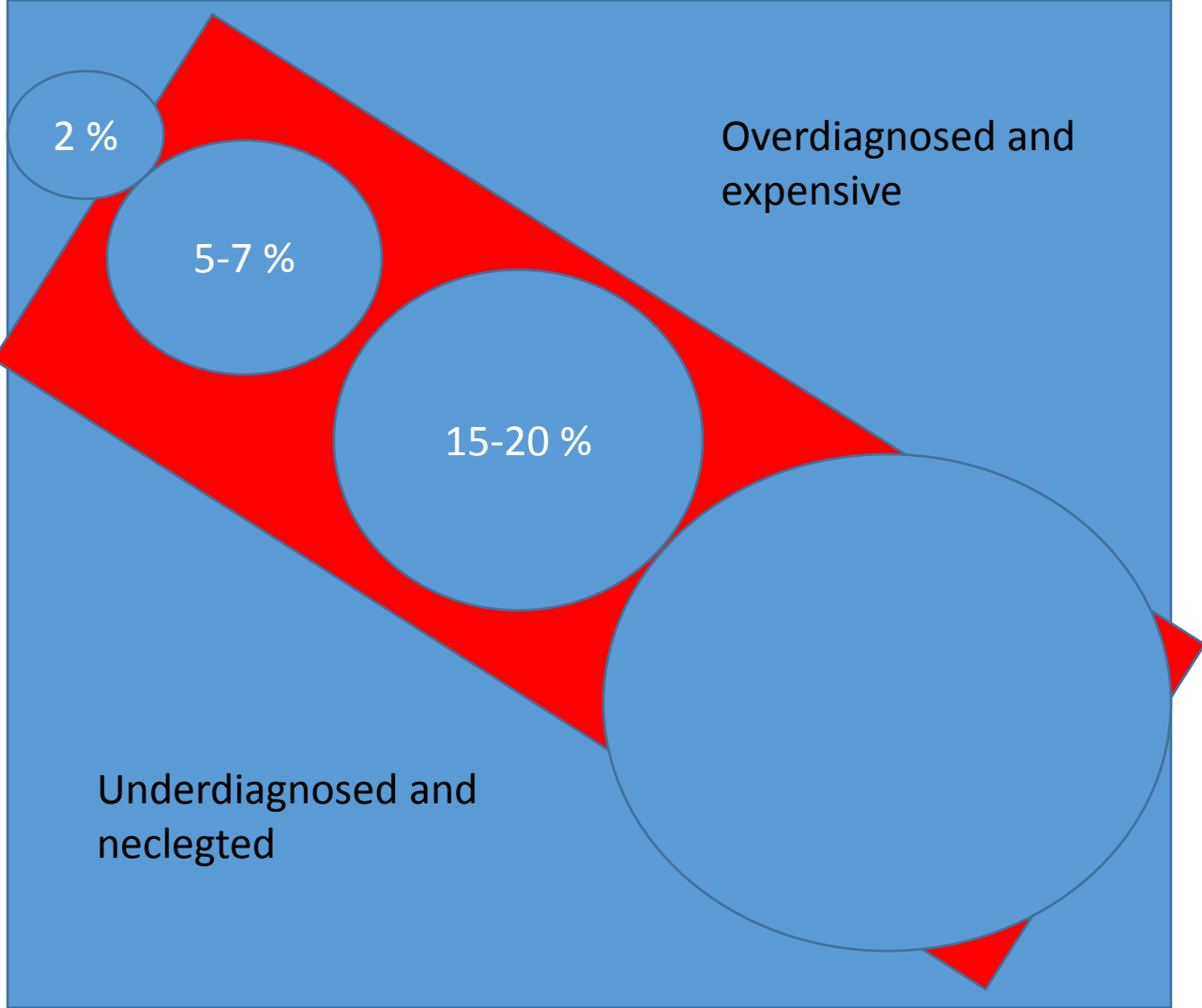
15-20 %

General

Standard

Underdiagnosed and
neglected

Overdiagnosed and
expensive



Some relevant history

- a new comprehensive system in 1968/1972-1977

- two new professional groups:

 - part-time special teachers**

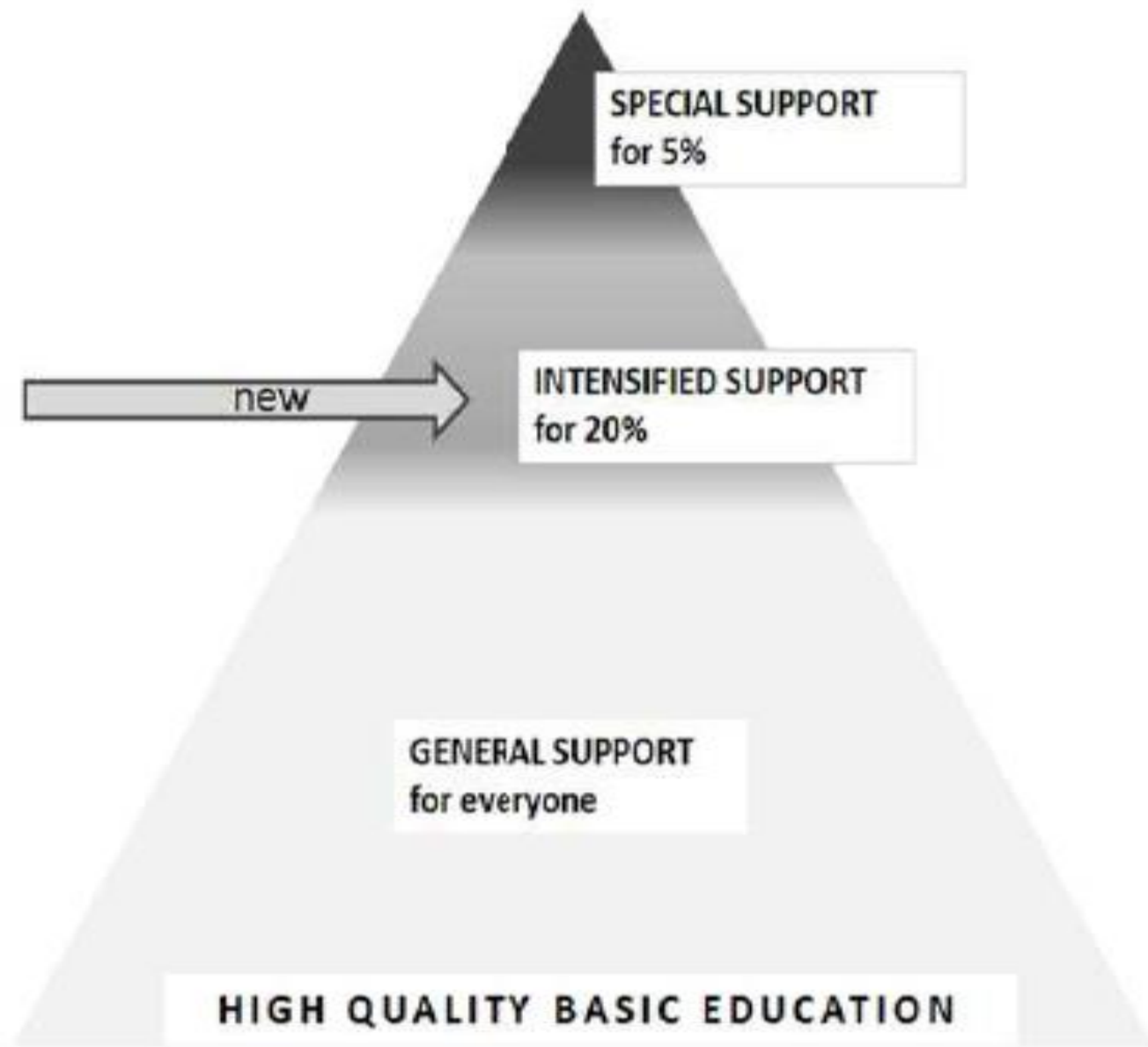
 - study counsellors

- outcomes:

 - educational equity** account

 - expansion of special education**, in the sense of support to learning for all **profiles** where the lowest performing students benefit relatively more than the most able students, made visible thru PISA (here using 2006 data)

 - most students continue** in their education (drop-out, 4%)



Student's active role "Ask the student first". Everything in cooperation with parents.
Teacher collaboration. Consulting the Student welfare group (SWG). Pedagogical leadership (principal).

From the 2-tiered to the 3-tiered model

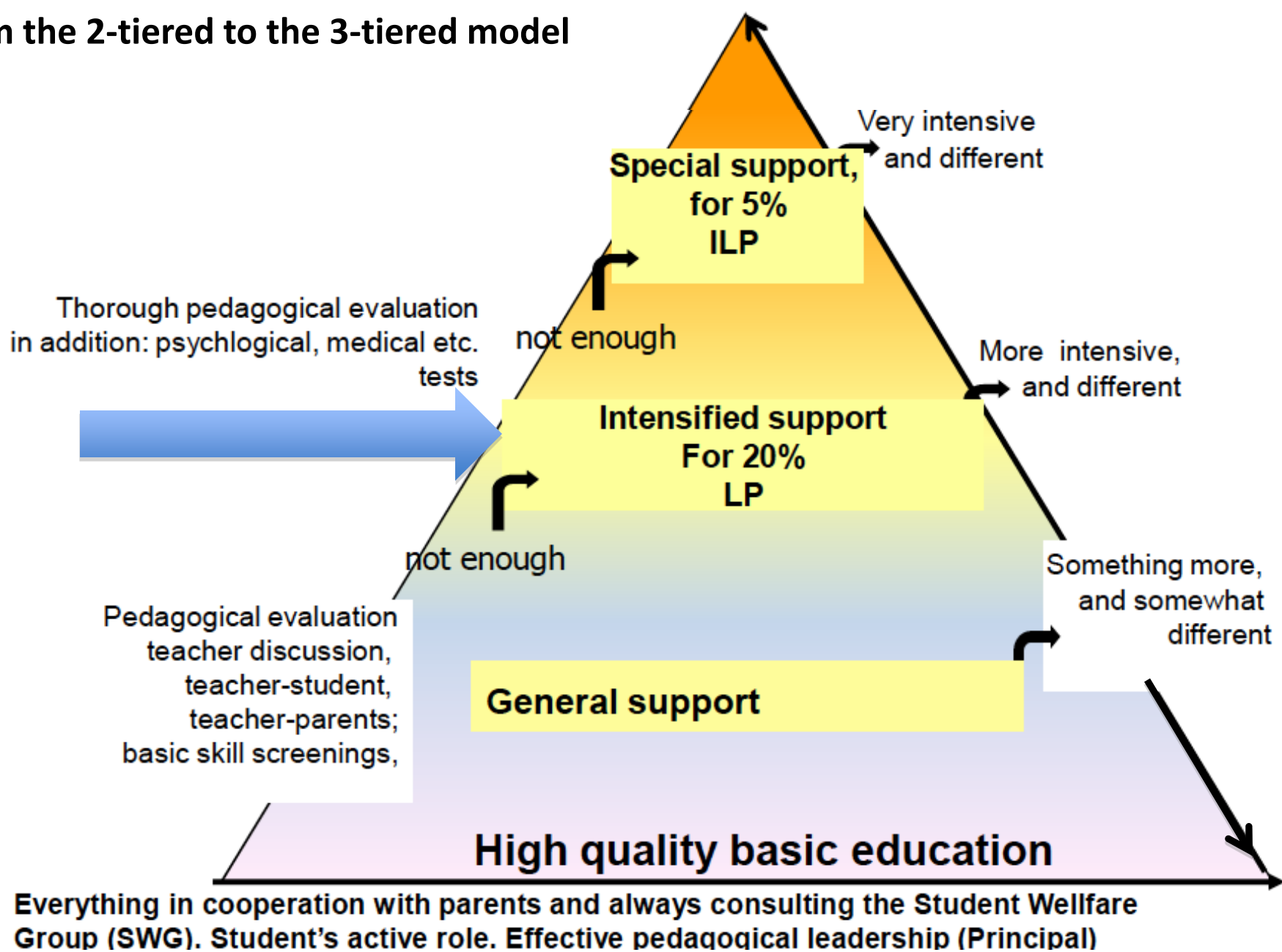


Figure 2. Model of Support

Main ideas of the new strategy:

inclusion, *nearest school*

Intensified support is a new concept (every child is entitled; no special education referrals if not given this type of support first). ***This support is not just the work of Sp. Ed. teacher but every teacher (class-teacher, subject teacher)***

Systematic, evidence-informed teaching and pedagogical evaluation

Multi-professionality

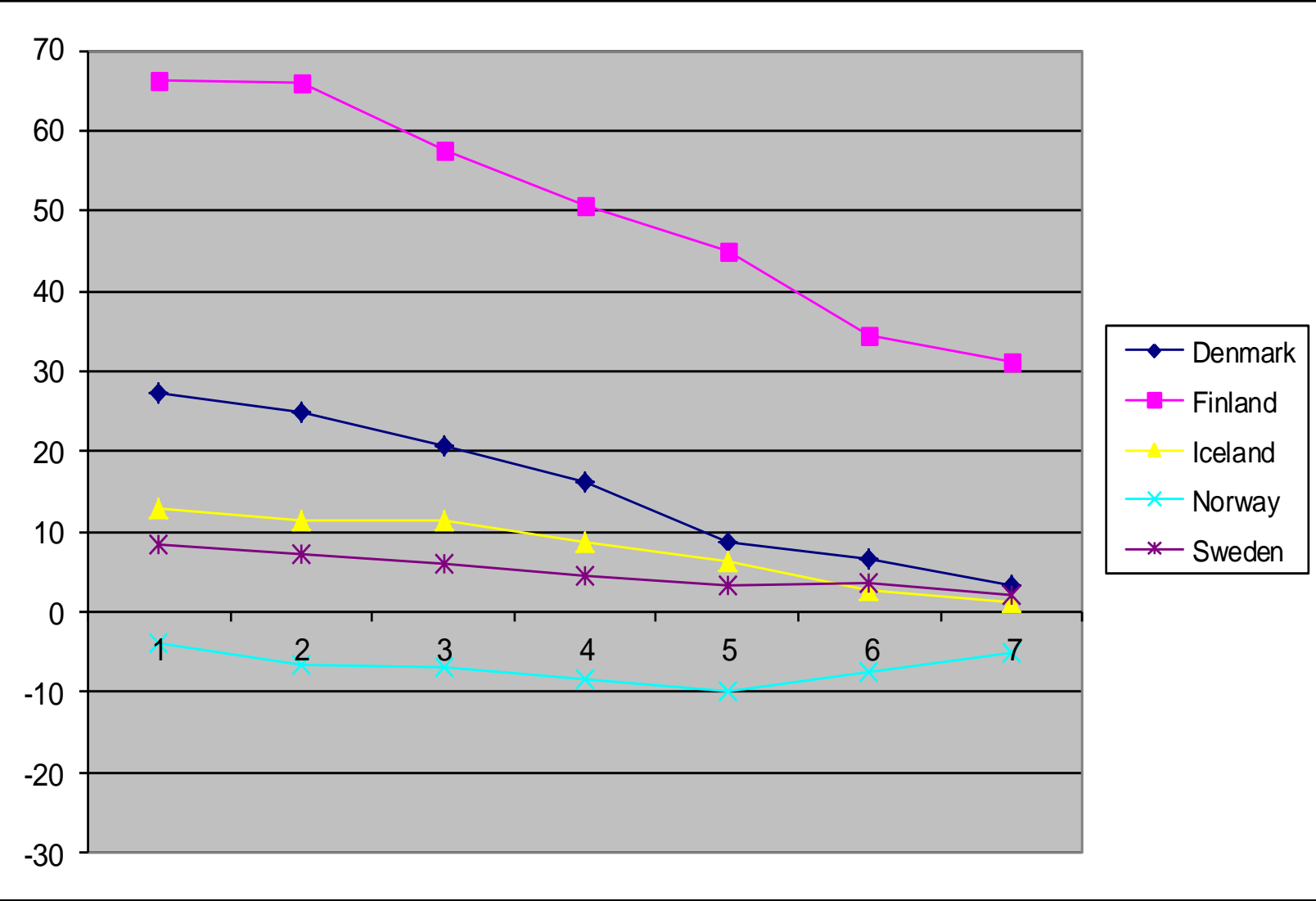
Co-teaching, co-educational

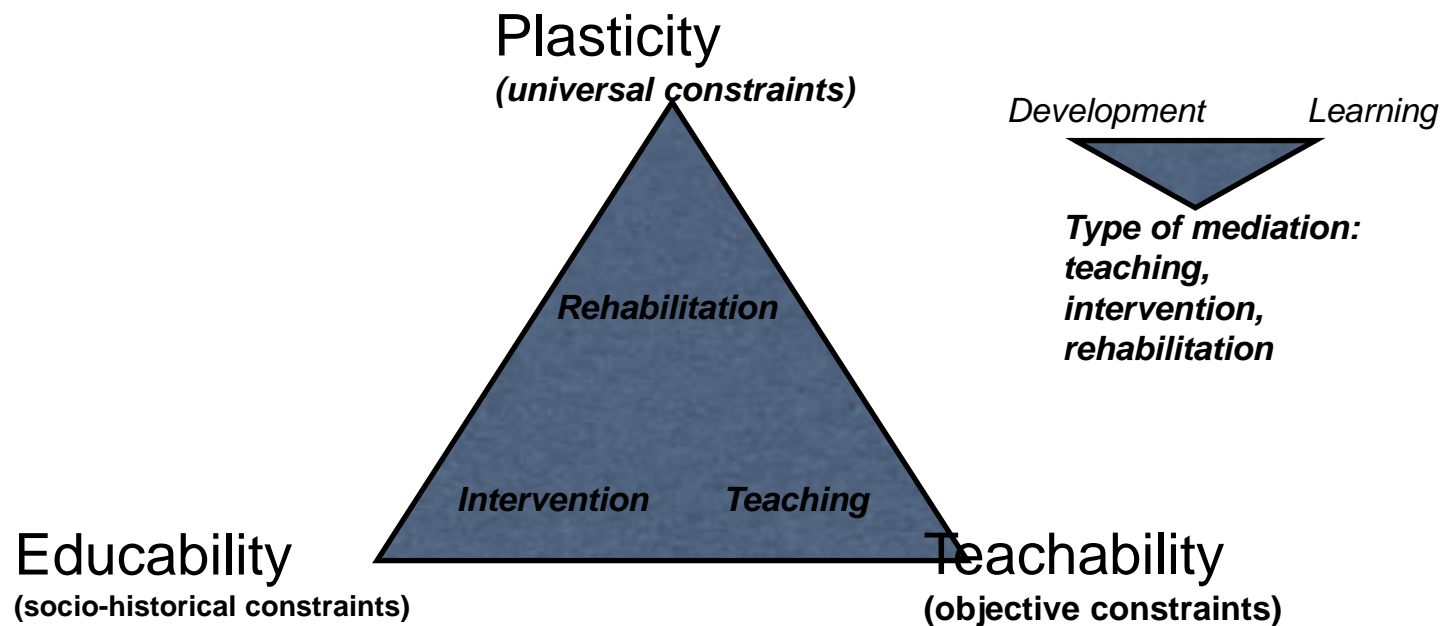
Flexible groupings and differentiation and individualizing of teaching

Emphasizing *pedagogical* instead of *psychological/medical*

(much in common with the RTI-model applied in US)

RTI – model : response_to_intervention (hoitovaste]





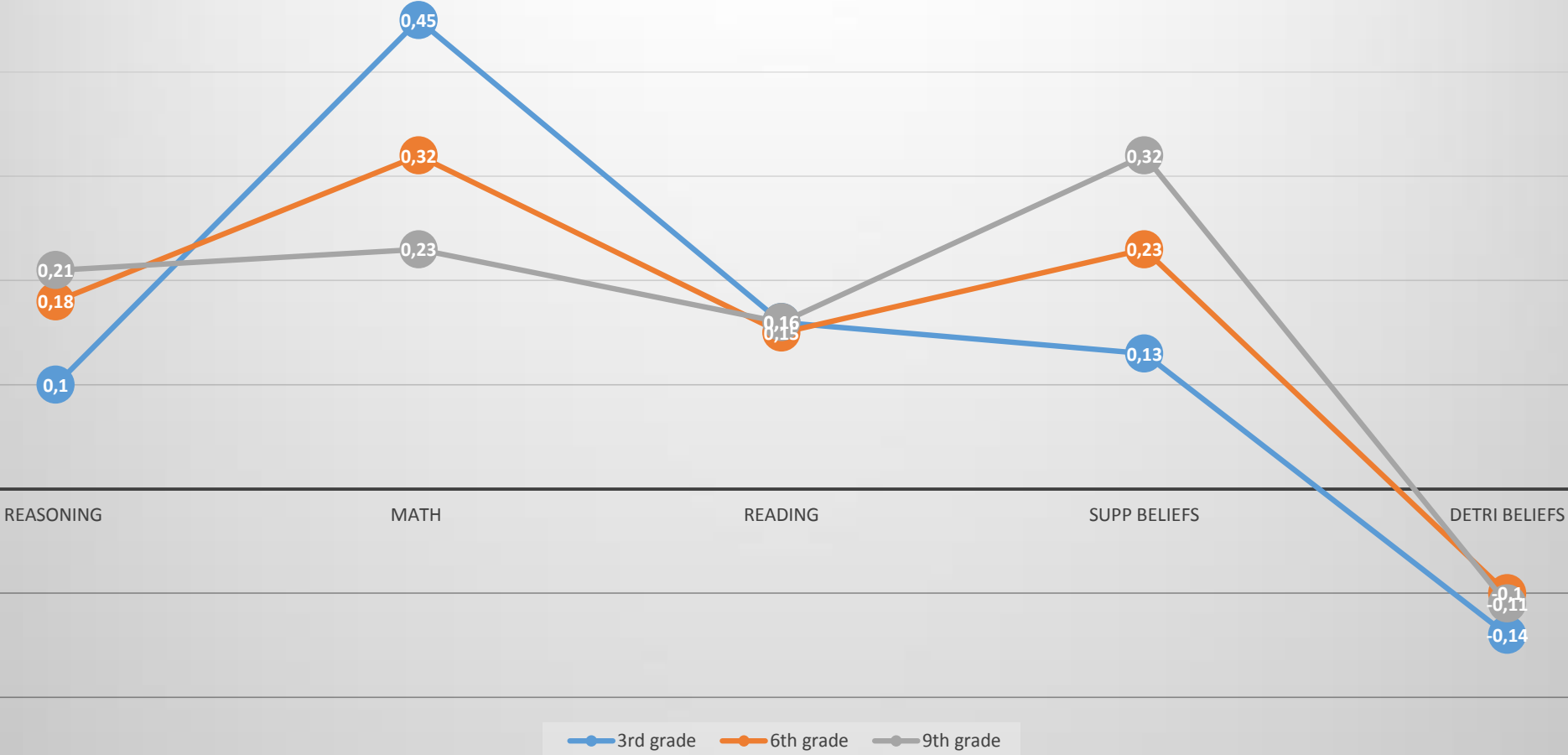
- A model of the **CONCEPTUAL FOUNDATIONS FOR SPECIAL EDUCATION** from a socio-historical and developmental approach, where **SPECIAL EDUCATION** is given a mediating position between 3 different types of **CONSTRAINTS** and various **TOOLS**, which are used/invented to overcome the constraints.
- The 3 types of constraints are **PLASTICITY** (universal constraints, like blindness), **TEACHABILITY** (objective constraints, like difficulties in comprehending/teaching geometry) and **EDUCABILITY** (socio-historical constraints, like gender and SES).
- Using this model it is possible to compare different modes of activity in SE field, i.e, the notions like teaching <> intervention <> rehabilitation can be described within the same model. Learning processes are modified differently in different modes of mediation, and lead through different ways into development, ie., the permanent bases for following developmental steps.

Tutor-Teachers as Mediators

- New Peruskoulu (Comprehensive Basic Education) Government Programme
- 2289 Tutor Teachers in
- Covering 99 % of all teachers and pupils
- 21/1 ratio of teachers/tutors
- Self-estimated competencies are
- best In technology and peer-learning
- worst in supporting assessment and grading



GPA Prediction models (standardized, GPA=0)
(Vantaa, each N > 2000), grades 3, 6, and 9



The Future of Reading

Assessment is like mapping a landscape, and if the landscape is changing/has changed, then the assessment should reflect this.

Has the cognition changed with the digital age? If yes, then also observations and interpretations should be modified.

The Future of Reading

Has the cognition changed with the digital age? One way is to address Reading

The very long historically established process:

Learning to read > Reading to Learn

Learning to read > Reading to Learn

The very long historically established process might be in need of more refined analysis:

A possible new division of modalities /types/ of reading (see Hayles, 2011).

Close Reading

Hyper Reading

Machine Reading

Learning to read > Reading to Learn

Close Reading

Hyper-reading

Machine Reading

Limiting constraints:

Attention

Time

Will and Need