Academic Thinking in the Context of Education

Risto Hotulainen

HELSINGIN YLIOPISTO
HELSINGFORS UNIVERSITET
UNIVERSITY OF HELSINKI

1

Centre for Educational Assessment

Risto Hotulainen

Risto.Hotulainen@Helsinki.fi

HELSINGIN YLIOPISTO
HELSINGFORS UNIVERSITET
UNIVERSITY OF HELSINKI

30.1.2017 2

Overview about who we are and what we are doing

The Centre for Educational Assessment (CEA) at the University of Helsinki.

The CEA was established in 1996 to define and develop an instrument for measuring learning to learn as the key transversal skills vital for lifelong learning (initiative from National Board of Education (FNBE))

We are assessing effects of "thinking curriculum"

HELSINGIN YLIOPISTO
HELSINGFORS UNIVERSITET
UNIVERSITY OF HELSINKI

http://www.helsinki.fi/okl/

CEA is a part of University of Helsinki, Department of Teacher Education.

We are financed by commissioned (often applied) time-limited projects from Ministry of Education Culture, National Board of Education, Prime minister's office, Academy of Finland, other research groups
and municipalities (and EU and OECD)

Staff members: 12 – 15

We are specialized in

- Learning to Learn (L2L) assessments
- Involved in PISA (2006, 2015*sub*, 2018*sub*)
- Computer based Assessment (CBA)
  - à General Problem Solving (Luxemburg, Hungary)
  - à Time-on-task in depth evaluations
- Advanced statistical methods
  - à Longitudinal designs
  - à Added value of school, class (teacher) for learning
- Well-designed and tested report forms for communicating the results (Finland, Czech, Japan, Russia, Hungary, ...)

Furthermore (part 1):

- We have conducted system evaluations (Finnish special education reform)
- We tailor and develop our assessment services in request (e.g. Developing Adaptive Testing Tool, FNBE)
- We arrange further education (e.g. Nationwide "Assessment as a precondition for learning" related to new core curricula¨, 2015-2016)
- We provide consultation in assessment
- We attend to scientific conferences and publish scientific papers

Furthermore (part 2):

We have several longitudinal research projects:

- Redefining Adolescent Learning: A multi-level longitudinal cohort study of adolescent (N = 10 000) learning, health, and well-being in educational transitions in Finland. From 7th grade (2011) to the end of upper-secondary school (2019)

- Tablets in Vantaa educational system –research (pre-school, 1st, 4th and 7th graders, academic and vocational upper secondary – and teachers, follow-ups for 1-2 years)

- Helsinki and Vantaa longitudinal studies (from the beginning till the end of Finnish nine-graded comprehensive school)

Furthermore (part 3):

- Our doctoral students are conducting research on

  - à Effect of class size and class composition for developing learning to learn skills among students with educational support needs (Ninja Hienonen)

  - à Grade (in)comparability and multidimensionality in the Finnish matriculation examination (Jukka Marjanen)

  - à Educational reforms and changing statistics in special education (Meri Lintuvuori)

  - à Changes in school policies and educational reforms (Raisa Ahtiainen)

Definition of Learning-to-learn (L2L)

- Learning to learn is defined as the willingness and the ability to settle down to novel tasks (Hautamäki, & al., 2010).

- It is assessed by administering cognitive tasks measuring general reasoning and thinking skills, and self-evaluation scales measuring beliefs and attitudes towards learning (Hautamäki & al., 2002).

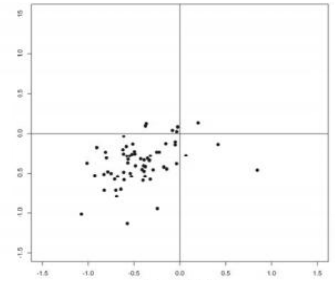
Assessing Learning-to-learn

§CEA has developed Finnish Learning-to-learn cales for 1st, 3rd/4th, 6th/7th, and 9th grades nd upper secondary school.

COGNITIVE COMPETENCIES
- §Reasoning skills (verbal and figural)
- §Reading comprehension
- §Mathematical thinking skills

LEARNING-RELATED ATTITUDES
- §Motivational beliefs
- §Academic self-concept
- §Commitment to school
- §Perceived support from the environment

Reporting the results (example 2001 vs. 2012)



Beliefs

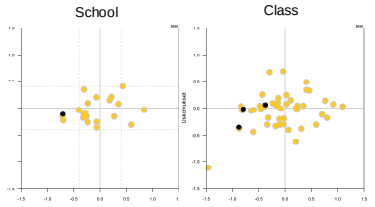
Reasoning

N = 7000
74 Schools

Schools representing all Regional State Admistrative Agencies

Reporting the results

§ School- and class-level reporting of the results

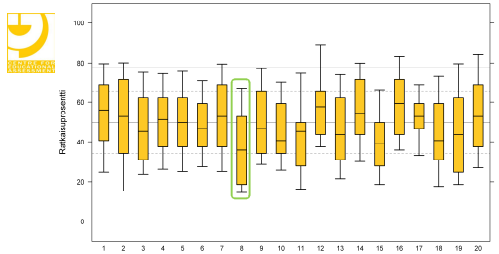


Beliefs

Reasoning

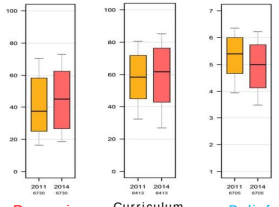
Reporting the results

Reasoning (4th grade) by schools



Reporting the results

Development of learning to learn skills and curriculum math and literacy



Reasoning Curriculum math & literacy Beliefs

Objective

After completing the study unit, students

- have gained preparedness to examine the historical structure of education, foundations of philosophy of science of education and societal meaning of education
- are able to analyse everyday and scientific thinking and understand the construction of scientific knowledge
- understand different educational goals and the educational emphases behind them as well as educational research and its core concepts
- understand educational research process, problem-setting of research and methodological solutions
- have gained preparedness for academic studies and pedagogical thinking, in particular an initial awareness of one's own personal practical theory

Contents

Education as a multidisciplinary system.

The methodological foundations of educational knowledge and the principles related to the nature, meaning and construction of knowledge.

Evaluation
The study unit is assessed on the basis of an exam *or other written assignment based on the lectures and literature on the scale 0–5.*

How to get there…?

26.01.17	Thu 12.15-13.45	***Orientation, Historical line, Risto***
30.01.17	Mon 12.15-13.45	***Scientific thinking, Risto***
02.02.17	Thu 14.15-15.45	***Public science, prof. Hannu Salmi***
06.02.17	Mon 12.15-13.45	***ER1: Ninja Hienonen & Irene Rämä***
09.02.17	Thu 14.15-15.45	***ER2: Social integration, Pia-Mari Niemi***
10.02.17	Fri 14.00-16.00	***Heureka visit, 30min, Risto***
13.02.17	Mon 12.15-13.45	***ER3: Classroom intervention, Risto***
17.02.17	Fri 10.15-11.45	*(Examination à group essay)*

Write group essay (2-4 people): about 5-7pages

This course has helped me by giving me the knowledge about:

1) historical structure of education, foundations of philosophy of science of education societal meaning of education

2) how to identify everyday and scientific thinking and understand the construction of scientific knowledge

3) understand different educational goals and the educational emphases behind them as well as educational research and its core concepts

Reflect how these aspects are assosciated with teacher's practical theory and practice

Task is due to 28.2. send by e-mail to Risto (risto.hotulainen@helsinki.fi)

Readings:

Stephen Dinham (2015) PSEUDO-SCIENCE, INEQUALITY AND DECLINE, Journal of Professional Learning

http://cpl.asn.au/sites/default/files/journal/Stephen%20Dinham%20-%20Pseudo%20Science,%20Inequality%20and%20Decline.pdf

Harri Pitkäniemi (2010) How the Teacher's Practical Theory Moves to Teaching Practice A Literature Review and Conclusions Education Inquiry Vol. 1, No. 3,

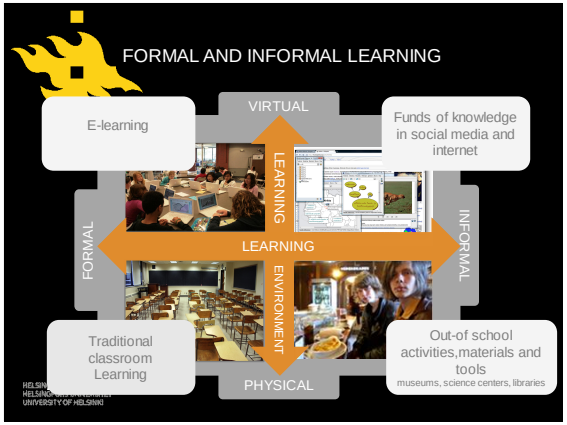
http://www.education-inquiry.net/index.php/edui/article/viewFile/21940/28688

Karl Popper, Science, and Pseudoscience: Crash Course Philosophy

https://www.youtube.com/watch?v=-X8Xfl0JdTQ

When writing your essey, please, refer lecturers and readings, and other used resources

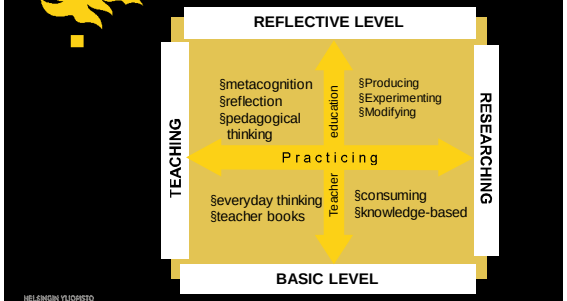
Context of Education



RESEARCH BASED TEACHER EDUCATION

- Teacher education is considered as higher education
- Teaching and learning is based on research
- Teacher educators conduct research
- Teacher students learn research skills as well as conduct research projects while integrating theory and practice in their learning.

TEACHER'S THINKING



HELSINGIN YLIOPISTO
HELSINGFORS UNIVERSITET
UNIVERSITY OF HELSINKI

Technology is integrated

Modern theories of learning *see the learner as central in the creation of meaning*, not the teacher, as the transmitter of knowledge.
(Biggs, 1996)

The philosophy of education (ideal one…?)

- emphasizes the need for learner autonomy and personal growth, empowering students to actively engage in lifelong learning.
- "Education in order to accomplish its ends both for the individual learner and for society must be based upon experience- which is always the actual life-experience of some individual" (Dewey, 1997)

Effective teaching connects learning in a meaningful way to the real life-experiences of students.

A philosophy of education must be based on substantial historical and philosophical foundations and promote technological change without being overwhelmed by such change.

No need to disagree…?

...historical structure of...

Gifted education - from psychology to education

Content:

1. Education of the gifted
2. Expert - novice Paradigm
3. Development of scientific thinking / research evidence
4. Differentiation of teaching (learning strategies) and interventions

Definition of Giftedness

Gifted (?)

Talented, Hochbegabung, begåvad, …
(gifted = naturally talent…or motivation, persistence)

…continuities in different capacities…

how to find the limits, from where giftedness starts
(psychometrics …???)

culturally bound

….use of descriptive words, causes preconceptions and beliefs

often defined by means of other concepts...

What is the most gifted fish…?

Clownfish

Shark

Bichir

https://www.youtube.com/watch?v=mKxRe0hAQmg

Factors behind early definition of gifted student

- Sir Francis Galton (1869) ”Heriditary Genious”
- Alfred Binet & T. Simon (1900) Task: ”To develop test to find those children who do not benefit from normal schooling”
- Lewis Terman (1916) Stanford-Binet Intelligence Scale
- Leta S. Hollingworth (1926) ”Gifted Children: Their nature and nurture” (à gifted have special needs - odds)
- Sputnik (1957) à ”Total talent mobilization” (groupings, differentitation, to grade skipping, accelaration…)

Gifted education ß Intelligence

Intelligence (understanding, insight, realization)
intelligence = gifted

It is conceivable that an intelligent person is most often gifted, but giftedness does not necessarily need intelligence (?)

Intelligence is usually combined with traditional cognitive performance

- General intelligence (g-factor)
- Fluid intelligence (Gf)
- Crystalized intelligence (Gc) - whether that effect. Such a (or x-factors), and if so, what interpretation it represents

The problem disagreements: a) what are the general intelligence measure the components and the importance of, and b) whether the intelligence is comprehensively measurable? (Cf.. Identification & Differentiation).

Measurement of ability, competence

Intelligence tests | Achievement tests | "Any" tests

What is measured

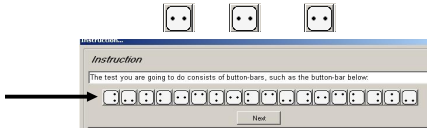
Reaction time

Fluid intelligence	Crystalized intelligence	National Tests (YO)	Multiple choice test

Inspection time

Reaction time –research à The computer-based test

In the this version testee needs to follow with the mouse a bar line from left to right and he or she has to click right positions on that line.



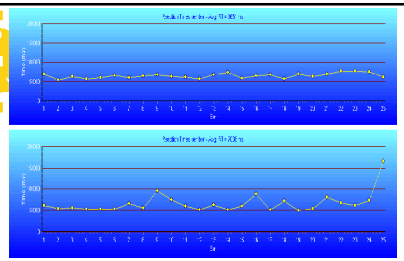
Prerequisities for the test according to the Inhibition –theory

The Attention Concentration Test (ACT), primarily measures attention or more specifically the concentration of attention

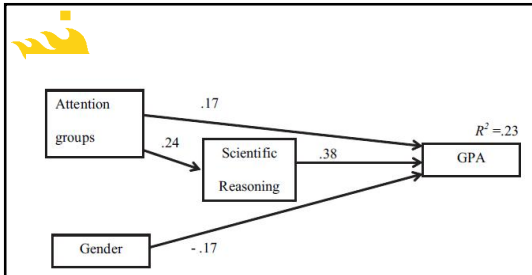
The test is based on the following assumptions:

1. Knowledge should not play a part in the final test score.
2. Individual differences in previous experience with the task should not be allowed (testee needs to get familiar with the task)
3. Temporal moods and feelings should not play part. Therefore, the testee is allowed to do the test as many times as he/ or he wants to.

The test is especially developed as attention-screening test for primary and secondary schools.



Ven, A.H.G.S. van der. (2001). A Theoretical Foundation of Speed and Concentration Tests. In: Frank Columbus (Editor): *Advances in Psychology Research*, *Volume 4*, Hauppauge, NY: Nova Science Publishers.
Shmulevich, Ilya & Ven, A.H.G.S. van der (2002). An inhibition-based stochastic countable-time decision model. *British Journal of Mathematical and Statistical Psychology*, **55**, 17-25.
Ven, A.H.G.S. van der, Gremmen F.M. & Smit, J.C. (2005). A Statistical Model for Binocular Rivalry. *British Journal of Mathematical and Statistical Psychology*, **58**, 97-116.
Ven, A.H.G.S. van der & Gremmen F.M. (2006). A Statistical Test of the Beta Inhibition Model for Binocular Rivalry. *British Journal of Mathematical and Statistical Psychology* (In Progress).



How to calcuate IQ -test

Example kindergarten:

In the test situation of each child authorized to perform the given tasks

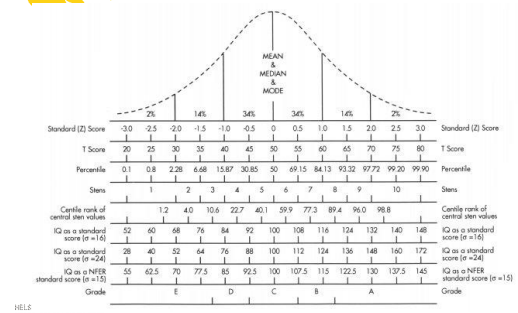
Each task corresponds to 1,5 months

"If 3 ½-year-old is able to perform all the tasks required to reach his or her age level and in addition he/she will perform the tasks of *drawing the square* and *the construction of the tower* (the next two tasks), add another 2 x 1.5 months (= in all 3 months) developmental age is thus formed 3 years 9 months (in all 3 x 12 + 9 = 45) .

$$IQ = \frac{\text{developmental age } 45 \times 100}{\text{chronological age } 36}$$

37

IQ-scores



38

Legacy of Luis Terman (Genetic studies of Genious)

The children included in his studies were colloquially referred to as "Termites".The gifted children thrived both socially and academically. In relationships, they were less likely to divorce.

Additionally, those in the gifted group were generally successful in their careers: Many received awards recognizing their achievements. Though many of the children reached exceptional heights in adulthood, not all did.

He naively assumed that his high IQ kids (nearly all white) would become the future leaders of science, industry, and politics.

His son Fredrick greatly expanded the science, statistics and engineering departments that helped catapult Stanford into the ranks of the world's first class educational institutions, as well as spurring the growth of Silicon Valley.

39

Marland report (1972)

à societal meaning of education

education programs. The definition established by th
reads:

Gifted and talented children are those identified by pro
persons who by virtue of outstanding abilities, are capable o
These are children who require differentiated educational pr
ices beyond those normally provided by the regular school p
realize their contribution to self and society.

Children capable of high performance include those with de
ment and/or potential ability in any of the following areas, s
tion:

1. general intellectual ability
2. specific academic aptitude
3. creative or productive thinking
4. leadership ability
5. visual and performing arts
6. psychomotor ability.

It can be assumed that utilization of these criteria for identi
and talented will encompass a minin

The following persons in addition to Marland report are taken the talent of the theory and a definition of its current content:

Renzulli (1978)
Gagne (1985) gifted à talented
Tannenbaum (1994) performers and producers
Gardner (1983, 1997) multiple intelligences
Sternberg (1985, 1997, 2003, 2008) development of information process

à There are a number of different theories which define giftedness in different way

Lahjakkuusmalli by Sternberg (Wisdom, intelligence, creativity, synthesized) = WICS

Creativity = producing new ideas

Analytical thinking = to know and understand, to evaluate quality of ideas and their usefulness

Practical intelligence = to apply, utilze, ideas and convince others

Wisdom ensures that decisions and execution produce common good

How to measure

	verbal	quantitative	figural
analytical	Learning concepts	Number series	matrix
creativity	Funny analogies / metaforas	New counting rules	Relationships between figures
practical	Solution of social situations	Algorithms (IKEA), recipes	Map reading / walking (pokemon)

Sternberg (2000; 2003) Theory of Developing Expertise / Successful Intelligence

…about gifted education

à The study of intelligence is no longer interested in the final result but a process.
à Success in intelligence tests correlates school performance
à However, there is no clear evidence between IQ and success outside of school

Intelligence can be broadly thought to represent the quality of thinking, which is valued in the environment (cf.. Gardner)

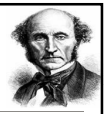
People adapt to their environment by means of their own experiences
à direct operations in their own information, relaying on their capabilities and strengths
à challenging learning situations that contribute to the adaptation
à gradually this lead appreciation of the exceptional know-how

Extreme adaptation to their environment

https://www.youtube.com/watch?v=mKxRe0hAQmg

2. Expert - novice Paradigm

1. Stories of child prodigies



1.1 John Stuart Mill

John Stuart Mill (1806 - 1873) was an English philosopher and economist. He is best known as the utilitarian godfather moral theory, a developer of Jeremy Bentham's ideas.

Father James Mill as a teacher: Subjects and principles of teaching

3 y-o. à the Greek language. Father had written cards, word lists, where the Greek word received an English interpretation.

6 y-o. à Translation exercises from Greek to English. After Aisopos's fairy tales he read in mm. Xenopfon, Heródotus, Diogenes

à Then they moved to a more demanding: a boy got into Plato's six dialogues. "Theaitetus" was perhaps too much for a little boy (James noted) incomprehensible.

à Father James Mill wrote the History of British India at the same when education took place. He was fully committed to teach his son (Mill 1960, 4)

In addition to the Greek John Stuart studied arithmetic.

à 8 y.o. began in Latin. Roman literary classics: Virgil, Horatiu, Liviusta, Ovidiu and Cicero.

- à Mathematics: basics of geometry and algebra and then shift to differential and integral calculus.
- à Hobby: history of Rome (in English).

à 10 y.o. John Stuart begun to work as his father's co-worker. A critical analysis of both India and in England societies and institutions work an introduction to social research.

- à Getting to know the physics and chemistry began with the actual science journals, which told the latest experiments.
- à However, the higher on the agenda was addressing logical thinking, which began about 12 age.
- à Usually days ended to long walks and discussions about today's topics and learning

When John was 14-years-old, father sent him to France (education was finished).

After returning he was an independent researcher. Satisfied with the given education à everyone could achieve the same results

1.2 George Bidder (calculating prodigy)

Mental calculations:

a) At age of 9. 7953 x 4648 =,

b) Snail 8 travels feet per day, how long it takes to travel through England?

c) 257 689 435 x 356 875 649 = (13min)

got a private promoters and reached the University at age of 14, after graduation worked as an important architect (marine, rail, port) and design engineer

1.3 Wolfgang Amadeus Mozart

At 5 years of age: presentations, which stunned the audience

His giftedness was taken as granted

- The father first author of the western music book (Mozart was tested Jr. holds)
- By that time everything he did was consider as exceptional. It was stated that he was competent on piano and violin under 10 years of age.
- Today most piano and violin students exceeds his skills.
- First compositions came early but there were not that remarkable
- Only after 20 000 - 30 000 hours practice became the first masterpiece

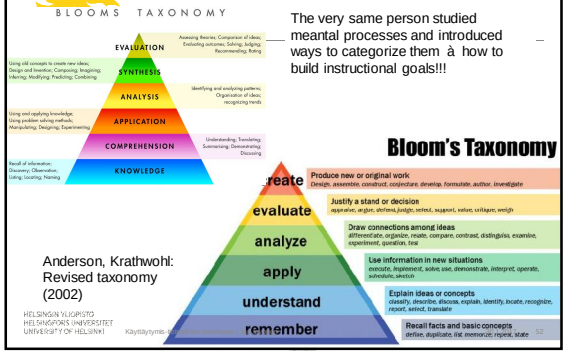
2. Research on expertise

1. ***Bloom (1985) retrospective research of world class top performers (n=120)***
   - à *Pointed the power of environment in developing such oustanding performers*
   - à *Need opportunity, practice, support, effort and inherent ability*

Before school age	8-12	12 à
- Learned something special - Private lessons / - Exercises - Model (father)/ - Enjoyment	- Focus on your art begins - competitions / performances become important - goal setting!!	- Fast development / need of external high quality help - Competitions, tests, and presentations provide information where to go à need of objective information - self-monitoring - Intensive training begins(15-25h/week)

External control → Internalization → Internal control

Bloom, B. & Kratwohl, D. Taxonomy of educational objectives: Handbook I: The cognitive domain.



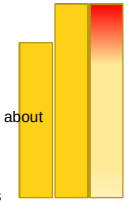
Anderson, Krathwohl: Revised taxonomy (2002)

The very same person studied meantal processes and introduced ways to categorize them à how to build instructional goals!!!

2. Ericsson: Theory of Deliberate Practice (1993, 1996, 2006, 2009)

Explored the reasons why some top performers are better than others
- Found three different groups
a) those who train 15-20h / week,
b) those who train a lot (x > 20h or more week), and
c) those who train a lot (x > 20h or more week), including more hard training

à first group of musicians ended up as teachers
à the second group received the profession and rose to the national level
à third group reached a peak level (international).
Differences between 2nd and 3rd group: Group 3, trained about 15-30min more intensively every day (3-5h / week).



These exercises develop the most cutting-level.
They also slept most when compared to other two groups

We need to first study on performance, and when we know it is time to concentrate on on learning (Nevell & Simon, 1972)

3. Research on expert problem solving

A summary of the results (Glaser, 1988)

Chi & Glaser, Farr 1988)

1. Experts have peaks only in their own field
2. Experts find meaningful connections to their own field
3. Experts are fast (they carry out their functions almost flawlessly).
4. The experts have excellent short-term and long-term memory.
5. Experts see and show the area of expertise related problems more deeply.
6. Experts are spending more time analysing the problem in terms of quality.
7. The experts have excellent activity for your checking and monitoring skills

Implications of expertise research

- Development paths should be traced (what is the optimum, where we are now and what is the next level of development?)
- The design of learning environments should take advantage of what expert study has been found
- The change in beliefs, how we should use gifted concept
  - à is there inborn talent and if yes, how we should support it
  - à support for each strength
- External support and help-seeking are in central role when developing strenghts and competencies
- Goal setting, guided thinking and action planning (monitoring, control, teaching strategies, and support for self-direction) are essential
- teaching self-regulatory mechanisms (self-regulation strategies)

Development of scientific thinking

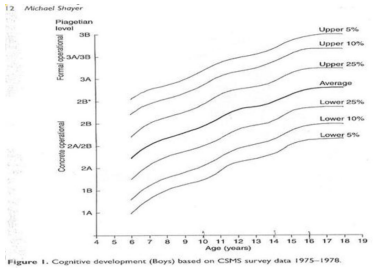


Figure 1. Cognitive development (Boys) based on CSMS survey data 1975–1978.