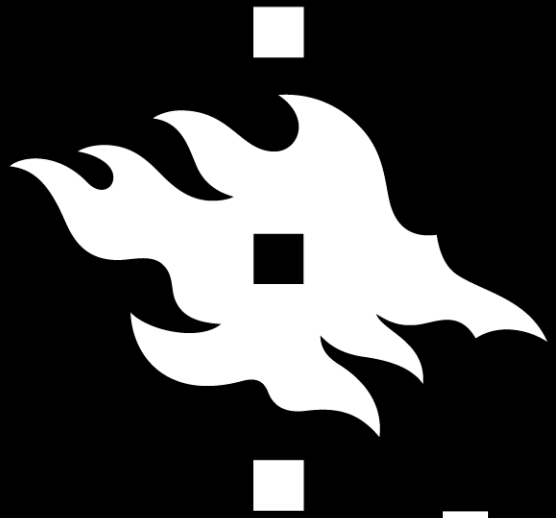

HELSINGIN YLIOPISTO
HELSINGFORS UNIVERSITET
UNIVERSITY OF HELSINKI

Early Mathematical Skills Learning and Learning Difficulties: Evidence-Based Assessment and Interventions

Pirjo Aunio
Professor, Special Education, University of Helsinki, Finland

Visiting Professor, University of Oslo, Norway
Visiting Professor, University of Johannesburg, South Africa

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Introduction of me

PhD Special Education (Beijing, Singapore, Helsinki)
1998-2006

- Development of early mathematical skills and mathematical learning difficulties
- Early Numeracy Test standardization
- Mathematics and Thinking skills interventions
- Children aged 3-8 y.
- Working memory

Researcher and project manager in Niilo Mäki Institute, University of Jyväskylä 2006-2010

- Development of early mathematical skills and mathematical learning difficulties
- Computer based interventions for children with mathematical learning difficulties
- Assessment tools (math learning)
- Research based web-base for educators, psychologists and parents www.lukimat.fi (funded by the National Ministry of Education and Culture)

University Lecturer and Professor in University of Helsinki
2010-present

- Interventions for children with mathematical learning difficulties
- Research based web service for educators ThinkMath (http://blogs.helsinki.fi/thinkmath/)
  - Johannesburg, South Africa
  - Oslo, Norway
- Mathematical skills development and related motivational and well-being factors
- Age group 9-16 y.: screener, test and interventions

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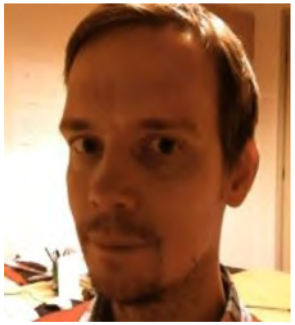
Our research group in Helsinki & Oslo & Johannesburg



Johan Korhonen

Minna Törmänen

Riikka Mononen

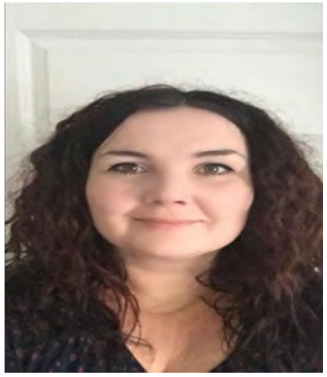
Markku Niemivirta

Lara Ragpot

Anna Tapola

Ulrika Ekstam

Heidi Hellstrand

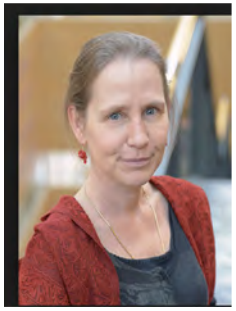


Anita Lopez-Pedersen

Elizabeth Henning

Eija Väisänen

Henrik Husberg

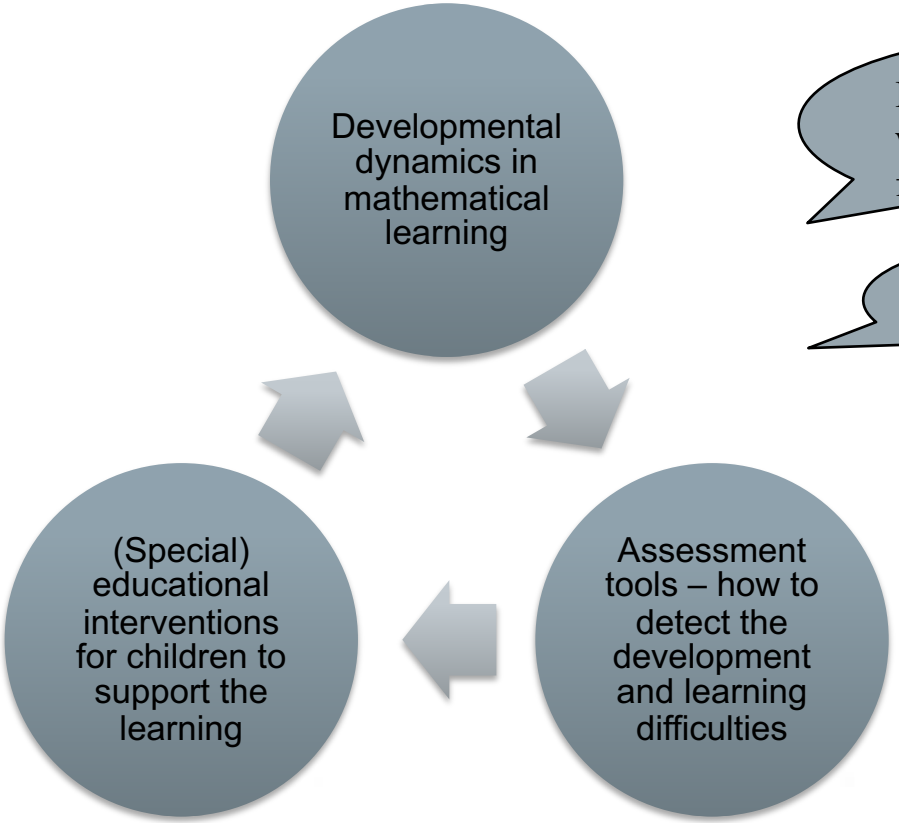


Renee Speyer

Sangwon Yoon

Airi Hakkarainen

Why it is so hard for some children to learn math?



Interest, motivation, well-being, executive functions

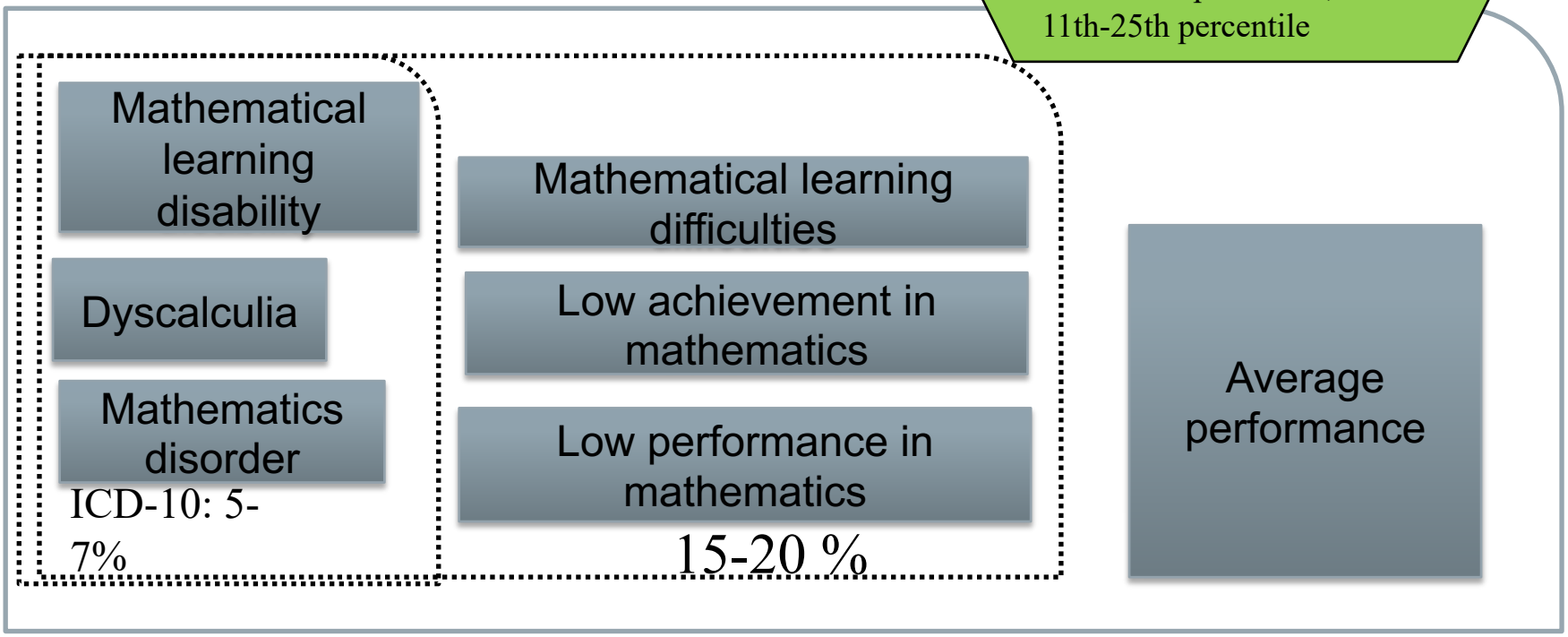
Age of students 5-18 years

To make learning easier for those who struggle -> EDUCATORS ARE IMPORTANT

Children with special educational needs in mathematics

(Aunio, 2014)

Geary (2013) : 2 concecutive years, MLD under 10th percentile; LA 11th-25th percentile

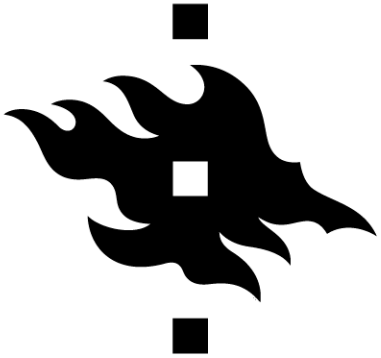


Intensity, specifity and time needed grows

Berch & Mazzocco 2007,
Geary 2013; Price & Ansari 2013

Topic of today

Topic	Other groups	Aunio et al. group
Models of development	Fritz et al. 2013 Krajewski & Scneider 2009 Clements & Sarama 2009 Steffe 1992 Wright et al. 2006	Core Factor Model 5-8 years Core Factor Model 9-12 y
Assessment		Early Numeracy LukiMat-screeners CodyTest
Interventions		ThinkMath-interventions



Research into

DEVELOPMENT OF MATHEMATICAL SKILLS

Attempts to model mathematical development in age group 5-8 years

- Fritz et al. (2013) constructed a hierarchical framework of competences grounded on earlier theoretical and empirical findings (average performing)
- Krajewski and Schneider (2009) presented a theoretical idea about the transition from a procedural to an increasingly conceptual understanding of number words via three levels (average performing).
- Sarama and Clements (2009) is based on theory and research on early childhood learning and teaching, with a focus on children's learning trajectories (average performing)
- Steffe's (1992) framework has a constructivist view on learning and was based on individual children's mathematical development (average performing)
- The Steffe's framework was a starting point for Wright et al., (2006), whose model has been used for providing individual support for low-performing children

Our aim was

- What are the most important numerical skills for children aged 5-8 years old? (so that no mathematical learning difficulties will appear later)
- An evidence-based model for educators to help to work with young children who are at risk for learning difficulties

Aunio & Räsänen (2015)

- We solved the problem:
  - Longitudinal studies 2000-2015
  - Assessment batteries:
    - should be published with norms
    - used by educators
    - Focus on multiple mathematical skills relevant in this age group of children
    - Not curriculum depended

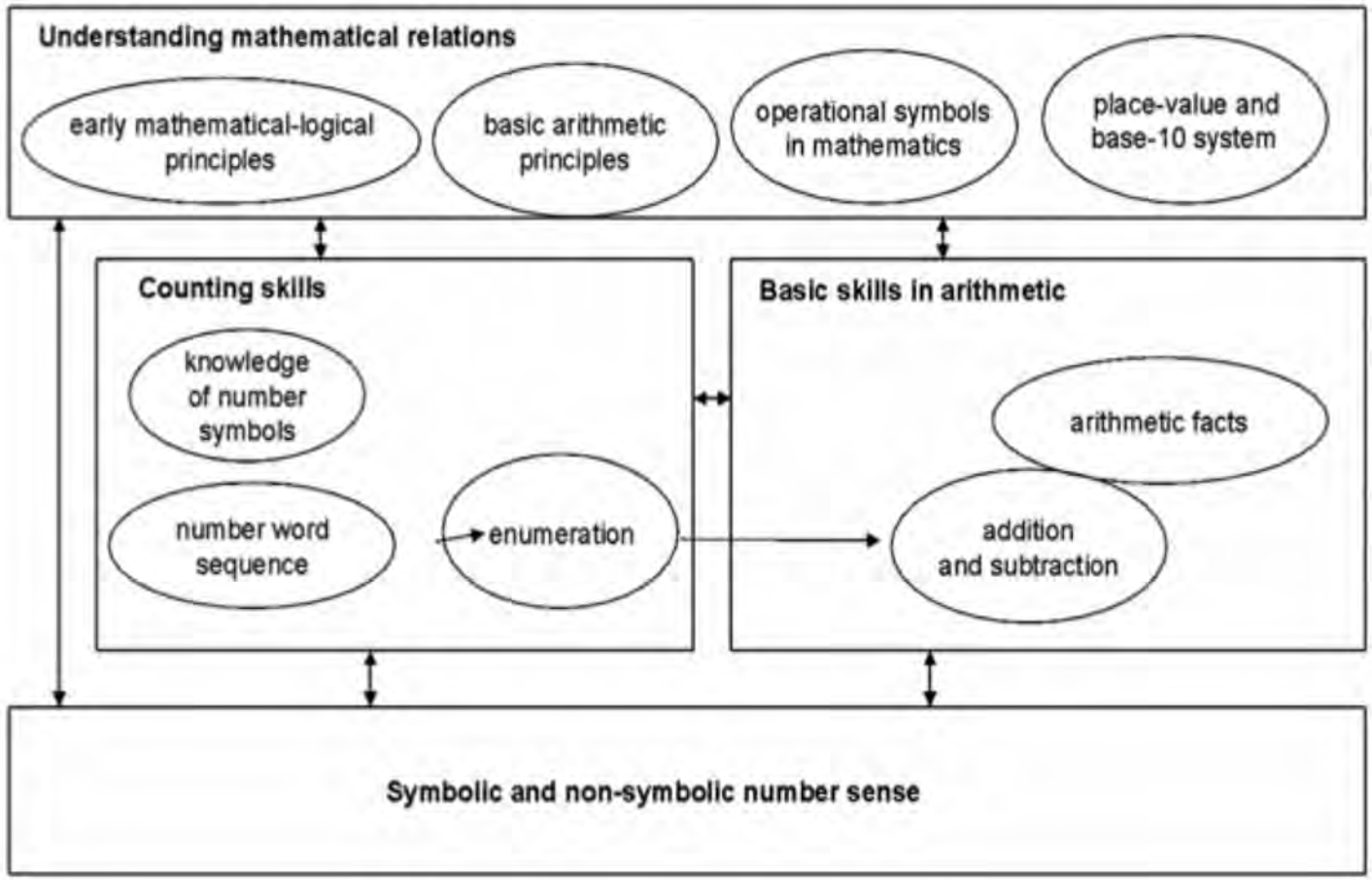
    1) Utrecht Test of Early Numeracy (Van Luit et al)
    2) Number Knowledge Test (Griffin 2003)
    3) Early Numeracy Test (Wright et al. 2006)
    4) Test of Early Mathematics Ability (Ginsburg & Baroody 2003)

Development of mathematical skills 5-8 years old children

European Early Childhood Education Research Journal
Publication details, including instructions for authors and subscription information:
http://www.tandfonline.com/loi/recr20

Core numerical skills for learning mathematics in children aged five to eight years – a working model for educators

Pirjo Aunio[a] & Pekka Räsänen[b]
[a] Department of Teacher Education, University of Helsinki, Helsinki, Finland
[b] Niilo Mäki Institute, University of Jyväskylä, Jyväskylä, Finland
Published online: 12 Jan 2015.


Understanding mathematical relations
early mathematical-logical principles
basic arithmetic principles
operational symbols in mathematics
place-value and base-10 system
Counting skills
knowledge of number symbols
number word sequence
enumeration
Basic skills in arithmetic
arithmetic facts
addition and subtraction
Symbolic and non-symbolic number sense

Nonverbal number sense (1)

- Operationalized: Subitizing, pattern recognition, magnitude comparison (some sort of sense making of numerical magnitudes)
- Number sense (two ways to use):
  - Educational scientists: A mélange of skills learnt before formal education (e.g., counting, number patterns, magnitude comparisons, estimating and number transformations) (Jordan, et al. 2007)
  - Neuroscientists: restricted to concept to cover only those numerical abilities that are common to animals and humans from infants to adults (e.g., approximate reprensentation of magnitude) (Dehaene, 1997/2011; Lipton & Spelke 2003)

-> number sense lays a foundation for learning formal mathematical concepts

Nonverbal number sense (2)

- Weakness in number sense

  - crucial role when difficulties in mathematical learning (Mazzocco, Feigenson & Halberda 2011a; Price & Ansari 2013)

    - Prediction power (approximate number system) to later learning of mathematical skills (Libertus, Feigenson & Halberda 2011; Mazzocco, Feigenson & Halberda, 2011b)
    - Mental representation of the magnitude of symbolic numbers or representation of non-symbolic magnitudes (De Smedt, Nöel, Gilmore & Ansari, 2013)

Understanding mathematical relations (1)

- Quantitative and non-quantitative relationships

I Mathematic-logic principles:

- Seriate (Bryant, 1996)
- Numerically compare two sets (Sophian 1998)
- Classify (Smith, 2002)
- One-to-one correspondence (Alibali & DiRusso, 1999)

Understanding mathematical relations (2)

II Basic-arithmetic principles,

often the understanding of part-whole relations in addition or subtraction tasks (Canobi, Reeve & Pattison 2002; Wilkins, Baroody & Tiilikainen 2001):

- additive composition principle: understands that the larger sets are made up of smaller sets
- Commutativity understanding: knows that enities added can be added in a different order and still have the same answer a+b=b+a
- Associativity understanding (i.e., decomposition, transforming strategy): knows that even if the sets are decomposed, and recombined in different order, they have the same answer, (a+b)+c=a+(b+c)
- Inversion: understanding the relationship between two different operations such as that addition and subtraction rule each other out, knowing the results in addition can be used to solve the subtraction problem (Robinson, Niowski & Gray, 2006)

Understanding mathematical relations (3)

III Understanding operational symbols in mathematics:

- less than (<)
- more than (>)
- equal to (=)
- not equal to (≠)

Understanding mathematical relations (4)

- IV Understanding place-value and base-10-system
  - Understanding of meaning of e.g., ones, tens and hundreds in the base-10 system
    - The number symbols have different value depending on the place they occupy in the series of numbers
    - The ability to match verbal labels to Hindu-Arabic numerals (i.e.. Number sequence skills) appears generally to precede single- and double digit comprehension, but the findings suggest that in the acquisition of place-value knowledge, there is also non-verbal numerical knowledge involved (Donlan & Gourlay 1999)

Counting skills (1)

- I knowledge of number words and symbols
  - Learning the number words
    - If culture does not have symbols representing exact quantities, without number words and tradition of counting, even adults are not able to do simple imitation or copying (one-to-one correspondence) tasks accuratey (Gordon, 2005; Pica et al. 2005)
    - Symbol-verbal and verbal-symbol transitions = word identification and recognition of numbers (e.g. choose number in VanDerHeyden et al. 2006)

Counting skills (2)

- II Number words sequence skills (NWS, synonyms often acoustic counting, reciting number words, counting) (VanDerHeyden et al. 2006; Clarke and Shinn 2004)
  - NWS-skills include:
    - ability to say number words forward and backward
    - by skipping for instance by twos, fives and tens
    - Saying number words forward and backwards from a given number

Counting skills (3)

- III Enumeration (often counting the numerosity of a set, counting, cardinal meaning of number, counting objects)
  - Child uses her/his number word sequence skills to enumerate (Aunio & Niemivirta 2010; Jordan et al. 2006)
    - To say NWS in correct order
    - To be able to create the one-to-one correspondence between number words and items to be counted + between number words and a marking act + between the marking act and items to be counted
    - To understand that the just named number word states the numerosity of the set
    - To know that objects of any kind can be collected together and counted
    - To know that objects of any kind can be collected together and counted and that items within a given set can be tagged in any sequence.

Development of counting skills

App. age	Phase	Skills
2 y.	Primary understanding of amounts	different number words refers to a different number of objects, only very basic discrimination of amounts
3 y.	Acoustic counting	say number words but not in correct order
4 y.	Asynchronic counting	Say number words in correct order and point to objects, pointing is not coherent
4,5 y.	Synchronic counting	Can recite number words and mark the counted objects correctly, by pointing or moving
5 y.	Resultative counting	Can say number words correctly starting with one, understand that countable objects should be makers one, last said number word indicates the number of objects
5,5 y.	Shortened counting	Recognize the figure five, for instance and can continue counting upwards from that

Basic Skills in Arithmetic

- At this age group mastering addition and subtraction with number symbols have been covered
  - Three types of tasks:
    - The question is presented verbally and manipulative or pictures are used to ease the memory load so that children can point to the correct answer from couple of possibilities.
    - Some or all of the items are unscreened (i.e., covered).
    - Only verbal prompts are used; the question is asked or shown in written form.
- The difficulty level depends also on the magnitude of numbers used in the tasks.

Aunio, P., Laine, A. & Räsänen, P. (manuscript in preparation)
Development of mathematical skills in 9-12 years old children

The aim of the study & method

- What are the core skills in mathematical development in grades 3-6 (9-12 years)?
- Phase one:
  - Review of existing assessment batteries for children's mathematical skills in grades 3-6 (9-12 years)
  - categorizing the skills measured
- Phase two:
  - Review of longitudinal studies measuring children's math skills in grades 3-6 (9-12 y.)

Phase one – “data”

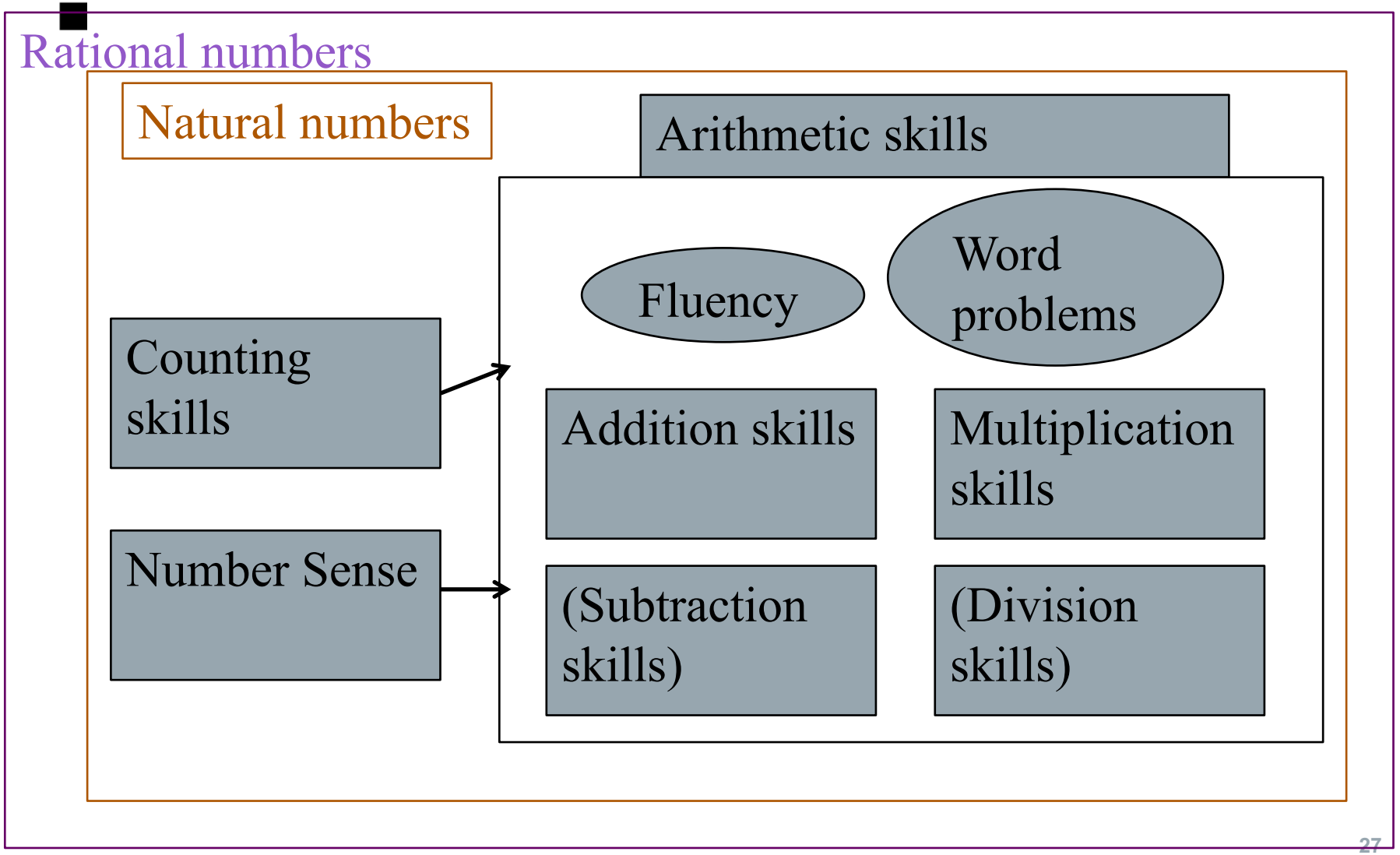
Finnish

1. Räsänen (2005) Banuca. Lukukäsitteen ja laskutaidon hallinnan testi. 7-9 years old children.
2. Räsänen (2004) RMAT. 9-12 years old children.
3. Häyrinen, Serenius-Serve & Korkman (2013) Lukilasse-2. 7-12 years old

International

1. Butterworth (2003) Dyscalculia Screener. 6-14 years.
2. Woodcock, McGrew & Mather (2001; 2007) Woodcock-Johnson Test of Achievement. 2-90+ years
3. Von Aster, Weinhold Zulauf & Horn (2006) ZAREKI-R (n 7-16 y.) leerjaar 3-> 2 klas voortgezet onderwijs

Potential core skills in mathematics in age group 9-12 years



Evidence-based

ASSESSMENT BATTERIES IN MATHEMATICS

Recent development with early numeracy assessment

- Long & brief measurement
- Curriculum Based Measurments (CBM)
- Computer assisted assessment

Long and Brief measurement

- To indentify young children with mathematics difficulties
- Test & screeners
- Jordan et al. 2006 (long) , 2007 (brief)

Counting	One-to-one correspondence Knowing stable order and cardinality principles Knowing the count sequence
Number knowledge	Discriminating and coordinating quantities
Number transformations	Transforming sets through addition and subtraction Calculating in verbal and nonverbal context Calculating with and without referents (physical or verbal)
Estimation	Approximating or estimating effect sizes Using reference points
Number patterns	Copying number patterns Extending number patterns Discerning numerical relations

Long and Brief measurement

- Screening + more information

Author	Name of the test
Purpura et al. (2015)	Preschool Early Numeracy Skills Screener-Brief
Weiland, Wolfe, Hurwitz, Clements, Sarama & Yoshikawa (2012) & Clements, Sarama & Liu, (2008)	The Research-Based Early Maths Assessment (REMA)
Siebert & Brendefur 2018 (Brenderfur et al. 2015; Brendefur, Strother & Thiede, 2012)	The Primary Math Assessment (PMA) (PMA-Screener; PMA-Diagnostic (number sequencing, operations (number facts) contextual problems, relational thinking, measurement and spatial reasoning)

Curriculum Based measurements

- To inform instruction and interventions

Authors	Name of test battery
Starkey, Klein & Wakeley 2004	The Child Math Assessment (CMA)
Polignano & Hojnoski 2012	CBM tasks for preschoolers (Cardinality, Pattern Completion, Shape Naming Fluency, Shape Selection Fluency, Shape Composition)
VanDerHeyden, Broussard & Cooley 2006	CBM preschool (Count objects, Choose number, Discrimination, Number naming, Free count)
Laracy, Hojnoski & Dever 2016	IGDIs-EN (Individual Growth and Development Indicators – Early Numeracy (Quantity comparison, Oral counting, One-to-one correspondence)
Lee 2016	Birthday Party (Number and operation, Shape, Space and Pattern) (short + long)
Conoyer, Foegen & Lembke 2016	Early Numeracy Curriculum Based Measurement (CBM) (Quantity Discrimination, Measurement)
Clarke & Shinn 2004	CBM measurement (Oral counting, Number Identification, Quantity Discrimination, Missing number)
Lee & Lembke 2016	CBM (quick retrieval, written computation, number sense)
Lembke, Lee, Park & Hampton 2016	CBM (Counting, Number Identification, Missing Number, Quantity Discrimination, Number Facts

Curriculum Based measurements

- Progress monitoring

  Lei, Wu, DiPerna & Morgan 2009:

  - EARLI (Early Arithmetic, Reading and Learning Indicators) Numeracy Measures (Numbers and Shapes, Measurement)

Evidence based test and screeners (Finnish teachers)

Test/Screener	Skills	Age group	Authors/source
Lukukäsitetesti (Early Numeracy Test) (Fin)	Math relational skills & counting skills	4-7 years	Van Luit, Van de Rijt & Aunio, 2006, Hogrefe Psykologien kustannus)
LukiMat-scales (Fin/Swe)	Number sense, math relational skills, counting skills, basic arithmetic skills	K-2 graders	www.lukimat.fi oppimisen arviointi
BANUCA (Fin)	number knowledge, arithmetic skills	1-3 graders	Räsänen (2005), Niilo Mäki Insitituutti
RMAT (Fin/Swe)	Arithmetics skills (Fluency)	3-6 graders	Räsänen (2004), Niilo Mäki Insitituutti
MATTE (Fin)	Word problem solving	4-5 graders	Kajamies, Vauras, Kinnunen & Iiskala (2003)Turun yliopisto, Oppimistutkimuksen keskus
KTLT (Fin/Swe)	Arithmetic skills (application)	7-9 graders	Räsänen & Leino, (2004) Niilo Mäki Insitituutti

Scandinavian Journal of Psychology

The Early Numeracy Test in Finnish: Children's norms

PIRJO AUNIO[1], JARKKO HAUTAMÄKI[1], PEKKA HEISKARI[2] and JOHANNES E. H. VAN LUIT[3]

Article first published online: 21 SEP 2006

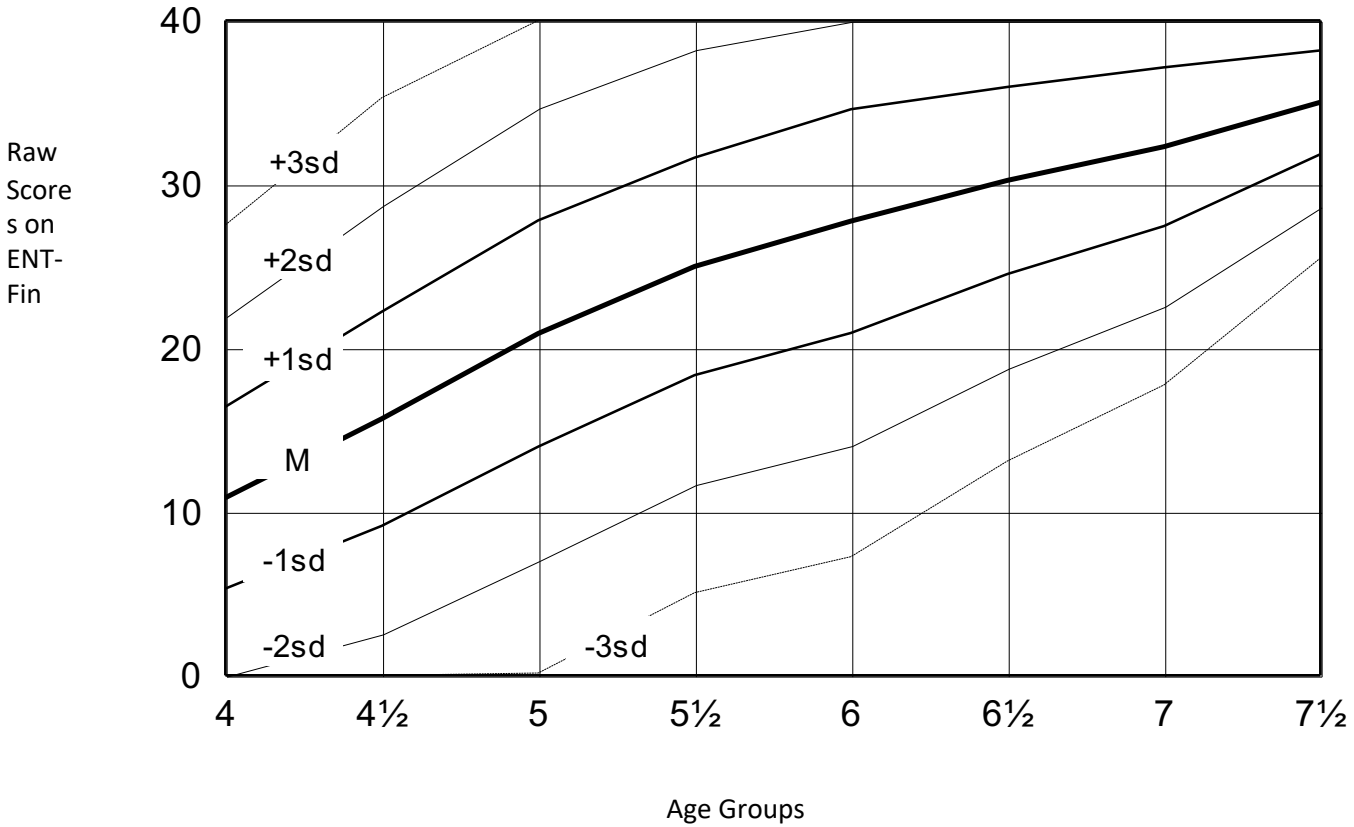
DOI: 10.1111/j.1467-9450.2006.00538.x

Issue

Scandinavian Journal of Psychology

Volume 47, Issue 5, pages 369–378, October 2006

Early Numeracy Test (4 – 7 y. 6 m.)



Aunio, P., Hautamäki, J., Heiskari, P. & Van Luit, J.E.H (2006) The Early Numeracy Test in Finnish: Children's Norms. Scandinavian Journal of Psychology, 2006, 47, 369–378


LUKIMAT
Tietoverkkovälitteinen peruslukutaidon sekä matematiikan oppimisvalmiuksien oppimis- ja arviointiympäristö.
Sivukartta | Saavutettavuus | Ota yhteyttä
Etsi sivustolta
Hae
Lukeminen
Tietopalveluun on koottuna tietoa lukemisen kehittymisestä, opettamisesta ja oppimisvaikeuksista sekä tukikeinoja lukemisvaikeuksien ennaltaehkäisyyn ja lukutaidon tukemiseen.
Vanhemmalle-osasta löytyy perustietoa lukemaan oppimisesta ja siinä mahdollisesti ilmenevistä ongelmista.
Materiaalit sisältävät tietoa lukemisen perustaitojen harjoitteluun tarkoitetuista Ekapeleistä sekä pelien latauslinkit.
EKAPELI
Matematiikka
Tietopalvelu-osassa tarjotaan tutkimukseen pohjautuvaa tietoa lasten matematiikan taitojen kehityksestä, oppimisvaikeuksista, taitojen arvioinnista ja tukemisesta.
Perustietoa ja käytännön neuvoja löytyy myös Vanhemmalle-osasta.
Materiaalit-osasta löytyvät tietokoneavusteiset harjoitus- ja arviointimenetelmät Numerorata, Ekapeli–Matikka ja Neure.
NUMERORATA
Ekapeli Matikka
neure
neure
Oppimisen arviointi
Tietopalvelu-osasta löytyy tietoa lapsen oppimisen arvioinnista.
Materiaalit-osasta välineitä lukemisen ja kirjoittamisen sekä matematiikan oppimisen arviointiin.
Oppimisen arviointi
Oppimisen arviointi
Uutiset
Uutta sivustolla:
Puhelintuki on päättynyt, 17.12.2015
LukiMat-tjänstens användarstöd fortsätter, 11.09.2015
LukiMat-palvelun ylläpito jatkuu, 17.07.2015
Ekapelille Nuori Voima-palkinto, 09.06.2015
Opetus- ja kulttuuriministeriö: LukiMat-palvelun ..., 29.05.2015
Kaikki uutiset ja tapahtumat..
LukiMat
Tykkää sivusta
1,9 t. tykkäystä
LukiMat
17. joulukuuta 2015 kello 5:45 - Jyväskylä
Käyttäjätuen puhelinnumero on päätetty sulkea toistaiseksi. Jatkossa tukipyynnöt vain sähköpostilla tai Ekapelipalvelimen yhteyslomakkeella.
NMI NIILO MÄKI INSTITUUTTI
JYVÄSKYLÄN YLIOPISTO
Åbo Akademi
Opetus- ja kulttuuri-ministeriö
Undervisnings- och kultur-ministeriet
Suosittele 241
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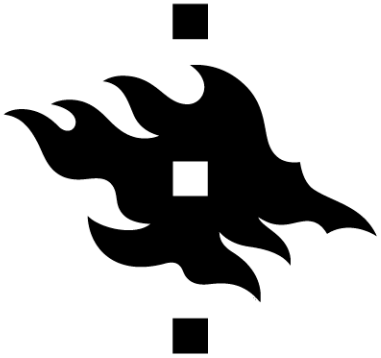
LukiMat- Math assessment

- For educators (kindergarten, first and second grade)
- To be used with group of children (not individually)
- To find those children who are potentially at risk to have problems with mathematics learning (screening)
- Validated and reliable tools (evidence based)
- Easy to use and analyze
- Free of charge
- Finnish and Swedish

LukiMat- kindergarten norms

(http://www.lukimat.fi/lukimat-oppimisen-arviointi/materiaalit/tuen-tarpeen-tunnistaminen/esiopetus/matematiikka/kayttajan-opas/E-mat-kasikirja)

Persentiili	Syksy (n = 563)	Talvi (n = 504)	Kevät (n = 486)	Persentiili
	kokonaispisteet			
100	48	25	27	100
95	·	·	·	95
90	·	·	·	90
85	47	·	·	85
80	·	·	26	80
75	46	·	·	75
70	·	24	25	70
65	45	·	·	65
60	·	23	24	60
55	44	·	·	55
50	42 - 43	·	23	50
45	40 - 41	22	·	45
40	·	·	22	40
35	39	21	·	35
30	37 - 38	20	21	30
25	35 - 36	19	20	25
20	33 - 34	18	19	20
15	30 - 32	17	17 - 18	15
10	24 - 29	13 - 16	14 - 16	10
5	0 - 23	0 - 12	0 - 13	5



Evidence-based

INTERVENTION PROGRAMS IN MATHEMATICS

Recent Development with Early Numeracy Interventions (Aunio, in press)

- High demand of randomized control trials (RCT), large scale interventions and replication studies (e.g. Gersten, Rolfhus, Clarke, Decker, Wilkins & Dimino, 2015)
- Meta-analysis and systematic reviews
- Several meta-analysis including students with learning difficulties in mathematics (Chodura, Kuhn & Holling, 2015; Codding, Burns & Lukito, 2011; Gersten et al. 2009; Jitendra et al. 2018; Kroesbergen & van Luit, 2003; Maccini, Mulcahy & Wilson 2007; Zhang & Xin, 2012) but only few have concentrated on young children (Dennis et al. 2016; Mononen, Aunio, Koponen & Aro 2014)

Aunio, P. (in press) Small group interventions for children aged 5-9 years with mathematical learning difficulties. In Fritz-Strandman & Räsänen International Handbook of Mathematical Learning.

Recent Development with Early Numeracy Interventions (Aunio, in press) (2)

Mononen et al (2014):

- small to average effect sizes in improvement of the early numeracy skills of children aged 4-7 years

- instrucational features:

  * explicit instruction,

  * computer-assisted instruction (CAI)

  * game playing

  * use of concrete-representational-abstract levels in representations of mathematical concepts

Recent Development with Early Numeracy Interventions (Aunio, in press) (3)

Dennis et al. (2016)

- kindegarten level interventions weaker effects than those at elementary level

- students with low performance in mathematics (at or below 35th percentile) – stronger effects than those above 35th percentile

- more effective when conducted by the researcher or research assistant, than by teachers

- instructional features: peer-assisted learning, explicit teacher led instruction (i.e. sequencing tasks from easy to difficult, task analysis), use of technology

- replicates the findings, at least partly in othe meta-analysis (e.g. Baker, Gersten & Lee 2002; Swanson et al. 1999)

Recent Development with Early Numeracy Interventions (Aunio, in press) (4)

- Previous meta-analysis (Chodura et al. 2015; Dennis et al. 2016; Jitendra et al. 2018; Mononen et al. 2012) reported weaknesses:
  - Longitudinall effects of interventions not measured/not reported
  - Identification of children with mathematical difficulties: challenges in selection and outcome measures, cut-off criteria)

Mini review in the beginning of the year 2018

- studies published 2014-2017

- 7 studies (small group, quasi-experimental with control group)

- US

- 3/7 used some kind of radomization, supplementary, children with low performance

- 3 studies: also low income backround (Barnes et al 2016; Dyson et al. 2015; Hassinger-Das, Jordan & Dyson 2015)

Recent Development with Early Numeracy Interventions (Aunio, in press) (5)

- ROOTS was used in 3/7 (Clarke, Doabler, Smolkowski, Baker, Fien & Cary, 2016; Clarke, Doabler, Smolkowski, Kurtz-Nelson, Fien, Baker & Kosty 2016; Doabler, Clarke, Kosty, Kurtz-Nelson, Fien, Baker & Kosty, 2016)
- All 7 studies used standardized measurements (Number Sense Brief Screener, SAT; TEMA-3, WJ-III) but also measurements.designed by research group were used (EN-CBM, ASPENS)
- All 7 studies report significant intervention effects
  - But only 3 reported delayed measurements (lasting effects) (Clarke, Doabler, Smolkowski, Kurtz-Nelson, Fien, Baker & Kosty; 2016; Dyson, Jordan, Baliakoff & Hassinger-Das 2015; Hassinger-Das, Jordan & Dyson 2015)
- Explicit and systematic small group interventions have effects on early numeracy learning of low performing students.

Evidence-based intervention programs (commercial)

Program	Age group	Skills practiced	Authors/source
NalleMatikka (Fin/Swe)	prekindergarten	Math concepts, math phenomena in every day environment	Mattinen, Räsänen, Hannula & Lehtinen (2010) Niilo Mäki Institute
Minäkin lasken!	4-7 years	Numerical relational skills, counting skills	Van Luit, Aunio & Räsänen (2010) Niilo Mäki Institute
Selkis -yhteenlasku	grades 1-6	Addition skills	Koponen, Mononen, Kumpulainen & Puura,(2011) Niilo Mäki Institute
Selkis-vähennyslasku	grades 1-6	Subtraction skills	Koponen, Mononen & Latva (2011) Niilo Mäki Institute
Matte	grades 4-6	Word problem solving skills	Kajamies, Vauras, Kinnunen & Iiskala, (2003) Turun yliopisto, Oppimistutkimuksen keskus.
HoPE – hopeisen pöllön etsintä Salaisten Lukujen valtakunnassa	grades 4-6	Word problem solving skills	Vauras & Kinnunen (2003) Turun yliopisto, Oppimistutkimuksen keskus.
Matematiikan ongelmanratkaisukurssi 6.luokkalaisille	Grade 6	Word problem solving skills	Leppäaho (2004) Helsinki: Sanoma Pro

Evidence-based programs (free for users)

Program	Age group	Skills practiced	Source
Numerorata (Fin/Swe)	5-8 years	Number sense, counting skills, arithmetic skills	www.lukimat.fi and www.thenumberrace.com
EkapeliMatikka (Fin)	5-8 years	Number knowledge, counting skills, addition skills	www.lukimat.fi
Vektor (Fin/Swe)	5-10 years (?)	Number knowledge, addition and subtraction skills, visuospatial skills	http://cognitionmatters.org/fi
ThinkMath (Fin/Engl)	5-8 years	Numerical relational skills, counting skills, arithmetic skills	thinkmathglobal.com

Ministry of Education and Culture is still active….

THINK MATH

- Produce evidence-based ***mathematics and thinking skills*** intervention materials for at-risk children in K-2 Grades
- Materials will be provided for teachers via web service (free-of-cost) http://blogs.helsinki.fi/thinkmath/ or https://thinkmathglobal.com
- Funded by the Finnish Ministry of Education and Culture (2011-2016)
- Math intervention materials:
  - Explicit teaching
  - Several ways to practice
  - Teacher led small groups (4-6 children)
  - Twice a week 45 minutes 8 weeks
  - Counting skills, numerical relational skills, basic arithmetic skills

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Valitse kieli
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A Mathematics intervention for low-performing Finnish second graders: findings from a pilot study

DOI: 10.1080/08856257.2014.922794
Riikka Mononen[a*] & Pirjo Aunio[a]
pages 457-473

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SOUTH AFRICAN JOURNAL OF CHILDHOOD EDUCATION, VOL 6, NO 1 (2016)

Abstract
Introduction
Research methods and design
Results
Discussion
Conclusion
Acknowledgements
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Appendix 1

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Original Research

Counting skills intervention for low-performing first graders

Riikka Mononen, Pirjo Aunio
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Abstract

Background: It is important to provide early educational support for children having weak mathematical skills, in order to prevent possible later mathematical learning difficulties. Currently, there is a lack of research-based mathematical intervention programmes for teachers to use.

Aim: This study investigated the impact of counting skills intervention for Finnish first graders with low performance. In addition, the relations between inductive reasoning, language and mathematical skills were examined.

Setting: This study applied a quasi-experimental design using control groups.

Methods: Intervention was provided in small groups 12 times during 8 weeks. The development of intervention children (LOWi, n = 11) was compared to the development of low-performing (LOWc, n = 26) and typically performing (TYPc, n = 114) children.

Results: The LOWi group made significantly greater gains in their mathematical performance from Time 1 to Time 2, compared with the LOWc and TYPc groups. Children with low performance in mathematical skills showed lower performance also in their inductive reasoning and reading fluency skills than the TYP children.

Conclusion: A relatively short counting skills intervention that applied explicit teaching showed promising effects in improving low-performing children's mathematical performance as a supplemental instruction.

Adolescents

LEARNING DIFFICULTIES, PERCEIVED LEARNING DIFFICULTIES AND EDUCATIONAL DROP OUT

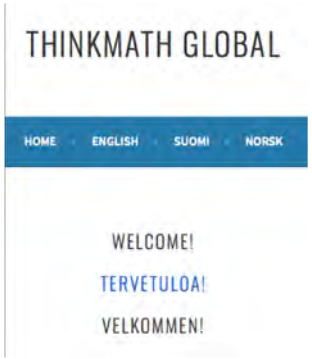
Aim: We were interested in what kind of performance and well-being profiles would be found in grade 9 students and how these profiles are related to dropout

Statistical analyses: Latent profile analysis chi-square

1. What kind of academic performance (mathematics and reading) and well-being profiles can be identified among grade nine students?
2. How do students with different academic performance and well-being profiles differ with respect to educational dropout rates in secondary education?

To sum up: Why evidence based tools are important?

- Understanding the learning of mathematical core skills
  - with research knowledge we can understand and make estimations (e.g. educational interventions)
- Proper identification of those children who have difficulties in learning
  - Accurate measurements rather than lottery (Get rid of bad measurements)
  - Economically (Society) and individually important
- Intervention
  - Targets the most important skills,
  - Most efficient ways to teach and practice
- Prevent educational drop-out



Let's collaborate and make the world better place for all children
- no need for extra suffering with math learning

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