

The Results of Student Achievement Monitoring in Primary School in the Context of Educational Environment

Ekaterina Enchikova, Elena Kardanova

National Research University Higher School of Economics
(Russian Federation)

enchikova@mail.ru, ekardanova@hse.ru



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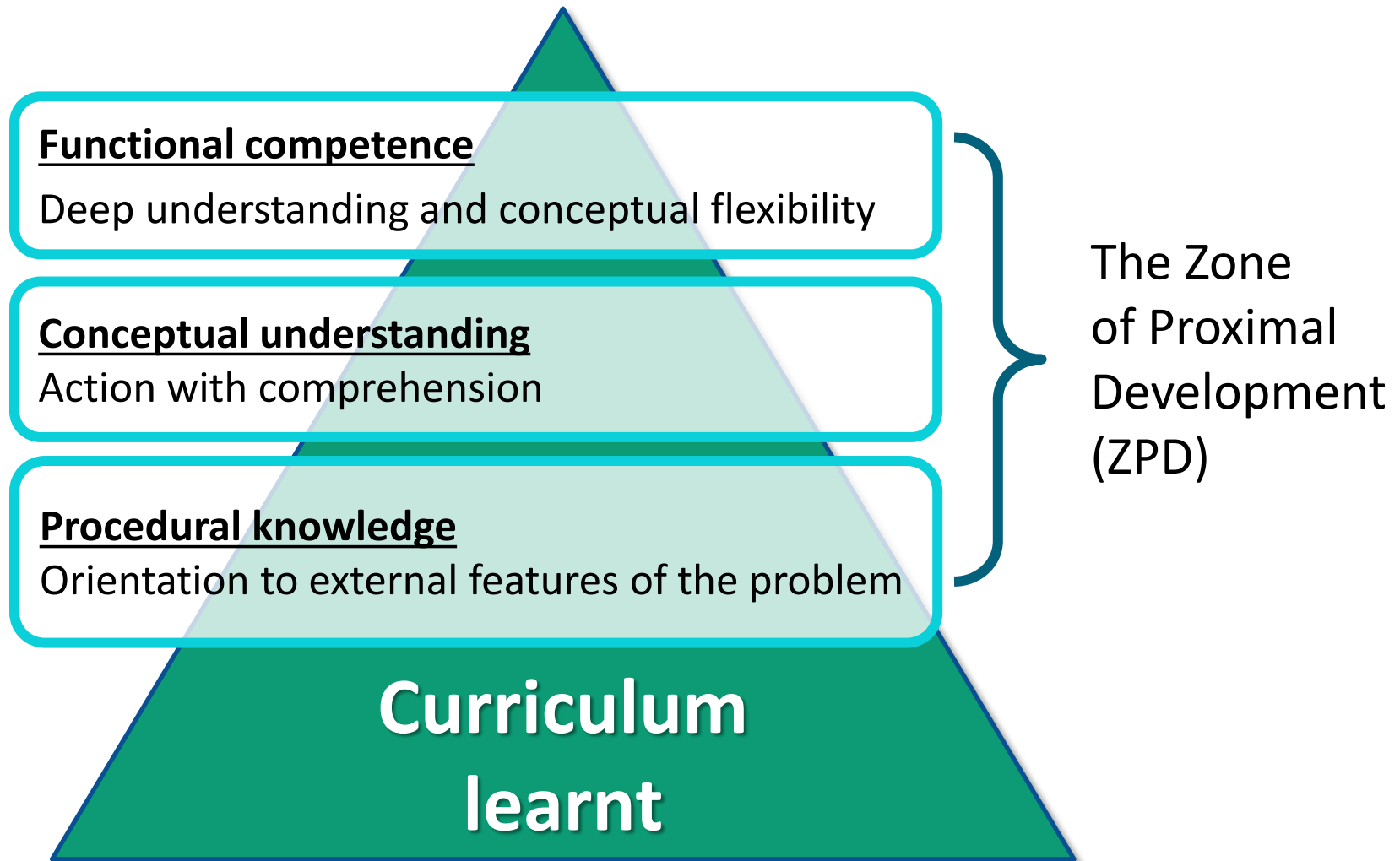
Singapore, 2014

SAM purpose: assessment of subject competences of primary school students in mathematics and Russian language

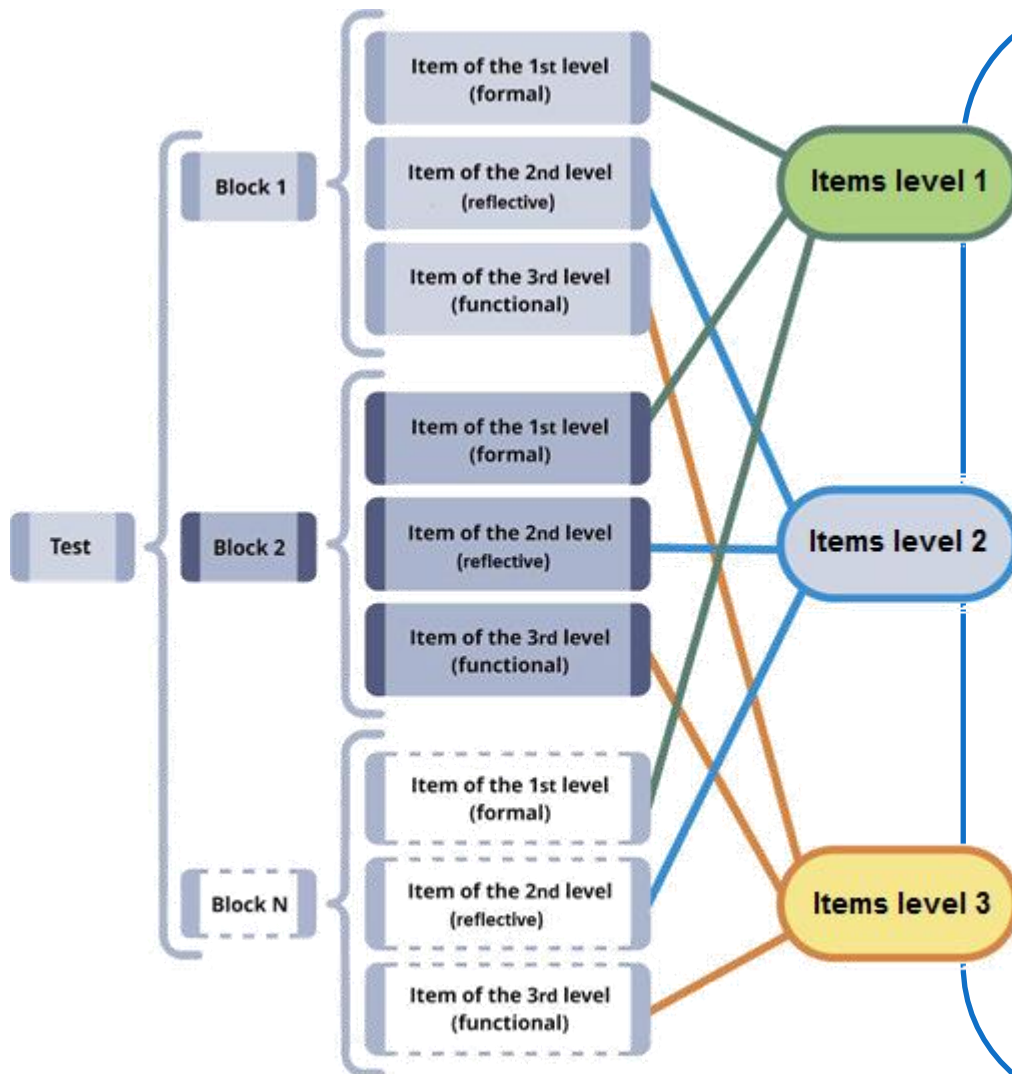
Theoretical framework: teaching/learning process concept based on L.S. Vygotsky's ideas

Primary school in Russia corresponds to the ISCED level 1. By the end of primary school children are 10-11 years old.

Multi-level model for assimilating subject content



SAM test structure

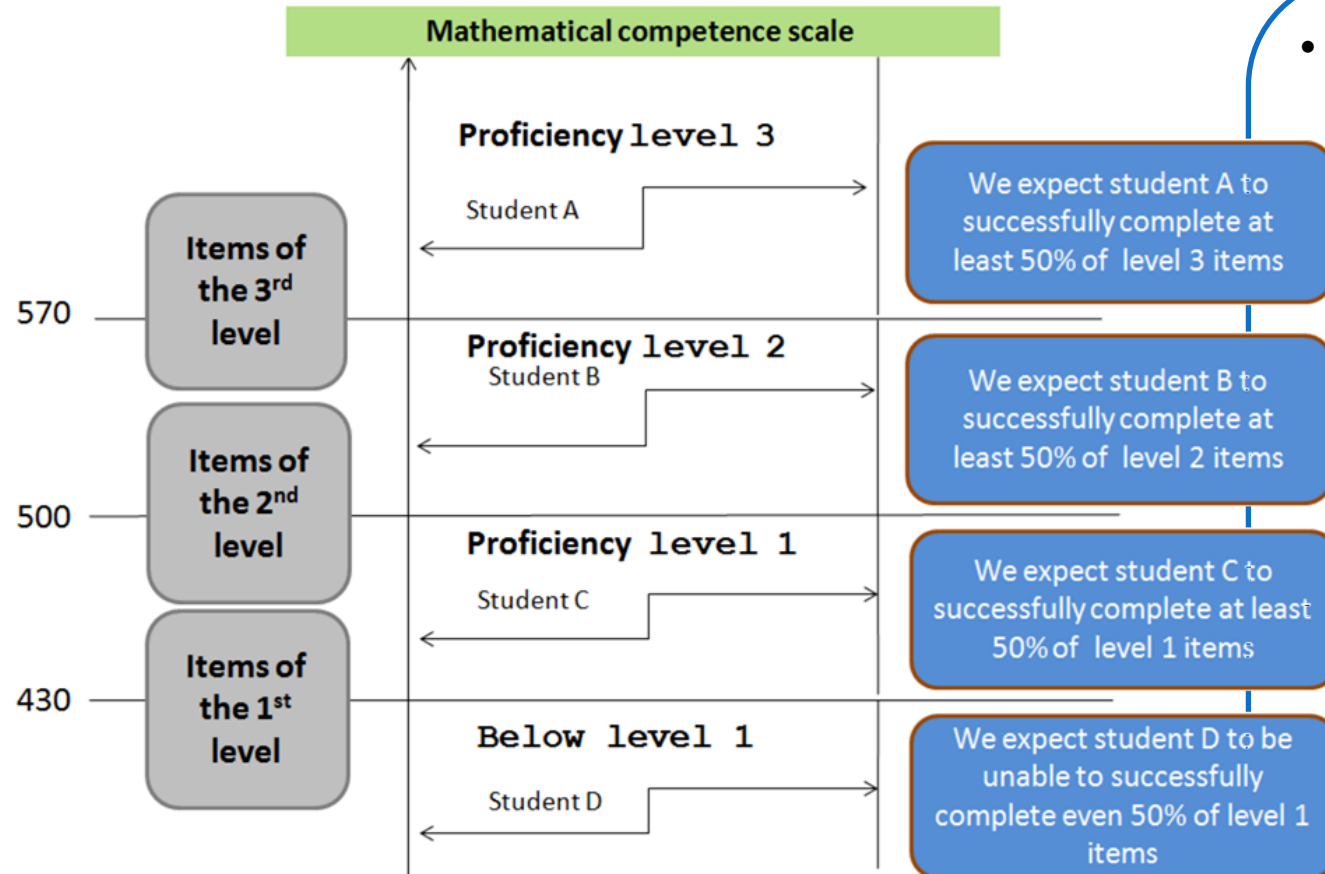


Each block includes three test items assigned to levels 1, 2, and 3

As a result, the test has two functions:

- The integral measurement of educational achievements
- The diagnosis of the student's level (a set of items blocks).

Estimation of examinees



- Rasch model is used as a test model

Test scores are reported on a 1000-point scale with a mean at about 500 and standard deviation of 50

Test scores of all participants are on the same metric scale regardless of the time of test administration and specific set of test items completed

Regional diagnostic study



Velikiy Novgorod
and its area
(Russia)

Regional diagnostic study



May 2012

Sample size: 4406
students of 4th grade
(the region's whole
population of fourth
grade students)

No selection at the school
or classroom level

Description of research sampling

SAMPLE:

- ✓ 4406 students
- ✓ 189 schools
- ✓ 297 classes
- ✓ 134 settlements
- ✓ 47% boys / 53% girls
- ✓ 72% urban / 28% rural

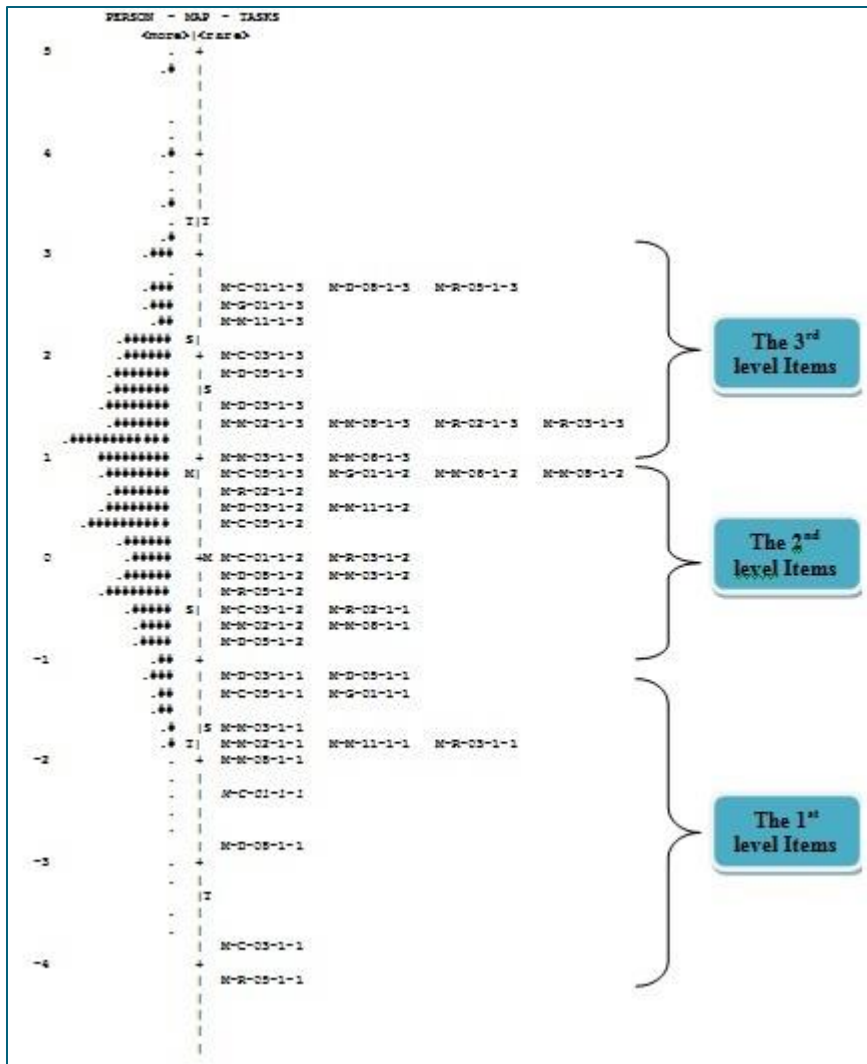


Psychometric quality of instrument (CTT)

Test form 1

Number of examinees	2216
Raw score out of 45 points: average (range)	26 (4-44)
Standard deviation	8.2
Item difficulty level: average (range)	0.61 (0.16-0.98)
Discrimination index	0.44
Reliability index (Chronbach's alpha)	0.90

Psychometric quality of instrument (IRT)

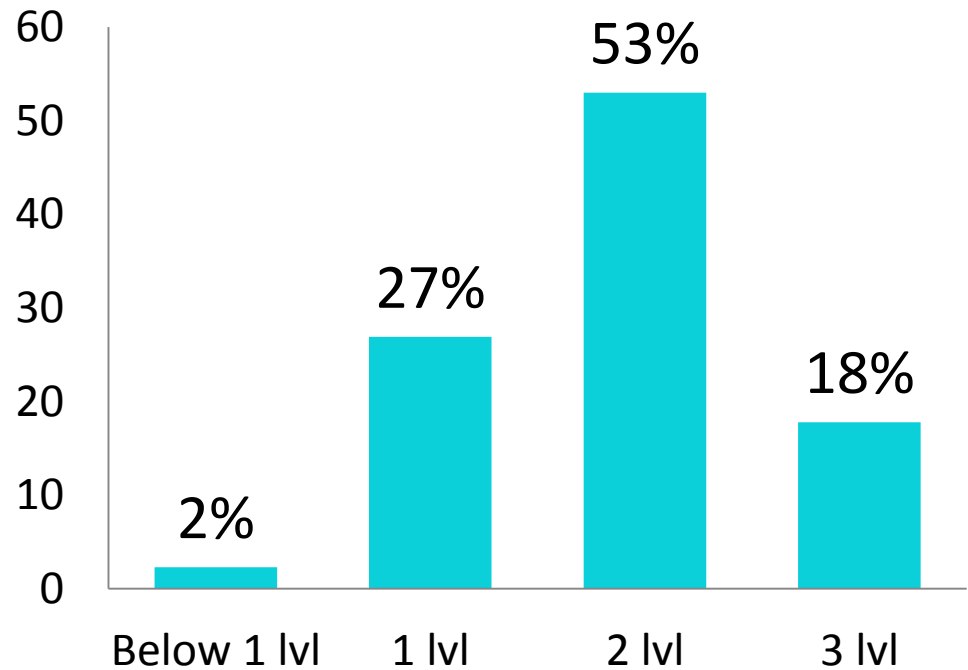


- Modern test theory IRT was used as a basis for SAM assessment design
- A dichotomous Rasch model was selected for test data modeling and students scaling
- Tests can be considered as essentially unidimensional
- All items demonstrate satisfactory psychometric characteristics and fit the model
- Validity study

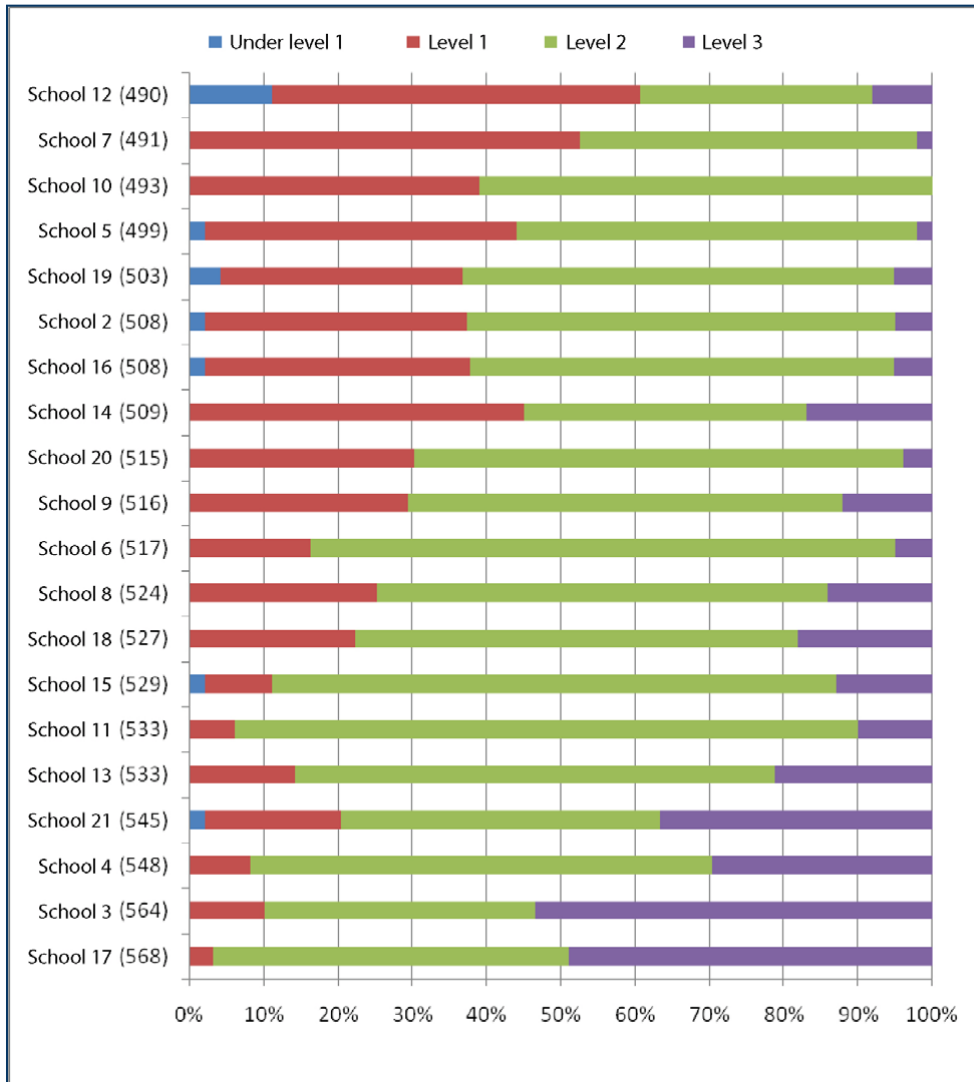
SAM tests can be acknowledged as a qualitative and valid measurement tool.

Distribution of test participants on proficiency levels (Mathematics)

- 53% of students achieve the second level of proficiency (conceptual understanding) by the end of primary school
- The third level (functional competence) is only starts to emerge
- Vygotsky's theory predicts that the development of the highest level of understanding of academic content proceeds beyond the point when this content has been presented to children (i.e., the notion of learning leading development)

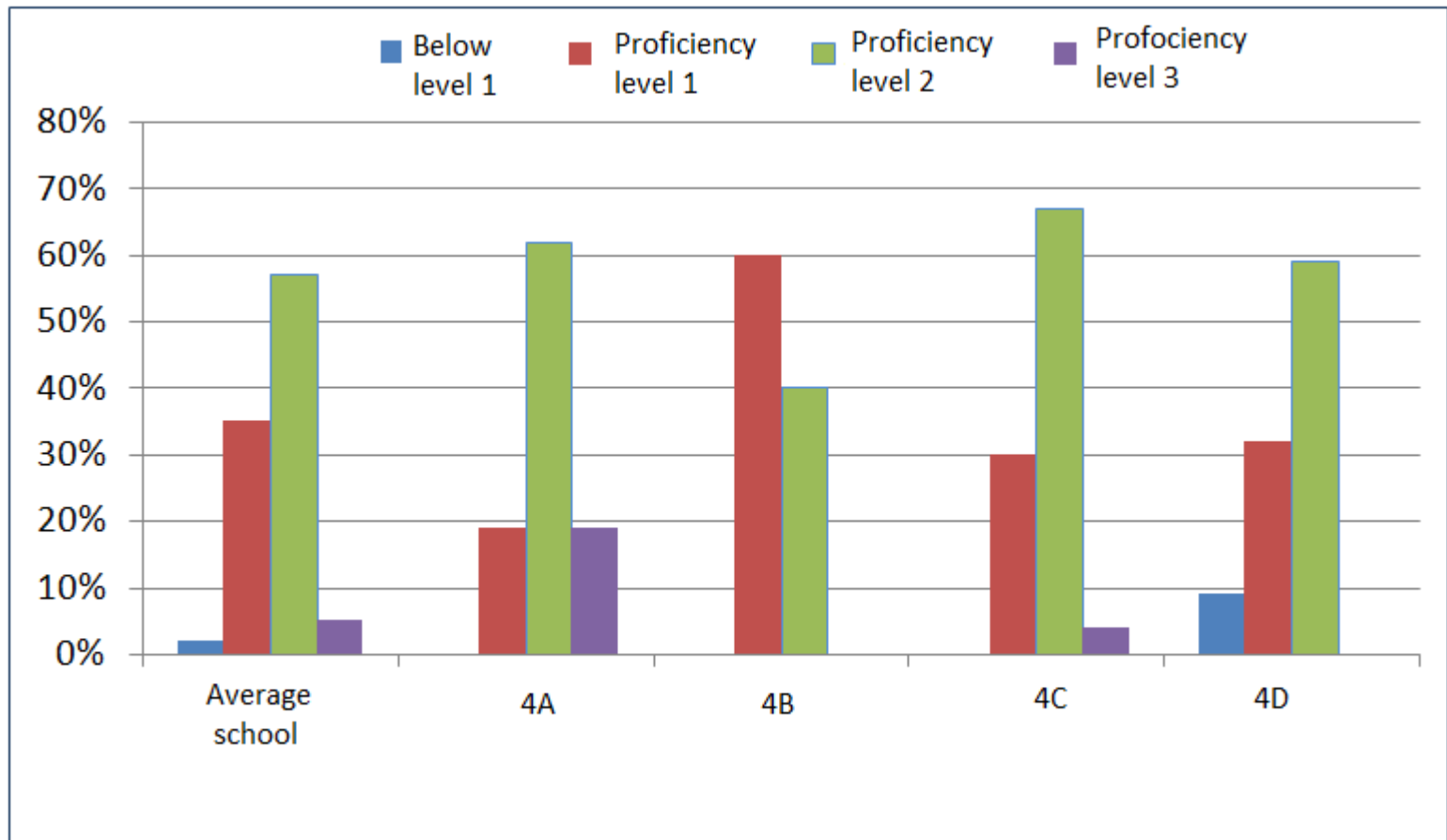


Distribution of students of different schools of the region at proficiency levels (mathematics)



- Schools put in order by increasing of the mean test score
- For every school the mean test score is indicated in brackets.

Distribution of students of different classes within the same school by achievement levels (mathematics)



Multilevel data structure (students are nested within classes) demands a specific method of statistical analysis. The hierarchical regression model (HLM) was used to investigate the interactions of variables.

Two-level hierarchical linear models (HLMs) were used:

- 4406 fourth-grade students (Level 1)
- nested within 293 classes (Level 2)

The integral test score is the depended variable in the regression model

Independent variables

The characteristics of educational environment come as the independent variables:

- Gender
- School location
- The school type (gymnasia)
- The “class size”
- The “educational program”
- The “teachers’ practices” – two pedagogical approaches: *constructivism* and *traditionalism* (Brooks & Brooks, 1993)
- The teachers’ experience

There are two types of independent variables:

- The characteristics, which can't be adjusted by school management
- The characteristics, which can be adjusted by school management

Pedagogical approaches

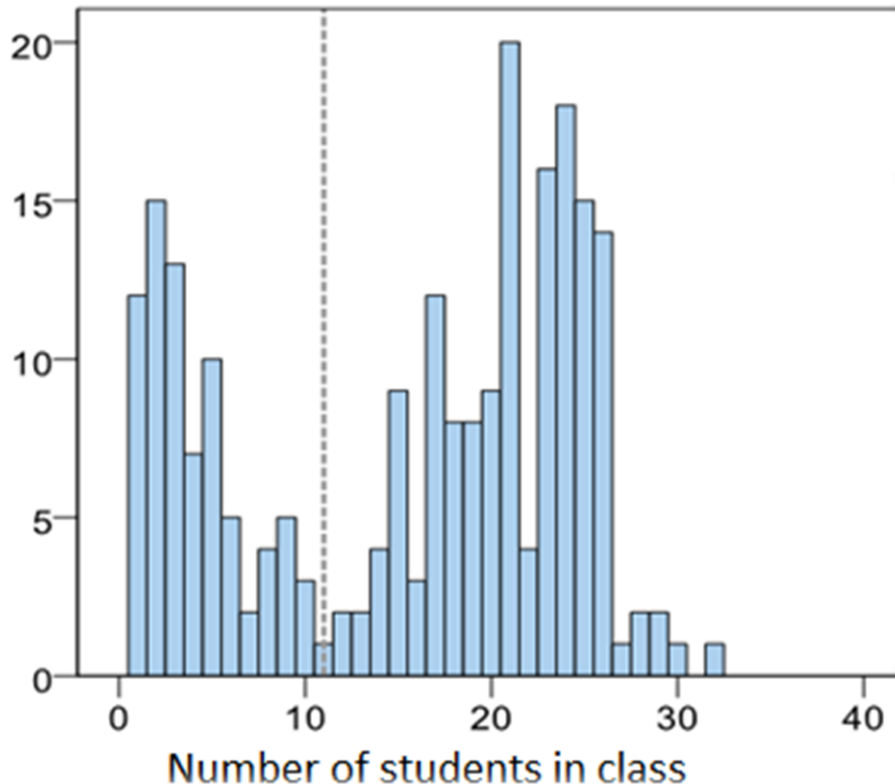
Currently it is assumed (OECD, 2009) that teachers' beliefs about the nature of teaching and learning include both:

- “direct transmission beliefs about learning and instruction” or, so called, “traditional beliefs”
- “constructivist beliefs about learning and instruction”

Thus there are 2 educational approaches: **traditional and constructivist**

- The **traditional** approach implies that teacher communicates knowledge in a clear and structured way, explains correct solutions, gives learners clear and resolvable problems and ensures peace and concentration in the classroom
- The **constructivist** approach implies that students are active participants in acquisition of knowledge, students' own inquiry is stressed developing problem solutions

Class size



We can single out 2 types of classes – big and small

Small classes are those that have less than 11 students, big classes have 11 and more students (maximum number of students in one class is 33)

There are 76 small and 152 big classes in the sample

Dependent variable		Mathematics (test score)		
MODEL #		Null model	Model 1	Model 2
FIXED EFFECTS				
	CLASS MEAN (γ_{00})	520.4*** (2.1)	517.4*** (4.5)	479.8*** (8.7)
Gender	Girls		1.6 (1.1)	1.6 (1.1)
Location (ref. cat. – big city)	Town location		5.7 (6.1)	3.7 (5.7)
	Rural location		-8.9 (6.4)	-9.9 (6.2)
School type	Gymnasia		21.5*** (7.6)	15.01** (6.5)
Class size	Small class		7.1 (5.4)	7.7 (5.3)
School program (ref. cat. – “School of Russia”)	School 2100			25*** (6.5)
	System of Zankov			6.6 (6.3)
	Other school programs			16.03*** (4.6)
Teacher characteristics	Constructivism teacher believes			1.5 (1.1)
	Constructivism teacher practice			4.2 (1.6)
	Traditionalism teacher practice			-2.4 (2.8)
	Teachers’ work experience			0.69* (0.26)
RANDOM EFFECTS				
Class mean	St. deviation, u_{0j}	34.4	33.3	31.3
	Variation	1180	1108	983
Level – 1	St. deviation, r_{ij}	33.9	33.9	33.9
	Variation	1151	1151	1151
Percentage of variance explained	Within class		0	0
	Between classes		6.1	16.6
Intraclass correlation coefficient (ICC)		50.6	49.04	46.1

Note: class-level variables were grand mean centered

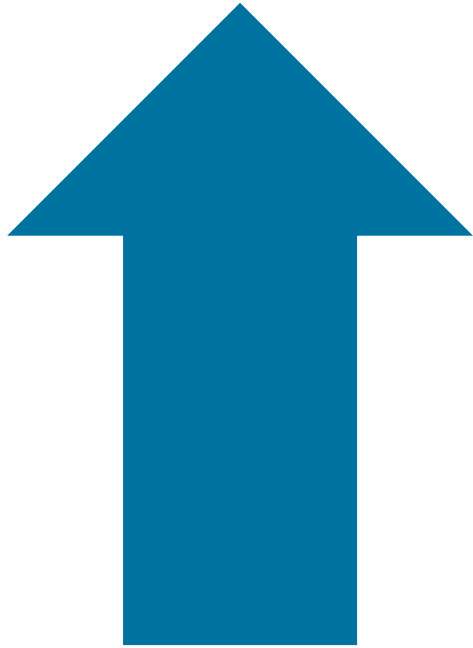
Standard errors in parentheses, *** $p < 0.01$, ** $p < 0.05$, $p^* < 0.1$

Dependent variable		Russian Language (test score)		
MODEL #		Null model	Model 1	Model 2
FIXED EFFECTS				
	CLASS MEAN (γ_{00})	498.7*** (2.2)	485.9** (4.6)	456.1*** (9.7)
Gender	Girls		13.7*** (1.2)	13.7*** (1.2)
Location (ref. cat. – big city)	Town location		7.7 (6.1)	6.07 (5.6)
	Rural location		-3.9 (6.8)	-4.2 (6.6)
School type	Gymnasia		17.8** (7.2)	11.8* (6.3)
Class size	Small class		12.7** (6)	13.8** (6)
School program (ref. cat. – “School of Russia”)	School 2100			23.1*** (6.5)
	System of Zankov			3.1 (6.2)
	Other school programs			10.9** (4.7)
Teacher characteristics	Constructivism teacher believes			0.88 (1.1)
	Constructivism teacher practice			4.3*** (1.6)
	Traditionalism teacher practice			-5.6* (3.1)
	Teachers’ work experience			0.53* (0.29)
RANDOM EFFECTS				
Class mean	St. deviation, u_{0j}	35.6	34.7	33.3
	Variation	1273	1209	1105
Level – 1	St. deviation, r_{ij}	35.8	35.3	35.3
	Variation	1285	1240	1240
Percentage of variance explained	Within class		3.5	3.5
	Between classes		5	13.2
Intraclass correlation coefficient (ICC)		49.7	49.3	47.1

Note: class-level variables were grand mean centered

Standard errors in parentheses, *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Main results



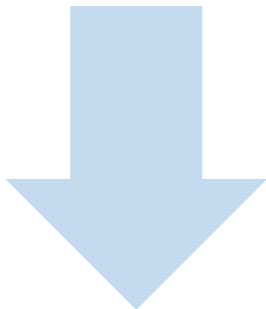
Gymnasia school

School educational programme

Teachers' work experience

Small class (for language)

Constructivism teacher practice (for language)



Traditionalism teacher practice (for language)

Discussion

- The results interpretation is limited with the features of the data design (there is no data on the personal level, so conclusions might claim only the connections between the examined characteristics, but not causal relationships)
- The model, based on the Russian data can be applied to the educational systems of other countries
- There is an interest to confirm the discovered patterns of variables' connections on different sample in different educational systems
- This research is the first step for the international project

Ekaterina Enchikova

enchikova@mail.ru

Elena Kardanova

ekardanova@hse.ru

Center for monitoring and quality of education

Institute of education

Higher School of Economics

<http://ioe.hse.ru/monitoring/>



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