Chess in school can improve math ability?
Differences between instructor training and teacher training from an experiment in Italian primary schools.

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Can Chess Improve Math Scores in primary school children?

- The implicit in the chess activities in school is the belief that skills acquired playing chess can transfer to other domains;

- Is this belief based on well-substantiated evidence?;

- Italian research 2006-2012 results → A basic in-presence Chess course of 30 hours can improve specific basic Math ability.

Gobet F., Campitelli G. (2006), *Educational benefits of chess instruction. A critical review,* http://people.brunel.ac.uk/~hsstffg/preprints/chess_and_education.pdf
Trinchero R. (2012), *Gli scacchi, un gioco per crescere. Sei anni di sperimentazione nella scuola primaria*, Milano, FrancoAngeli.

Can Chess improve Math Literacy, as defined by Oecd-Pisa?

- Italian research 2012-2013 demonstrates a correlation between chess training (performed by FSI Chess instructors) and the score obtained on a subset of Oecd-Pisa math items;

- The gain in math scores is proportional to the time spent in the chess course.

Trinchero R. (2013), *Can chess training improve Pisa scores in mathematics?*, Paris, Kasparov Chess Foundation Europe, http://www.kcfe.eu/sites/default/files/Trinchero_KCFE.pdf

The Math test

Seven Oecd-Pisa released item (selected to be faceable by 7-11 years-old pupils):

Oecd-Pisa item code	Math abilities involved	Oecd-Pisa Estimated difficulty	Analogy with chess ability
M145Q01	Calculate the number of points on the opposite face of showed dice	478 (Level 2)	Calculate material advantage
R040Q02	Establish the profundity of a lake integrating the information derived from the text and from the graphics	478 (Level 2)	Find relevant information on a chessboard
M520Q1A	Calculate the minimum price of the self-assembled skateboard	496 (Level 3)	Calculate material advantage
M806Q01	Extrapolate a rule from given patterns and complete the sequence	484 (Level 4)	Extrapolate checkmate rule from chess situation
M510Q01T	Calculate the number of possible combination for pizza ingredients	559 (Level 4)	Explore the possible combination of moves to checkmate
M159Q05	Recognize the shape of the track on the basis of the speed graph of a racing car	655 (Level 5)	Infer fact from a rule (e.g. possible moves to checkmate)
M266Q01	Estimate the perimeter of fence shapes, finding analogies in geometric figures	687 (Level 6)	Find analogies in chessboard situations

An Example of item (Level 2, easy)
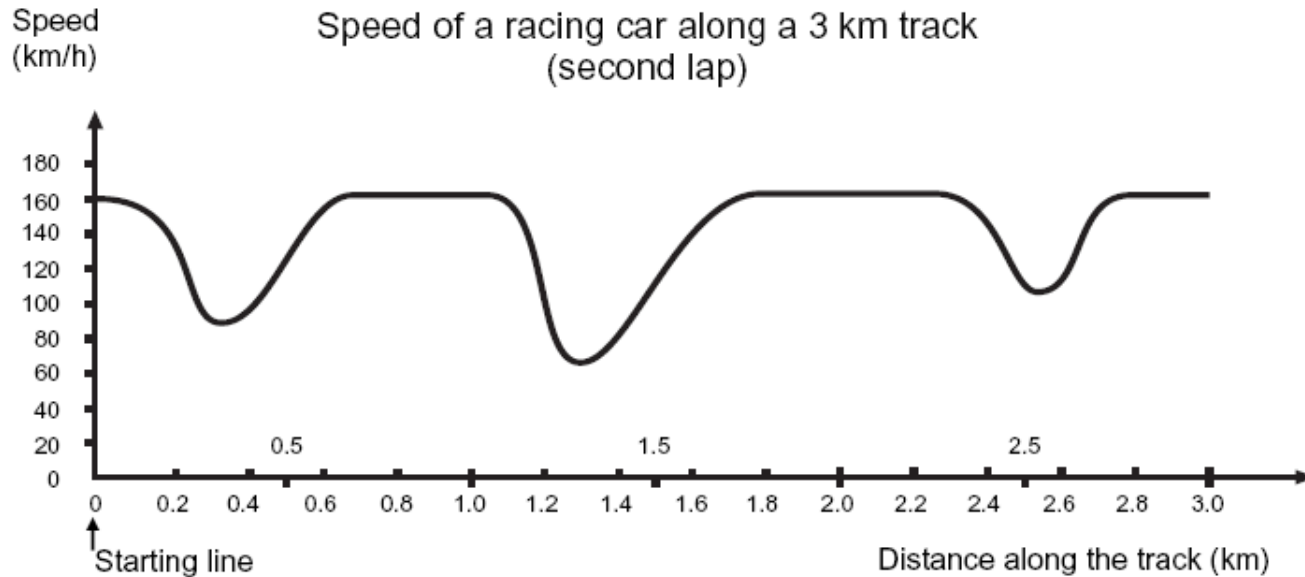
Question 1: CUBES

In this photograph you see six dice, labelled (a) to (f). For all dice there is a rule:

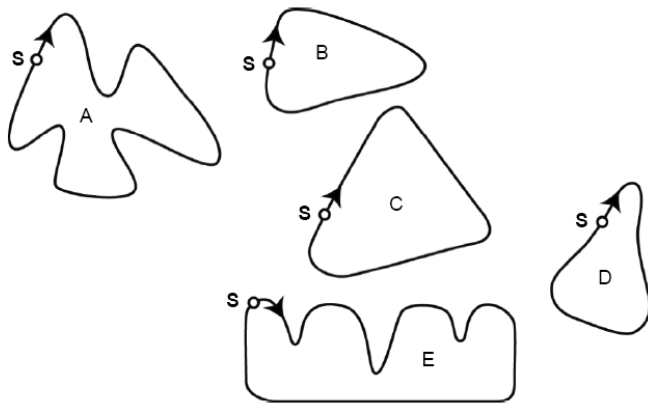The total number of dots on two opposite faces of each die is always seven.
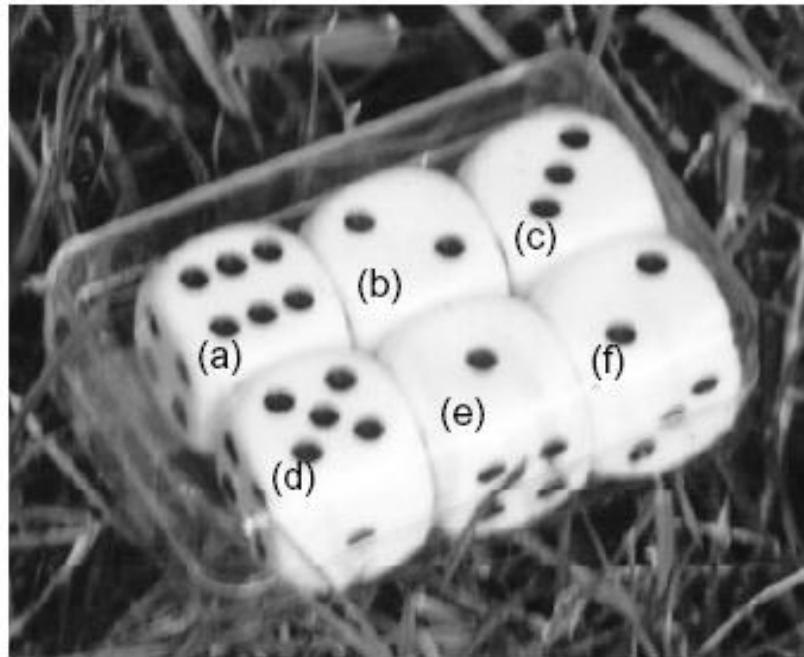
Write in each box the number of dots on the **bottom** face of the dice corresponding to the photograph.

An Example of item (Level 5, difficult)

14. The graph shows how varied the speed of a race car while running through the second round of a flat circuit 3 km long.

Speed of a racing car along a 3 km track
(second lap)

Speed (km/h)

Starting line

Distance along the track (km)

Along which of these circuits was the car driven to produce the Speed graph shown above?

S: Starting point

6

The same results can be obtained by means of **chess training performed by school teacher**?

- This question originates the present research (2013-2014);

- Starting problem: lack of trained chess instructors to do massive courses of Chess in Italian school.

The research sample

1057 children aged from 7 to 11, attending primary schools in several provinces of Italy, subdivided in three randomly selected groups:

Group	N.	Activities
G1 (Experimental)	221	Chess training with school teacher (several groups, from 6 to 30 hours in presence, not extra time) + CAT
G2 (Experimental)	402	Chess training with FSI chess instructor (several groups, from 10 to 25 hours in presence, not extra time) + CAT
G3 (Control)	434	Ordinary school activities

CAT = Computer Assisted Training for Chess beginners (*www.europechesspromotion.org*)
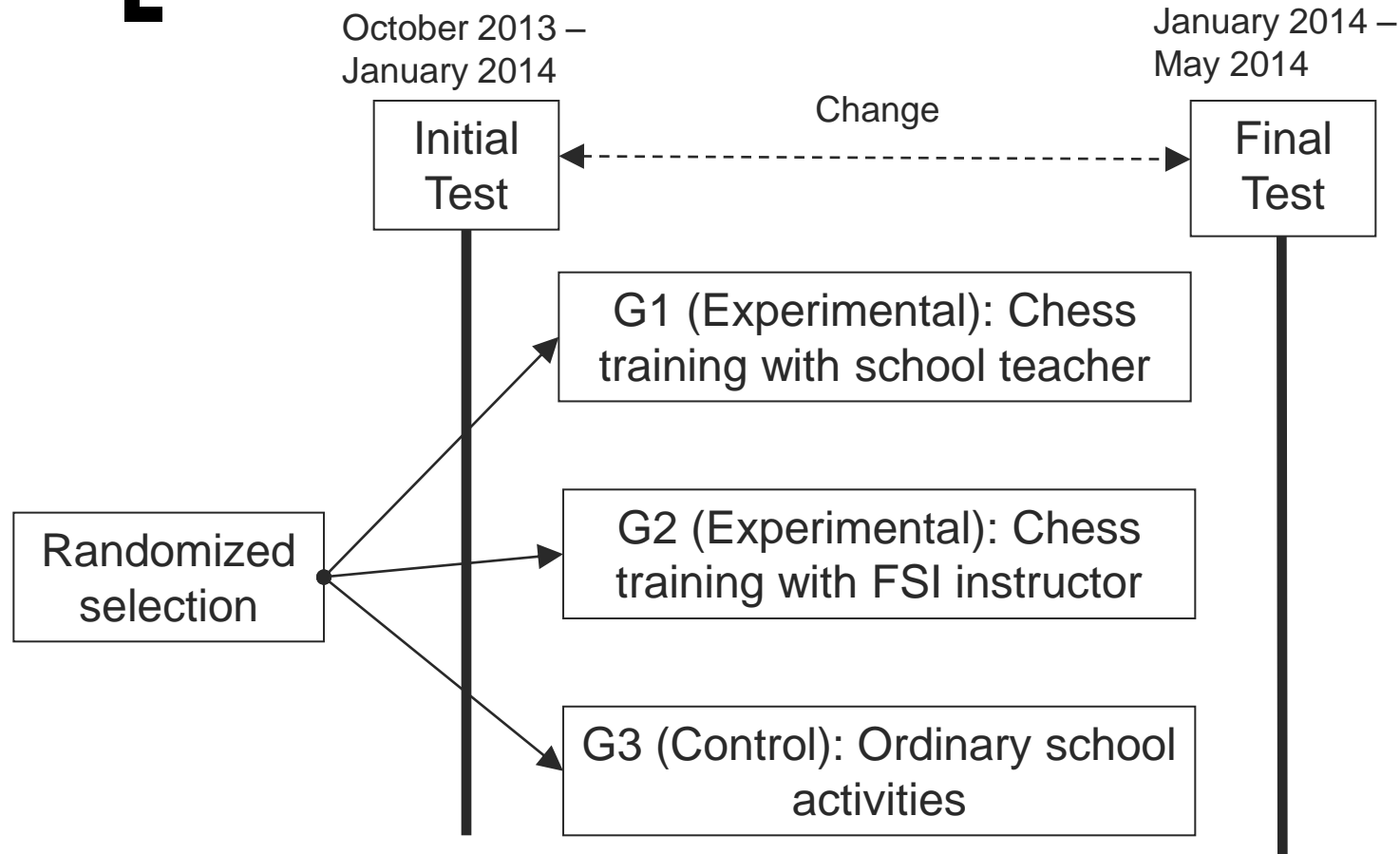
FSI = Italian Chess Federation

8

The research sample

- The experimental group G1 – school teachers - was entirely composed by schools involved in the CIS Towns project, done by FIDE, which in Italy initiated in 2013;

- Teacher training was done mainly via the internet, only in some cases in presence, with meetings, lasting a total of 5 hours;

- In addition to these meetings, all teachers have attended CAT, which required, on average, 8 hours to get to the end;

- We used the same teaching protocol in all groups.

Starting hypoteses of the study

- **Hypotesis 1**: A blended (in-presence+online) basic Chess course hold by a **trained class teacher** can improve Oecd-Pisa Math Scores in children of 7-11 age;

- **Hypotesis 2**: The improvement promoted by a **trained class teacher** is not statistically different from the improvement promoted by **FSI chess instructor**.

The Experimental Design: 3-group test-retest

October 2013 –
January 2014

January 2014 –
May 2014

Change

Initial Test

Final Test

Randomized selection

G1 (Experimental): Chess training with school teacher

G2 (Experimental): Chess training with FSI instructor

G3 (Control): Ordinary school activities

Hypotesis 1 is corroborated if *Change(G1)>Change(G3)*
Hypotesis 2 is corroborated if *Change (G1)>Change(G2)*
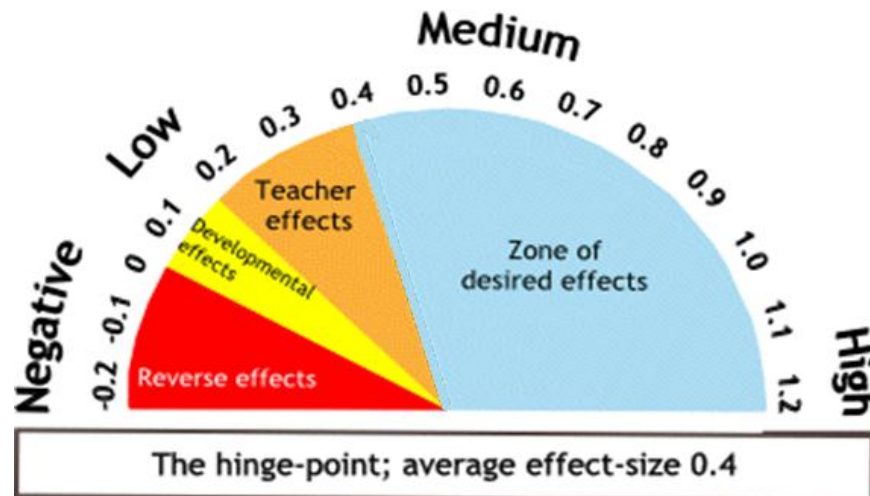
Score gain in mathematic ability: General results

Groups	Initial score		Gain	Gain
	Mean	St. dev.	Mean	Sign. (Anova)
G1 (Exp – Teachers)	1.54	1.15	0.21	Not significantly better than G3
G2 (Exp – Instructors)	1.38	1.14	0.56	Significantly better than G1 (p <= 0.01) and G3 (p <= 0.001)
G3 (Control)	1.65	1.25	0.13	-

There is a little but significant **increase** of Math scores in **Instructors** Experimental Group (0,56 vs a maximum of 7) → chess training with FSI instructor has an Effect Size (Cohen's d) on math ability of 0,46

Teachers Experimental Group shows **no significant increase** → Hypoteses 1 and 2 are not corroborated by data.

12

# John Hattie (2009), *Visible Learning*

- A syntesis of more than 50000 studies (200 milion of students) about factors that have an effect on scholastic achievement;

- Useful to compare the **effect size** of chess training on scholastic achievement with other factors' effect.

13

Hattie J. (2009), *Visible Learning: A synthesis of over 800 meta-analyses relating to achievement*, London, Routledge.

Effect size of Chess training with Instructor on math abilities

Effect size is greater than the mean of the effect size of factors considered by Hattie

Effect Size= **0,46** (Cohen's d)
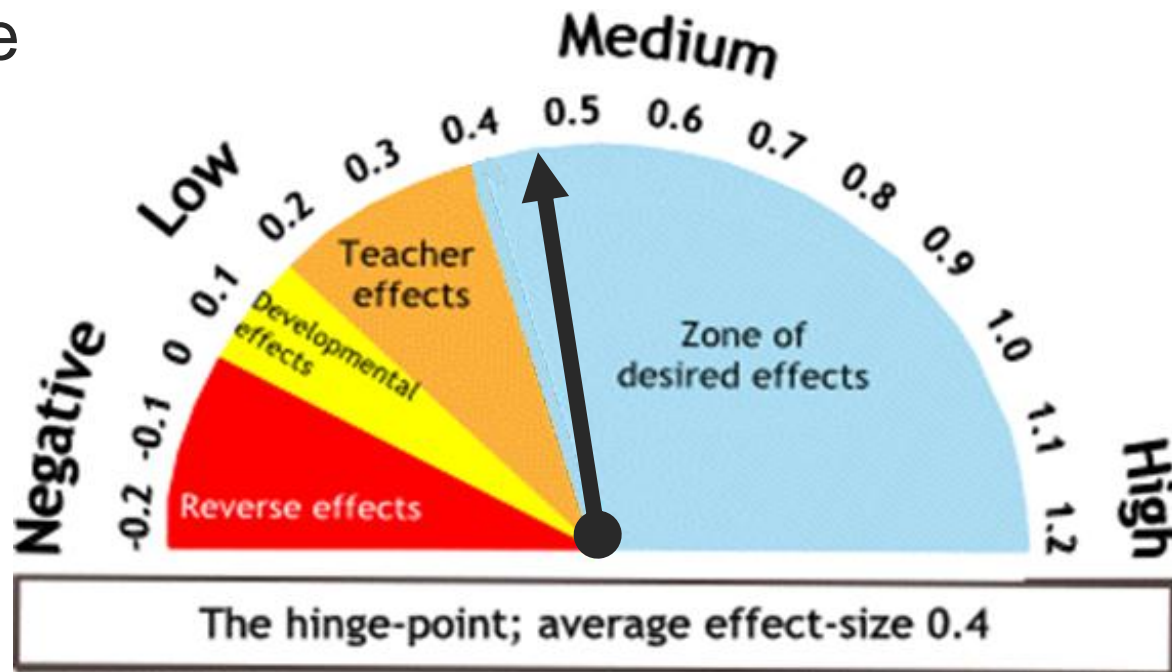
Score gain in mathematics ability: G1 (Teachers) subgroups analysis

Subgroup	Pre-test score		Gain	Sign.
	Mean	St. dev.		
G1m3-4-10-1	1.86	1.38	-0.43	0.105
G1s3-20-1	1.55	1.21	-0.28	0.341
G1m4-20-1	1.53	1.02	-0.06	0.848
G1s4-20-1	1.65	1.06	0.11	0.750
G1s5-17-4	2.24	0.97	0.17	0.548
G1m3-6-1	1.43	1.21	0.19	0.446
Whole G1	*1.54*	*1.15*	*0.21*	-
G1c3-10-1	1.38	0.82	0.37	0.142
G1m4-10-1	1.33	1.32	0.43	0.143
G1m3-30-1	1.23	1.11	0.63	**0.031**
G1p3-12-1	0.93	0.83	0.64	0.082
G1c4-24-1	1.45	1.15	0.8	**0.008**

Better results with a longer training (24 hours or more)

Score gain in mathematics ability: G2 (Instructors) subgroups analysis

Subgroup	Pre-test score		Gain	Sign.
	Mean	St. dev.		
G2g4-10-2	2.05	1.07	-0.53	0.045
G2d3-15-1	1.39	1.05	0.03	0.900
G2a3-14-1	1.12	0.93	0.12	0.707
G2u3-15-1	1.25	1.28	0.25	0.732
G2g3-10-1	1.43	0.98	0.28	0.284
G2c5-10-3	1.71	1.49	0.43	0.165
G2a4-14-2	2.00	1.38	0.48	0.156
G2uv4-15-1	1.00	1.09	0.54	0.011
Whole G2	*1.38*	*1.14*	*0.56*	-
G2br4-13-1	1.34	1.10	0.63	0.017
G2c3-14-1	1.00	0.89	0.67	**0.006**
G2d4-15-1	2.13	1.30	0.74	0.022
G2c4-14-1	1.54	1.10	0.8	**0.000**
G2a2-25-1	0.95	0.99	0.81	**0.000**
G2r5-15-2	1.96	1.22	0.85	0.018
G2an3-22-1	0.85	0.59	1.5	**0.000**

Better results with a longer training (22 hours or more)

Score gain in Chess ability: Teacher training (G1) vs Instructor traning (G2)

	Pre-test score		Gain	Gain Sign. (Anova)
Group	Mean	St. dev.		
G1 (Exp – Teachers)	1.52	3.40	4.51	*Significantly better than G3 (p <= 0.001)*
G2 (Exp – Instructors)	2.41	4.30	5.80	*Significantly better than G1 (p <= 0.001) and G3 (p <= 0.001)*
G3 (Control)	2.16	3.84	1.02	-

Teacher training is effective to develop chess ability, but instructor training is better.

Overall results: **Teaching method makes the difference**

- Chess training performed by chess instructor seems to promote the developing of metacognitive problem solving abilities in children (planning actions and self-reflection on their own strategies);

- Planning actions and self-reflection on their own strategies can become specific *habitus* that pupils transfer to other knowledge domains;

- Trained school teacher seems to not adopt the same strategies that the FSI instructor adopt;

- These results are compliant with results of previous Italian research (2006-2013).

Main peculiarity of FSI Instructor method

FSI Instructor
Focus his/her activity on planning and evaluating strategies
Focus his/her activity on attention to the dynamic relationship between the pieces
Has specific experience on involving children to play
Provides immediate and rich feedback to pupils
Promotes exercise of high order skill

Syntesis of italian research 2006-2012

R. Trinchero (2012), *Gli scacchi, un gioco per crescere. Sei anni di sperimentazione nella scuola primaria*, Milano, FrancoAngeli.

R. Trinchero (2012), *Chess, a game to grow up with: a synthesis of six years of research*, Milano, FrancoAngeli (the book has a chapter in English that summarize the research results).

Roberto Trinchero

Gli scacchi, un gioco per crescere

Sei anni di sperimentazione nella scuola primaria

Percorsi di ricerca

FrancoAngeli

In progress…

- The Italian experience has lead to CASTLE Project 2014-2017;

- Financed by Erasmus Plus EU Programme;

- Aims:

  ○ Study and recover the gap FSI Instructors-school teachers;

  ○ Experiment metacognitive problem solving teaching strategies in chess training for the children.

Thanks…

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Presentation available on

www.europechesspromotion.org