

Under which conditions chess in school can improve Math ability? Suggestion from Italian research.



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# Can Chess Improve Math Scores in primary school children?

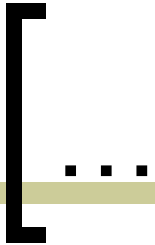
- The implicit in the chess activities in school is the belief that skills acquired playing chess can be transferred to other domains;
- Under which conditions this transfer occurs?.

Gobet F., Campitelli G. (2006), *Educational benefits of chess instruction. A critical review*, [http://people.brunel.ac.uk/~hsstffg/preprints/chess\\_and\\_education.pdf](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.

# [ Analysis of success conditions in three Italian researches 2006-2014 ]

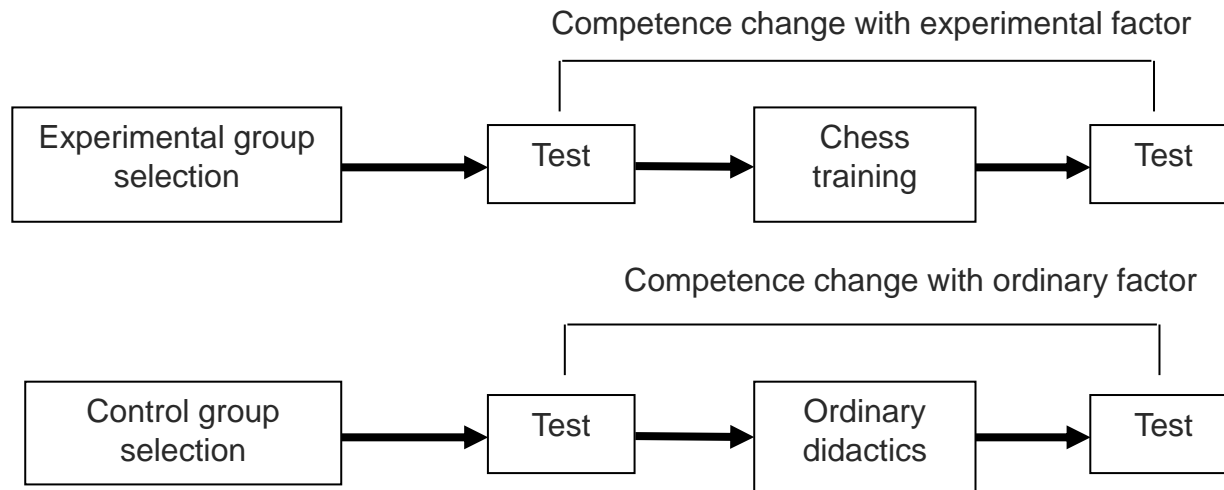
- Chess and Math competence 2006-2007;
- Chess and Oecd-Pisa scores 2012-2013;
- Comparison between chess instructor training and teacher training 2013-2014 ;



# 2006-2007 Research: Chess and Math competence

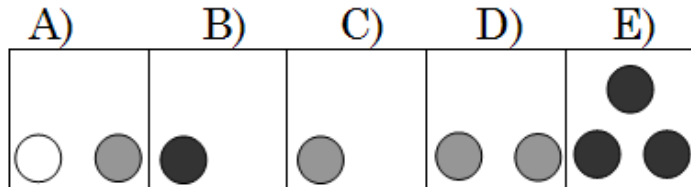
# 2006-2007 Research

- **Hypotesis:** An in-presence 30-hours basic Chess course can improve Math competence in children of 8-11 age;
- **Sample:** 8 equivalent paired classes (from Piedmont), randomly assigned to experimental and control groups;
- **Method:** 2-group test-retest experimental design.

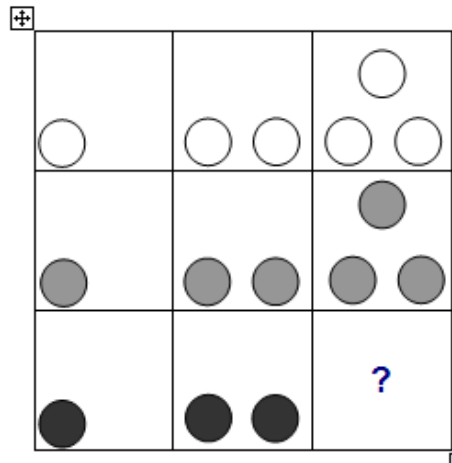


# Example of Math problems used (1)

3) See the following figures:



What figure must replace the question mark?



These items are inspired to Raven's Progressive Matrices

Explain why you have chosen that figure:

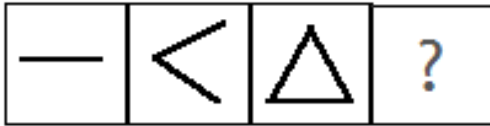
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# Example of Math problems used (2)

5) See the following sequence:



What figure must replace the question mark?



A)

B)

C)

Explain why you have chosen that figure:

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# Example of Math problems used (3)

8) See the two following symbols:



choose two of the following symbols (A, B, C, D)  
that have the same ratio.



A)

B)

C)

D)

Explain why you have chosen that figures:

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# Example of Math problems used (4)

10) Mary was born exactly on the day of the third Sally's birthday. How old will be Sally when Mary will have the half of the Sally's age?

1 year	2 years	6 years	4 years	10 years
A)	B)	C)	D)	E)

Explain why:

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# Results: Successful classes

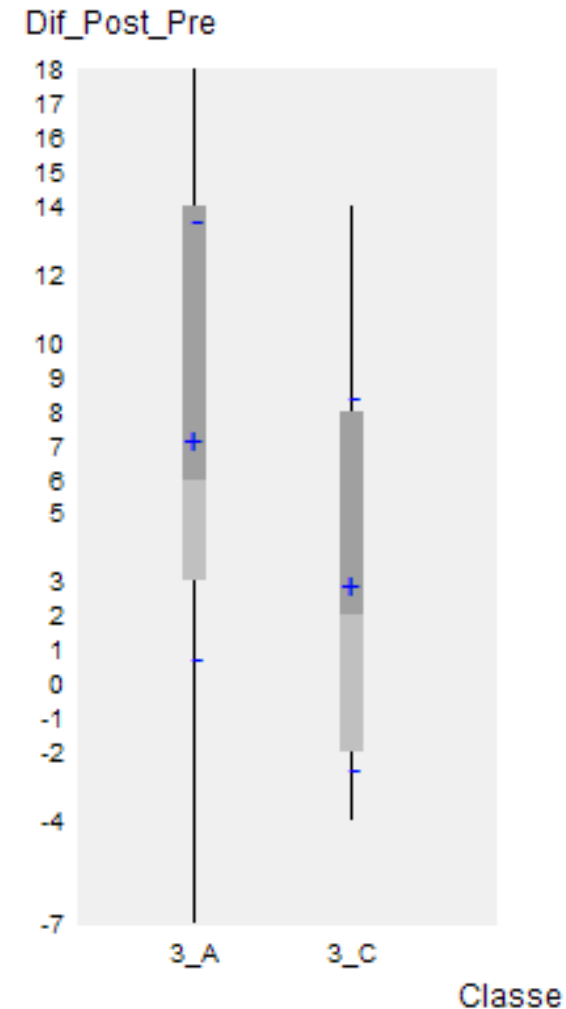
Analisi della varianza:  
Classe x Dif\_Post\_Pre

Categoria	Numero di casi	Media	Devianza	Scarto tipo
3_A	24	7.08	977.83	6.38
3_C	22	2.86	652.59	5.45
<b>Intero campione</b>	46	5.07	1834.8	6.32

Eta quadro = 0.11. Significatività = 0.02.

Effect Size  
(Cohen's d)  
= 0,71

- Instructor's approach oriented to promote self-reflection on pupil's own strategies;
- More time dedicated to the game;
- No problem of involvement of students.



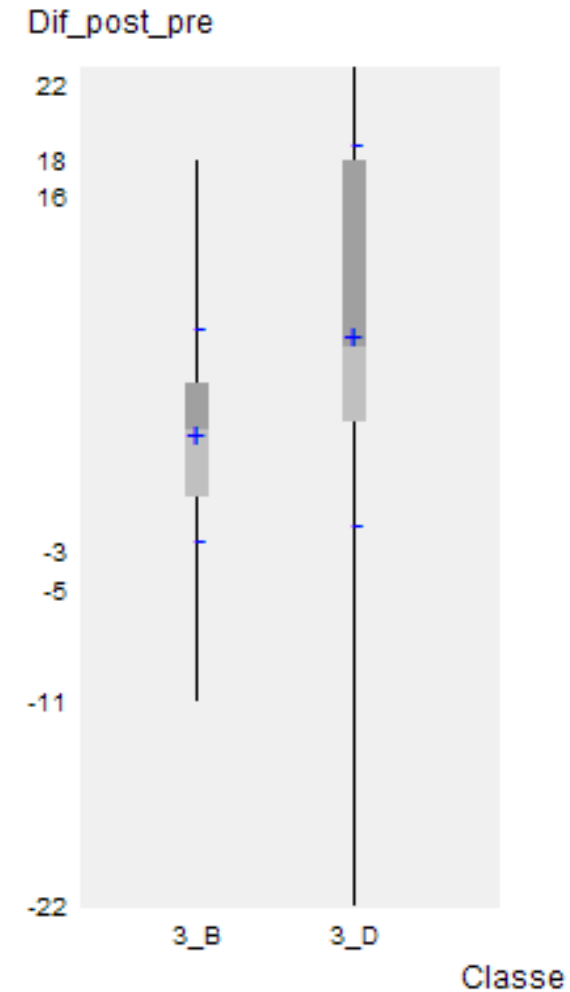
# Results: Successful classes

Effect Size  
(Cohen's d)  
= 0,67

Analisi della varianza:  
Classe x Dif\_post\_pre

Categoria	Numero di casi	Media	Devianza	Scarto tipo
3_B	22	3.23	717.86	5.71
3_D	20	8.55	2066.95	10.17
<b>Intero campione</b>	42	5.76	3081.62	8.57

Eta quadro = 0.1. Significatività = 0.05.



# Results: Unsuccessful classes

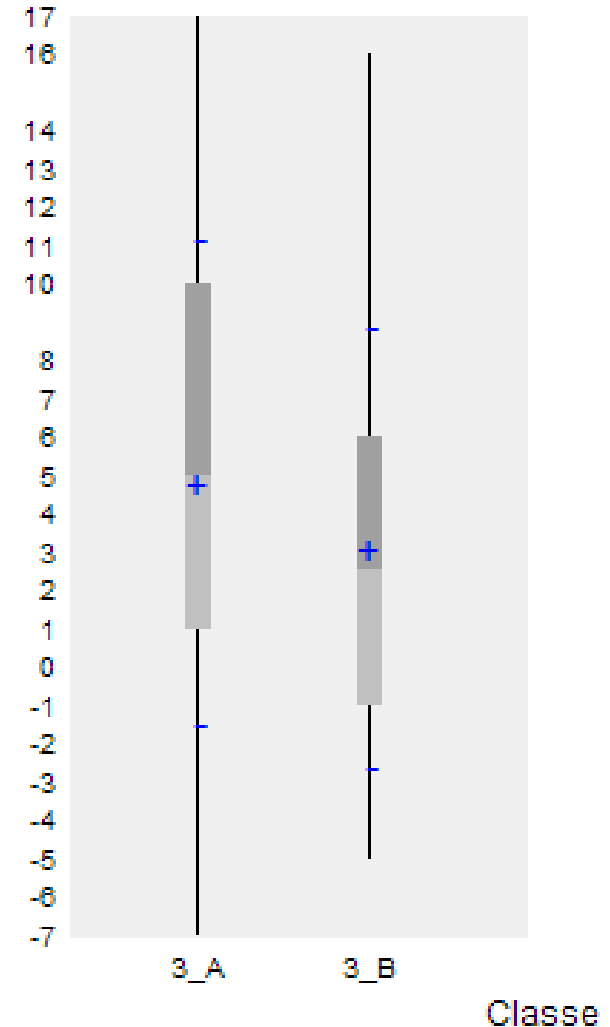
Analisi della varianza:  
Classe x Dif\_post\_pre

Categoria	Numero di casi	Media	Devianza	Scarto tipo
<b>3_A</b>	24	4.75	970.5	6.36
<b>3_B</b>	22	3.05	726.95	5.75
<b>Intero campione</b>	46	3.93	1730.8	6.13

Eta quadro = 0.02. Significatività = 0.36.

- Instructor oriented only to teach the fundamentals;
- Problems in the involvement of students;
- Little time dedicated to the game.

Dif\_post\_pre

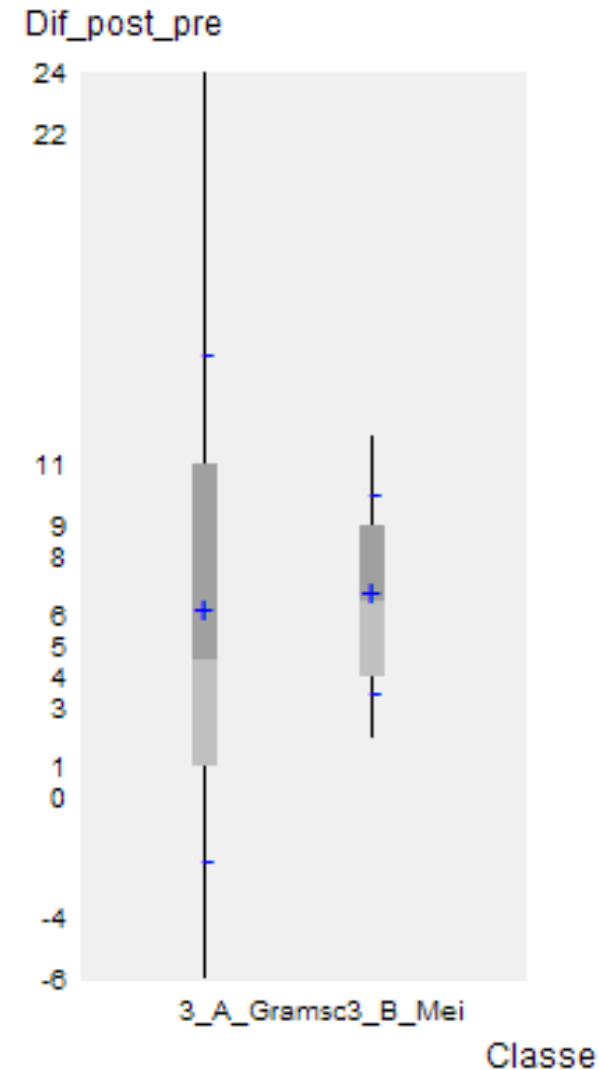


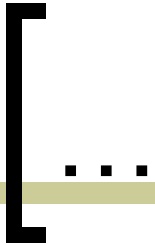
# Results: Unsuccessful classes

Analisi della varianza:  
Classe x Dif\_post\_pre

Categoria	Numero di casi	Media	Devianza	Scarto tipo
<b>3_A_Gramsci</b>	14	6.21	986.36	8.39
<b>3_B_Mei</b>	14	6.71	150.86	3.28
<b>Intero campione</b>	28	6.46	1138.96	6.38

Eta quadro = 0. Significatività = 0.84.





# 2012-2013 Research: Chess and Oecd-Pisa Math Scores

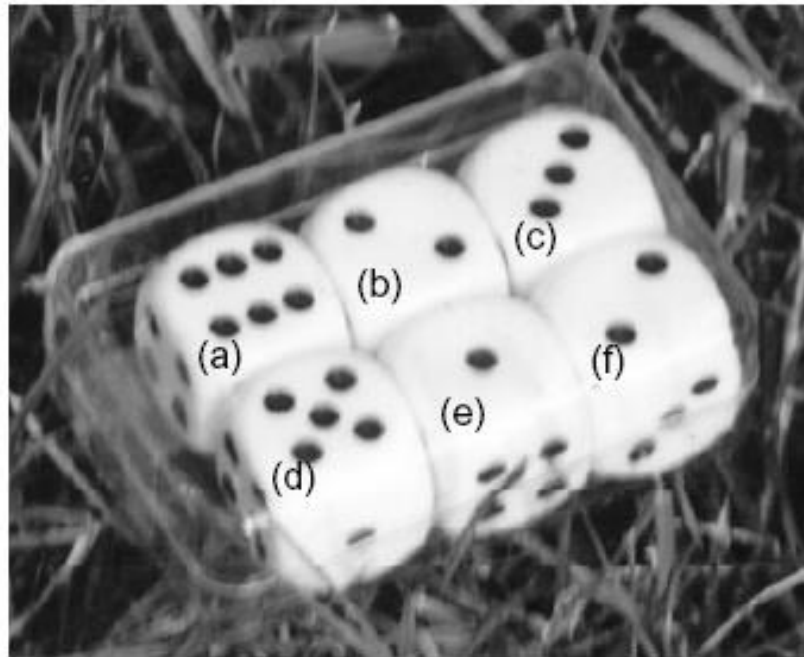
# [ 2012-2013 Research ]

- **Hypothesis:** A blended (in-presence + Computer Assisted Training) basic Chess course can improve Oecd-Pisa Math Scores in children of 8-11 age;
- **Sample:** 568 pupils of Italian primary school (non-random sample from Piedmont and Lombardy);
- **Method:** Solomon 4-group test-retest experimental design;
- **Subsamples:** The Experimental Group was differentiated by:
  - Class attended (grade 3, 4, 5);
  - Number of hours of the course (10, 11, 14, 16);
  - Year of chess course (1, 2, 3).

# 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.

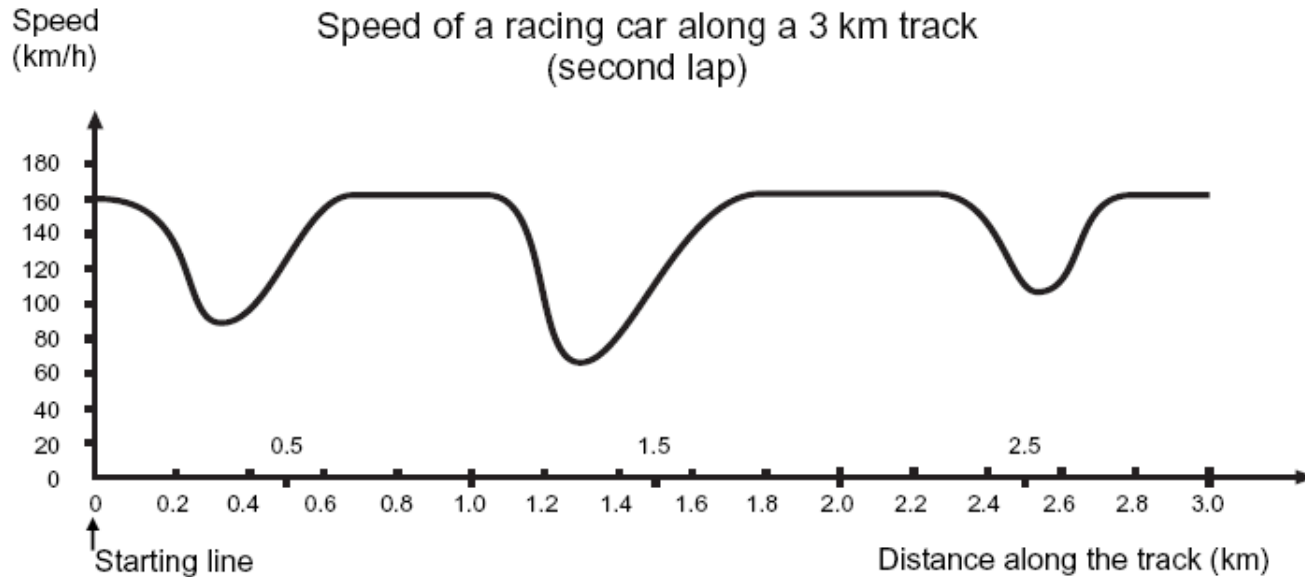


Write in each box the number of dots on the **bottom** face of the dice corresponding to the photograph.

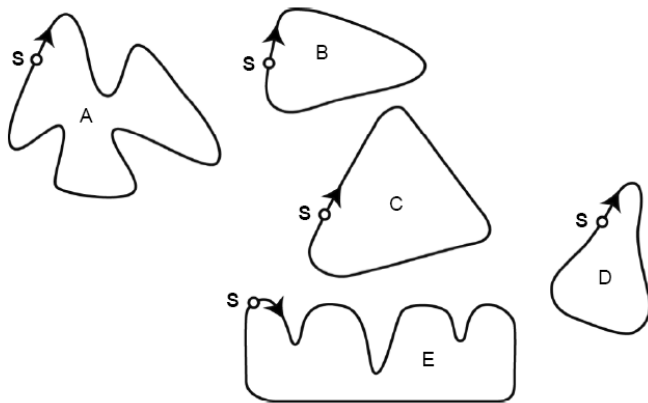


# An Example of item (Level 5, difficult)

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.



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



S: Starting point

## 2012-2013 Results: Successful subgroups

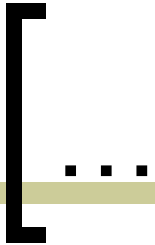
Subgroup	Chess training	Effect Size (Cohen's d)
G1p5-16-1	<b>16 hours</b> in presence, 2 hours per week (first year of training) + 96% CAT (mean level 7,36)	0,58
G1r4-10-1	<b>10 hours</b> in presence (first year of training) + <b>80% CAT</b> (mean level <b>9,00</b> )	0,73
G1c4-14-2	<b>14 hours</b> in presence, 2 hours per week ( <b>second</b> year of training) + 50% CAT (mean level 9,43)	1,22
G1b5-14-2	<b>14 hours</b> in presence ( <b>second</b> year of training) + 17% CAT (mean level 8,00)	0,68
G1c5-14-3	<b>14 hours</b> in presence, 2 hours per week ( <b>third</b> year of training) + 27% CAT (mean level 11,00)	2,19

Successful subgroups attended a chess course of **almost 14 hour** OR had greater involvement in the Computer Assisted Training (CAT). Better results at the second and third year of training.

# 2012-2013 Results: Unsuccessful subgroups

Subgroup	Chess training
G1a4-11-1	11 hours in presence ( <b>first</b> year of training) + 98% CAT (mean level 7,16)
G1g4-10-1	10 hours in presence ( <b>first</b> year of training) + 98% CAT (mean level 5,75)
G1g3-10-1	10 hours in presence ( <b>first</b> year of training) + 93% CAT (mean level 6,08)
G1d4-10-1	10 hours in presence ( <b>first</b> year of training) + 95% CAT (mean level 5,86)
G1p4-8-2	8 hours in presence, 2 hours per week (second year of training) + 95% CAT (mean level 5,38)
G1b4-14-2	14 hours in presence (second year of training) + <b>32% CAT</b> (mean level 10,33)

Exception: a class with a very high initial score, and with several organizational problems in post-test.

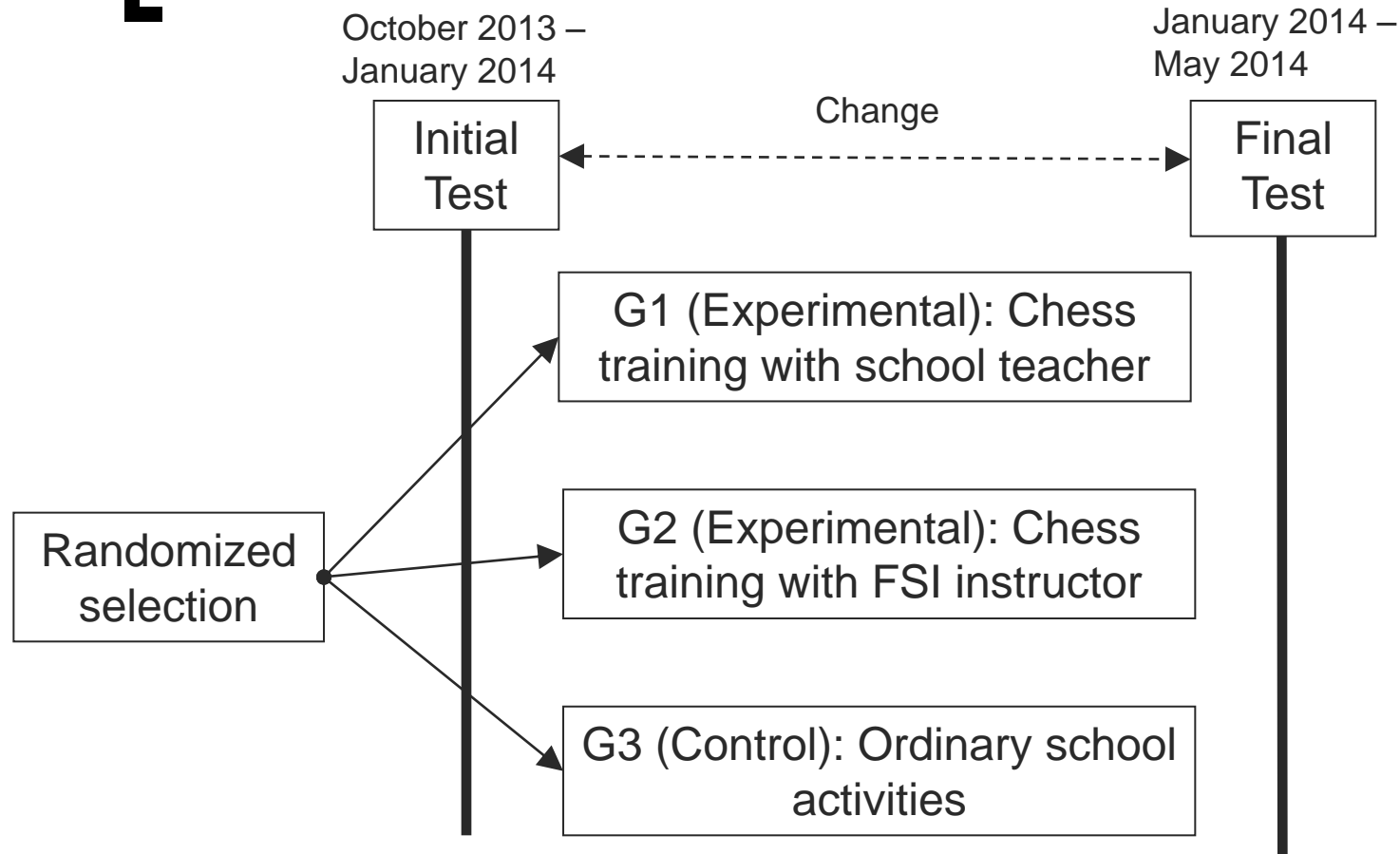


# 2013-2014 Research: Comparison between FSI instructor chess training and school teacher training

# [ Starting hypothesis of the study ]

- **Hypothesis:** 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 (as a course hold by a FSI instructor);

# The Experimental Design: 3-group test-retest



Hypotesis is corroborated if  $Change(G1) > Change(G3)$  and  $Change(G2) > Change(G3)$



# [ The research sample ]

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

CAT = Computer Assisted Training for Chess beginners  
([www.europechesspromotion.org](http://www.europechesspromotion.org))

FSI = Italian Chess Federation

# 2013-2014 Results: Successful subgroups (instructor training)

Subgroup	Chess training	Effect Size (Cohen's d)
G2c3-14-1	<b>14 hours</b> in presence, 2 hours per week (first year of training) + 97% CAT (mean level 6,00)	0,66
G2c4-14-1	<b>14 hours</b> in presence, 2 hours per week (first year of training) + 95% CAT (mean level 9,85)	0,71
G2a2-25-1	<b>25 hours</b> in presence, 2 hours per week (first year of training) + 71% CAT (mean level 5,44)	0,63
G2an3-22-1	<b>22 hours</b> in presence, 2 hours per week (first year of training) + 70% CAT (mean level 5,57)	1,46

Successful subgroups attended a chess course of **almost 14 hour**.



# 2013-2014 Results: Successful subgroups (class teacher training)

Subgroup	Chess training	Effect Size (Cohen's d)
<b>G1m3-30-1</b>	<b>30 hours</b> in presence, 2 hours per week (first year of training) + 77% CAT (mean level 7,00)	0,72
<b>G1c4-24-1</b>	<b>24 hours</b> in presence, 2 hours per week (first year of training) + 100% CAT (mean level 11,35)	0,70

Successful subgroups have attended a chess course of **almost 24 hour**.

# 2013-2014 Results: Unsuccessful subgroups characteristics

- Instructor training:
  - 15 hours of in-presence training or less;
  - No difference in the engagement in CAT with the successful subgroups;
- Teacher training:
  - 20 hours of in-presence training or less;
  - No difference in the engagement in CAT with the successful subgroups;



...



Putting results  
together...

# Increasing Math ability playing Chess: What makes the difference?

- The **motivation** for the game?
- The **time** dedicated to the game?
- The **in-presence, online CAT or blended** strategy?
- The **duration** of the training?
- The **approach** of the instructor?
- The **game of Chess** itself?

# [ The **motivation** for the game? ]

- The motivation is an important prerequisite to obtain engagement in the game, but it seems not sufficient to explain increase of Math ability;
- There are highly motivated students that reach highest level in chess CAT and don't have a significative improvement in math.

# [ The **time** dedicated to the game? ]

- The time dedicated to the game is important but doesn't seem a key variable;
- There are students that dedicate a lot of time to play chess in CAT and don't have a significative improvement in math.

# The in-presence, online CAT or blended strategy?

- Supporting in-presence training with Computer Assisted Training is especially useful for chess training;
- But seems not to be a key factor to promote Math ability increase.

# [ The duration of the training? ]

- The duration of training is a key variable. To observe an increase in Math scores are necessary almost:
  - 16 hours of training with instructor;
  - 22 hours of training with class teacher;
- The increase in Math scores grows if grows the duration of training;
- Second and third year training is more effective.



# [ The approach of the instructor? ]

- A chess teaching approach that aims to develop specific skill and *habits of mind* in pupils:
  - self-reflection about their strategies and consequence of their actions (metacognition);
  - analyze situations and problems;
  - grasp the important elements in a situation;
  - remain focused on completing the solution process.
- seems to be a key factor.

# [ The game of Chess itself? ]

- Chess offer several situations to exercise and to develop complex thinking and metacognitive skills;
- The instructor can take advantage from the game situations to exercise and to develop skills and habits of mind.

# 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

# [ 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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Dario Mione - Gianluca Argentin

Presentation available on  
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