

Dose lego training stimulate pupils' ability to solve logical problems?

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Outline

- ▶ Introduction
- ▶ Method
- ▶ Results
- ▶ Concluding discussion

Introduction

- ▶ Theoretical background
Based on the constructionist theory

Method

- ▶ Outline of the project

- ▶ 1. two groups:

- ▶ control group —12 classes, 169 pupils in the fifth grade and 205 in the ninth grade

- ▶ lego group—12 classes ,193 pupils in the fifth grade and 129 in the ninth grade

- ▶ 2. training time : around 2 h a week during 12 months.

Method

► Methods

Qualitative and quantitative research methods

Hypothesis test

$$y_{ij} = \mu_i + \varepsilon_{ij}, \begin{cases} i = 1, 2 \\ j = 1, \dots, n \end{cases}$$

$$H_0 : \tau_1 = \tau_2$$

$$H_A : \tau_1 \neq \tau_2$$

Results

► Qualitative results

1. different strategies of learning the material

Trial-and-error

Asking the fellow workers

Taking help from the teacher or the instruction.

2. pupils learning

There is no significant difference between the younger and the older pupils or between girls and boys concerning the ability to build, program and handle the lego material.

3. learning context

A large space is needed.

The working group should not be too big (maximum 2-3 pupils/LEGO box)

The task given to the pupils must be concrete.

Quantitative results

- ▶ ANOVA

No statistical evidence to support that the average pupils gains from lego teaining.

► T-statistic

Table 1
Descriptive statistics for grade 5

Factor		<i>N</i>	Mean	Standard deviation	Standard error mean
Maths	Lego	170	29.44	5.04	0.39
	Non-lego	161	28.84	5.46	0.43
Problem	Lego	184	11.16	2.96	0.22
	Non-lego	160	11.53	2.45	0.19

Table 2
t-Tests for grade 5

	<i>t</i>	df	Significant (2-tailed)	Mean difference	Standard error difference
Maths 5	1.03	322	0.30	0.60	0.58
Problems 5	-1.26	341	0.21	-0.37	0.30

The differences are insignificant.

Quantitative results

- ▶ Apply the test scores from the previous year to classify the pupils

Table 3

Test of treatment effect grade 5 given test scores grade 4: mathematics

Test scores class 4	<i>t</i> -Statistic	<i>p</i> -Value	$d = \bar{X}_{\text{lego}} - \bar{X}_{\text{no lego}}$
5-6p	$t = 1.04$	$p = 0.32$	$d = 3.44$
7-8p	$t = 0.69$	$p = 0.50$	$d = 1.73$
9-10p	$t = 2.28$	$p = 0.03$	$d = 4.51$
11-12p	$t = 3.22$	$p < 0.01$	$d = 5.82$
13-14p	$t = 0.79$	$p = 0.44$	$d = 0.97$
15-16p	$t = -0.54$	$p = 0.59$	$d = -0.44$
17-18p	$t = -0.73$	$p = 0.47$	$d = -0.70$

Table 4

Test of treatment effect grade 5 given test scores grade 4: problem solution

Test scores class 4	<i>t</i> -Statistic	<i>p</i> -Value	$d = \bar{X}_{\text{lego}} - \bar{X}_{\text{no lego}}$
2-4p	$t = 0.13$	$p = 0.90$	$d = 0.19$
5p	$t = -0.76$	$p = 0.45$	$d = -0.78$
6p	$t = -0.92$	$p = 0.36$	$d = -0.54$
7p	$t = 0.50$	$p = 0.62$	$d = 0.54$
8p	$t = -1.13$	$p = 0.145$	$d = -0.56$
9p	$t = -0.69$	$p = 0.49$	$d = -1.12$

Table 5

Test of treatment effect grade 9 given test scores grade 8: mathematics

Test scores class 8	<i>t</i> -Statistic	<i>p</i> -Value	$d = \bar{X}_{\text{lego}} - \bar{X}_{\text{no lego}}$
0-7p	$t = -2.15$	$p = 0.04$	$d = -7.6$
8-9p	$t = -1.69$	$p = 0.11$	$d = -4.50$
10-11p	$t = -1.78$	$p = 0.09$	$d = -3.47$
12-13p	$t = -1.49$	$p = 0.14$	$d = -3.79$
14-15p	$t = -1.17$	$p = 0.25$	$d = -2.72$
16-17p	$t = -1.28$	$p = 0.21$	$d = -4.90$
18-20p	$t = -0.69$	$p = 0.49$	$d = -3.69$

Table 6

Test of treatment effect grade 9 given test scores grade 8: problem solution

Test scores class 8	<i>t</i> -Statistic	<i>p</i> -Value	$d = \bar{X}_{\text{lego}} - \bar{X}_{\text{no lego}}$
1-4p	$t = 0.11$	$p = 0.91$	$d = 0.14$
5-6p	$t = 0.38$	$p = 0.70$	$d = 0.36$
7-8p	$t = -1.11$	$p = 0.27$	$d = -0.78$
9-10p	$t = -0.81$	$p = 0.42$	$d = -0.88$

Quantitative results

- ▶ To use correlations

$$H_0 : \rho_A = \rho_B$$

$$H_A : \rho_A < \rho_B$$

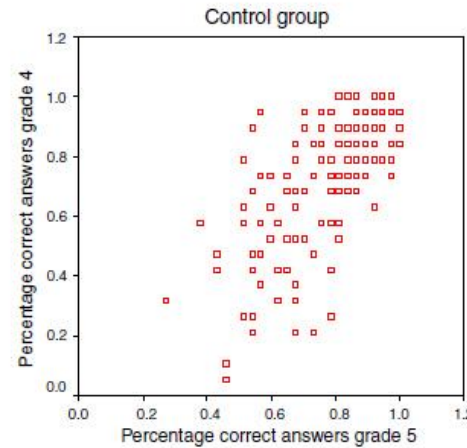


Fig. 1. Scatterplot for math test, control group.

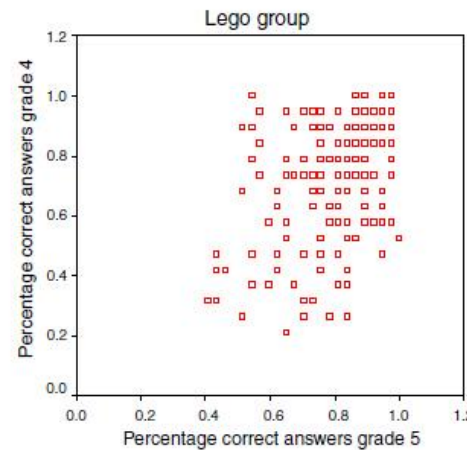


Fig. 2. Scatterplot for math test, lego group.

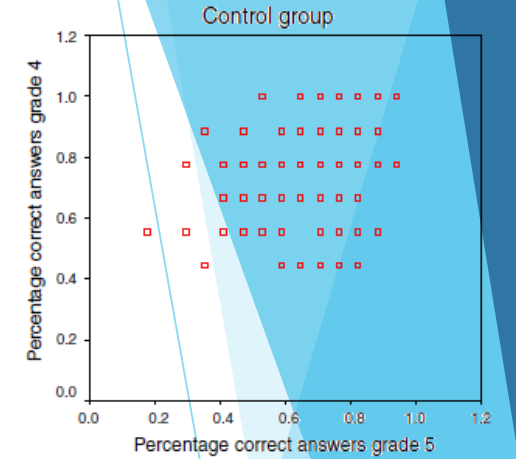


Fig. 3. Scatterplot for problem test, control group.

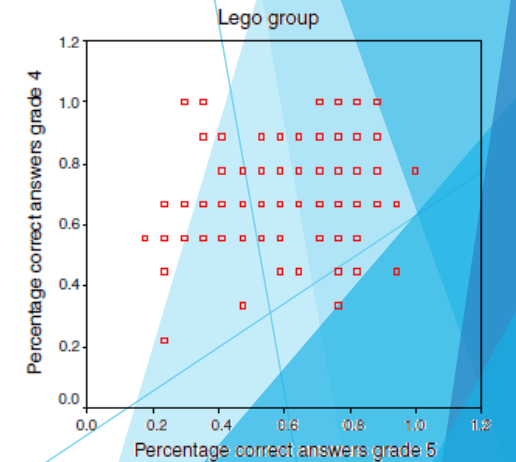


Fig. 4. Scatterplot for problem test, lego group.

$P=0.0003$

$p=0.31$

Concluding

- ▶ It is **difficult** to confirm the hypothesis that LEGO has positive effects on cognitive development. But certain positive effects can be shown for categories of pupils.