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Cognitive Benefits of Chess Training in Novice Children

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Abstract

The present study aim demonstrate of role chess training has on school performance, memory, sustained attention and creativity. A group of 20 novice primary school students took part in 10 blended learning chess lessons and in a final chess competition (the chess group, ChG). Eighteen control students participated in 10 fun math lessons. Most cognitive skills increased from pretest to posttest in both groups but the School Performance Test increased significantly more in the ChG. Resistance to monotony and not IQ at pretest predicted success in the chess contest.

Keywords: chess, blended learning, cognitive capacities, Romanian primary school

1. Introduction

Historically chess has been the primary domain for psychological studies of human expertise. Expertise in chess requires the acquisition of specialized knowledge, including memorization of a large number of chess specific patterns that may elicit appropriate moves, evaluations or plans (Gobet & Simon, 1996) for novices as well as for masters. Expertise in chess is gained through practice and study. It comes only from having more, better, or more efficiently organized knowledge in a domain. Gobet & Campitelli (2007) demonstrated that a long period of practice and study is required to become a master and that the best period to begin studying seriously or to join a chess club, for players who obtained a title, is 12 years old.

Chess is a game with a complex rule structure and the individual level of playing depends on representation of this rule system and it is anticipation and creative use by player during the game. Educators consider utilizing the game of chess as an instructional strategy to stimulate intellectual processes such as attention, memory, concentration, creativity and reasoning (Krogius, 1972), or to reinforce skills as concentration, problem identification, problem-solving, planning strategies, creativity and lucid thinking for students with SEN (Storey, 2000).

Chess educators from the US have argued that chess is beneficial for both intellectually gifted as well as for children with learning disabilities and hyperactive children (Horgan, 1987). There are few experimental studies on children testing the cognitive/educational benefits of chess training in comparison with studies about/on experts/masters of chess. A critical review (Gobet & Campitelli, 2006) of experimental research on children highlights few studies, some of them unpublished in peer-reviewed journals: Christiaen (1976)-testing chess and

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cognitive development; Frank & D'Hondt (1979) and Frank (1981)-on chess and aptitudes; Liptrap (1998) - on chess and standard test scores; Ferguson studies (1988) - on developing reasoning and memory through chess; Margulies (undated) - on the effect of chess on reading scores. In a very recent study Aciego, Garcia & Betancort, (2012) examined the benefits of regularly playing chess for the intellectual and socio-emotional enrichment of a group of children (6-16 years old). In contrast to the comparison group, which played soccer or basketball, the chess group had better cognitive abilities (e.g. attention, memory, concentration, planning and foresight), better coping and problem solving capacities and socio-affective development. Most of the studies which analysed the cognitive or socio-emotional effects of chess on children took place during the school year and the lessons were taught by an instructor. In Hong & Bart (2007) the experimental group (students at risk for academic failure) received chess lessons for three month (12 lessons) and the last six lessons took place in a computer lab with chess software. But the results of this study indicate a lack of cognitive benefits of chess, in contradiction with previous studies (e.g. Christiaen, 1976 or Frank & D'Hondt, 1981). The authors' interpretation is that students at risk could require more time for chess instruction and those novice chess players at risk for academic failure could hardly develop their cognitive skills until they have reached a certain level of chess skill. They did not receive chess lessons specifically developed for students at risk or with disabilities and whose needs are individually different.

Educators were concerned with finding ways of introducing chess in schools either as a curricular or as an extracurricular activity. Experiments were carried out, for example, in Venezuela (1988-89) and New York, USA (1986-1990) and chess is now a part of the curricula in nearly 30 countries around the world (Linder, 1990 cited in Ferguson, 1995).

In Romania, chess in schools is an important manifestation of the chess currently played in the country. The Romanian Chess Federation regards the implementation of chess in schools and kindergartens as a priority. But starting a national project is not very simple and there are some barriers, such as: disinterest on behalf of the Ministry of Education, a failure to inform teachers, principals and parents of the benefits of learning chess in school, the lack of a well prepared staff able to teach chess.

The strategy of the Romanian Federation was to create some pilot counties (e.g. Iasi County) which developed chess training with students with the aim of finding students with a talent for chess. This project was completed with the organization of European Youth Team Championship in 2011 and World School Chess Championship in 2012.

None of the attempts of introducing chess in school were followed by research studies in order to measure the cognitive or socio-emotional benefits that chess can bring in Romanian school. In addition to this, the importance that blended learning lessons can have on chess training has not been studied in Romania, or in other countries. Blended learning refers to a method of instruction that utilizes two or more complementary approaches to teach the same material, for example computer mediated teaching and classical instruction (Bodie et al., 2006). It is assumed that traditional chess teaching methods may not sufficiently motivate students that are very familiar with computer technology. We also know little about the minimum number of chess lessons needed to produce an improvement in school performance, memory or attention for novice students.

The purpose of this study is to demonstrate the role that chess training has on school performance, memory, sustained attention and creativity, through blended learning lessons for novice primary school students.

2. Methods

2.1 Sample presentation

Our sample consists of 20 novice chess students (Chess Group-ChG) and 18 students who participated in a fun math program (Control Group-CG) in grade III (18 students) and IV (20 students). ChG includes 10 girls and 10 boys (average age=9.85, SD= .67) and CG, 8 girls and 10 boys (average age=9.71, SD= .77). Students were distributed randomly in ChG and CG and they received parental consent to participate.

IQ was determined using the Dearborn test (a nonverbal intelligence test), standardized on the Romanian population (Bontila, 1971) Groups did not differ in IQ (ChG, average IQ = 102.4, SD=17.08; CG, average IQ=99.39, SD=13.72

Although the students and their parents signed an agreement to participate in all training sessions (chess or fun math), of the 45 students who participated in the beginning of our study, 7 withdrew for health reasons.

2.2 Procedure

ChG students received one training session per week for ten weeks. A chess contest was organized in the last week of the study. Chess lessons were delivered by an international chess grandmaster and included e-learning lessons (computer-based animations, tutorials, interactive games and knowledge testing).

The lesson titles were: board and chess pieces, how chess pieces move, checkmate with queen and the rook, checkmate with two bishops and with bishop and knight, elementary endings, multiple attacks, pinning pieces in chess, basic principles in opening.

Literary creativity, school performance in math and Romanian language (using a School Performance Test-SPT- for III and IV grades), focused/sustained attention and resistance to monotony (Kraepelin Test), verbal memory (Rey Test) and digit memory (digit span subtest of the WISC) were measured through a pretest-posttest method. These tests were applied simultaneously to the whole sample by an educational psychologist (FG).

2.3 Statistical analysis

For data processing we used SPSS 16. One-way ANOVAs for equal samples (ChG and CG) were applied as well as post hoc t-test, comparing the average of the two groups, and Pearson correlation for assessing the relationship between different tests' performance.

2.4 School Performance Tests (SPT)

The SPTs include 9 items: 5 math items, 3 Romanian language items, one item for literary creativity. Items are different for III and IV grades and they are based on the Romanian curriculum for primary grades (I-IV). The creativity item asked students to make an original composition using seven words (for students in grade III) and using four main ideas (for students in grade IV). Maximum SPTs score was 10 points (10 is the maximum mark in the Romanian education system and 5 is the minimum required to pass the test). The creativity item was also analysed separately: half of the score was given for the use of supplied data-words or ideas- and the other half for the original composition performed.

2.5 Focused Attention and Memory Tests

The Kraepelin test, which uses additions and subtractions between numbers from 1 to 9 following a certain rule, determines focused attention per minute, short-term focused attention (for five minutes) and resistance to monotony (after 11 minutes of calculation). Playing chess means maintaining focused attention for a long time, using well-established rules for moving chess pieces- skills tested by the Kraepelin test.

The Auditory word memory test (Rey test) that requires students to recall as many words as possible from the 30 read is standardised for Romanian students (Vlad, 1999). A digit span subtest of the WISC was applied in order to check digit memory. Playing chess also means memorization of the positions of the chess pieces, of the general rules of the game and the movement rules for different chess pieces around on the chessboard.

3. Results

We compared the results obtained between pretest and posttest for ChG and CG. We were interested to see whether the changes from pretest to posttest are different (larger) for ChG compared with CG. For each variable (literary creativity, school performance for math and Romanian language, focused attention and monotony resistance, words memory, digit memory) we used an ANOVA with repeated measures (pretest, posttest) in which we introduced the group variable (chess, control). Group X Test interaction has to be statistically significant as evidence for chess improving cognitive abilities.

For literary creativity, the interaction is marginally significant (F (1.36) =2.268, p=.141). When we analyse the results of SPT, GroupXTest interaction is statistically significant (F (1.36) =5.629, p=.023). This means that the results of SPT from pretest to posttest are dependent on the group, ChG being higher than CG. Differences between averages (t-test) are statistically insignificant for pretest (p>.05) and marginally significant for posttest (p=.109) (Table 1). ChG has significantly improved school performance in math and Romanian language and we assume that this was due to the chess training program.

The interaction is statistically insignificant for GroupXTest after one minute and five minutes of focused attention (measured with Kraepelin test), but it becomes marginally significant, for resistance to monotony (F (1.36) =2.903, p=.097) (Table 1) after 11 minute long calculations. While the results of CG are similar in both phases of testing, they are significantly different for ChG from pretest to posttest

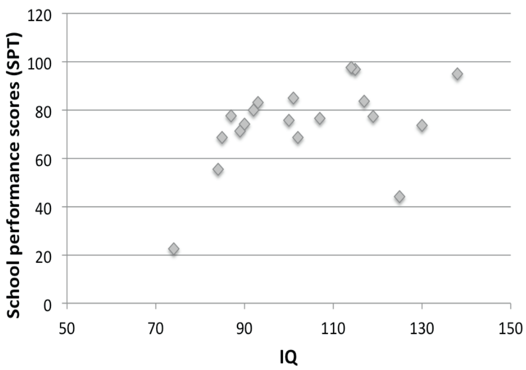
Results for the Rey test indicate an interaction for GroupXTest which is marginally significant (F (1.36) =3.073, p=.088). T-test indicates a significant difference between averages for pretest (p=.037) and a statistically insignificant difference for posttest (p>.05) (Table 1). The results of this test indicate that increasing the volume of auditory word memory is greater for CG at posttest but statistically insignificant.

Contrary to auditory word memory, the digit memory from the WISC test indicates an interaction that is statistically insignificant for GroupXTest (Table 1). Digit memory does not increase more in ChG than in CG.

For students from ChG who participated in a final chess contest, we also analysed the relationship between their intelligence quotient, the results from SPT and the ranking in the chess contest. The Pearson coefficient indicates a correlation between IQ and the results of SPT for pretest (r=.52, p=.009) and posttest (r=.48, p=.02) (Figure 1 (a)). On the other hand, the correlation is statistically insignificant for IQ and the results of the chess contest (p>.05) (Figure 1 (b)).

Table 1: The results obtained at pretest and posttest for ChG and CG

	ChG		**CG**		**Group XTest (F)**	**p**	**t-test**		**p**	
	Pretest	posttest	pretest	posttest			pretest	posttest	pretest	posttest
Literary Creativity	.255	.455	.306	.289	2.268	.141				
SPT	6.62	7.15	6.57	6.138	5.629	.023	.075	1.645	Ns	.109
Minute focused attention	12.05	16.1	9.56	15.17	.454	ns				
Short-term focused attention	43.3	68.9	43.0	63.5	.297	ns				
Resistance to monotony	48.3	63.9	62.67	65.17	2.903	.097				
Auditory words memory	8.05	10.75	6.72	10.89	3.073	.088	2.16	-.17	.037	ns
Digit memory	10.0	13.5	10.5	12.94	.467	ns				



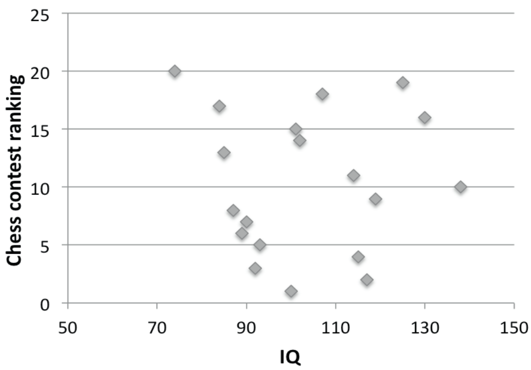


Figure 1 (a) School performance scores (SPT) correlates with IQ; (b) IQ and ranking in the chess contest are not correlated

4. Discussion

The aim of this study was to demonstrate that chess training produces cognitive benefits for novice children in primary school. The chess training sessions were held in the form of blended learning lessons. The results have improved in both groups for many of the tests applied (Kraepelin, Rey or digit memory-WISC tests). Students from ChG have improved their resistance to monotony (Kraepelin test). This is probably because chess training encouraged them to spend more time in front of the chess board and to consistently apply chess rules, which explains the increase in their resistance to monotony. The Rey test and the digit memory test indicate an improvement of the results for both groups, sometimes in favour of CG, but the interaction is marginally significant or statistically insignificant. Memorizing chess positions using letters and numbers does not necessarily mean an increase in digit memory at least in this phase of chess training for novice students. This is consistent with the results of Schneider, Gruber, Gold and Opwis (1993) that examined the role of chess expertise in memory recall in both children and adults, and both within and outside the domain of expertise. Chess skill for students shows little transfer to the memorization of digits.

The Chess Group has significantly improved school performance in math and Romanian language. This is consistent with the results obtained by Frank & D'Hondt, Margulies, Liptrap (Gobet & Campitelli, 2006) – the chess group performed on numerical aptitude and language and reading skills. As observed in the study by Frank & D'Hondt, the SPT results increase for the Chess Group and, for unknown reasons, fall for the Control Group at posttest (Table 1). Improvements in language skills transfer to literary creativity which increases for ChG.

Bilalic, McLeod & Gobet (2006) highlight that for novice chess students there is a moderately positive correlation between intelligence and chess skill thus confirming previous studies (e.g., Horgan & Morgan, 1990; Frydman & Lynn, 1992). In the cited study, the smarter children achieved a lower level of chess skill. The authors highlighted the importance of the amount of time spent on chess. The statistically insignificant correlation we find between IQ and the results of the chess contest is consistent with the results of Bilalic, McLeod & Gobet (2006).

A portrait of the student who took first place in the chess contest indicates average intelligence, poor auditory word and digit memory, but increased resistance to monotony and an approximately constant and very good performance in SPT at both pretest and posttest. Although high IQ is beneficial for school performance (as demonstrated by the correlation between IQ and SPT results) sustained attention is the most important for performance in chess (and possibly the amount of time spent in sustained training).

Blended learning chess training produced some cognitive benefits for novice chess students after a short training period (2.5 months). It is possible that in order to achieve greater improvements we would need to increase the number of chess training hours to at least 20. Another limitation of this study is the small number of students involved in the project and the lack of a comparison group who learns classical chess only with the help of a chess instructor.

This study, which is part of a pilot project introducing chess in the Romanian curriculum, showed that cognitive benefits can be obtained through blended learning chess lessons. We hope that future studies will demonstrate the efficacy of chess blended learning lessons compared to classic chess lessons, in both typically developing students and students with learning disabilities.

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