Chess as a cognitive training ground. Six years of trials in primary schools.

By Roberto Trinchero

1. Chess in schools to improve intelligence

Does playing chess improve the cognitive abilities of children? Can the game of chess help in "educating intelligence"? This document presents the results of six years (from 2005 to 2011) of trials in primary schools of different chess training strategies and a study of the relationship between chess training and improved skills and abilities of children. The trials, sponsored by the Piedmont Regional Committee of the Italian Chess Federation and funded by the Compagnia di San Paolo, were conducted under the scientific coordination of Roberto Trinchero and organisational coordination of Alessandro Dominici. Andrea De Magistris, Mariella Piscopo and Giuliano D'Eredità (University of Palermo) collaborated in the research. Roberto Rivello was in charge of the trial.

The starting point of the trials were the numerous empirical studies that have shown positive relationships between playing chess and intellectual abilities. According to these studies, systematically playing chess is linked to the ability to maintain a high level of attention and concentration on the task, to focus on details, to persevere in the pursuit of objectives but also to derive information from situations and use it in planning strategies, to critically reflect on one's actions and to predict the course of events. These abilities are particularly important in school-age children as they can have a non-marginal impact on their achievement in curricular subjects.

Nevertheless, the findings of previous studies have also shown that the causal direction of the relationship is uncertain (Gobet and Campitelli , 2002). There are three possible scenarios to support the empirical evidence collected: a) the game of chess actually improves people's intellectual abilities, b) those with better mental abilities play better chess, achieve better results and thus tend to play more; c) there are intervening factors such as motivation towards the task, the ability to consider several alternatives and decide which is the best in a limited period of time, which mediate both the expression of intellectual abilities and ability in the game of chess.

Apart form these issues, it is undeniable that the game of chess can be considered a true “cognitive training ground”. Competition inherent in the game motivates children to grapple with numerous minor problems of a cognitive nature, for which they must plan possible solutions, evaluate them, decide which is the best, experience their choice and have an almost immediate feedback on the consequences of their decisions. This process is useful in developing their decision-making autonomy, responsibility for their actions and acceptance of the consequences. “Autonomy” and “Responsibility” are precisely the terms used to describe competence, defined by the EQF - European Qualification Framework as the “proven ability to use knowledge, skills and personal, social and/or methodological abilities, in work or study situations and in professional and/or personal development”.

“Think before acting”, adopt a strategic approach, evaluate strengths and weaknesses of the various options, reflect on one's mistakes and abstract rules of conduct, consider several factors simultaneously and make an effort to reach a goal are just some of the lessons that chess can teach children. Through play

children can socialise with each other and - on a nearly equal basis - with adults, develop empathy towards others and learn to win and lose and develop self-esteem.

Learning the game of chess thus provides the opportunity to deal with a set of cognitive and relational processes of particular importance for the education of children and youngsters and it is therefore important that this opportunity is provided at school, both to give all children the same chance of learning and to emphasise the relationship between skills involved in playing chess and those involved in learning curricular content.

2. Six years of Chess trials in Schools.

1. In the 2005/2006 school year pilot trials were conducted in the third, fourth and fifth years of primary school and the first year of first-level secondary school (involving 290 students in the provinces of Turin and Cuneo). The study design randomised children into two groups: both groups were administered a pre-test to measure their logical-mathematical competences, then one of the two groups was given a chess course during class-time, for a total of 10 hours, while the second followed the normal teaching schedule; both groups were then administered a post-test similar to the pre-test. In most of the trial classes there was a significant difference between the pre-test and post-test scores, however, there were no significant differences between improvements by children in the trial classes and those in the control classes (a significant difference was found only in one school). These trials revealed that a 10-hour course is not sufficient to produce any visible effects on pupils' cognitive structures and that the lack of uniformity between trial and control classes could have a significant influence on the results.

2. Based on the results of this pilot study, in the 2006/2007 school year a trial based on a 30-hour course in class-time was designed. This trial focused on third year pupils (8 year-olds), paying particular attention to matching trial and control classes in each school so as to be able to have utmost uniformity between the two groups. It was expected that after acquiring the fundamentals of the game of chess in a 30-hour course (plus possible games by themselves) children would be able not only to give an exact answer to the questions in a logical-mathematical proficiency test (*product*), but also to more adequately explain the *process* followed to arrive at the solution. The pre-test was administered to a total of 289 children in a total of 14 third year classes at 4 primary schools. From these 14 classes, 4 trial classes and 4 control classes were identified, for a total of 166 children, on the basis of the similarity of results obtained in the test. The two protocols were then administered: 30-hour chess course for the trial classes and normal teaching schedule for the control group. The results differed according to the experience of the instructor and factors related to the characteristics of the class: in the trial classes where experienced instructors worked, who were able to motivate children towards the game, establish a good relationship with them and were adequately supported by class teachers, there were significantly greater improvements in logical-mathematical skills than in the control classes.

3. In the 2007/2008 school year, a trial was carried out to identify whether playing chess with the aid of an on-line software application designed to teach the fundamentals of the game (developed by the Piedmont Italian Chess Federation (FSI) Committee in collaboration with the CNR in Rome, under the scientific supervision of Domenico Parisi and available at www.scacchiedu.it) might affect the broader comprehension skills of children in the third year of primary school. It was expected that children who have been taught certain basic chess skills would be able to apply those skills to non-chess content and that the use of this skill by the group of children trained with the chess software would not differ from that by the

group of children who followed the traditional course. The study was conducted on a third year class of 22 children (9 girls and 13 boys) at the "F. Costa" School in Saluzzo (Cuneo). The class was divided into two groups: 12 children followed the traditional chess training course and 10 followed the computer-assisted course. Despite the limited validity of conclusions due to the design of the research (small and not representative sample, absence of a control group), verification of the hypothesis showed that in order to have significant improvements in a given skill, training must be targeted to increase the skill in question, that is, induce children to use that specific skill. For example, if the training does not induce the use of the skill of exemplifying configurations (such as checkmate) on the chess board, it will be harder for the child to demonstrate that skill in the test. Computer-assisted chess training appears to have the same level of effectiveness as traditional training and a chess course of only 8 hours appears to be largely insufficient to have an impact on competences and skills.

4. In the 2009/2010 school year, focus was placed on the effectiveness of different chess training strategies in schools. The empirical research aimed to verify, on a nationwide sample of 813 children in 29 Primary schools (selected by random sampling and therefore with no claim to be representative), the presence of significant differences among the chess skills of children trained using four different strategies: the on-line chess training software already mentioned, a course with the presence of an FSI instructor, a course with an FSI instructor supported by class teachers and a course with two FSI instructors supported by class teachers. For the trial, four groups were created and a pre and post-test was administered to each one in order to measure chess skills before and after training and quantify any improvements in these. The results showed a significant difference in the results obtained with two instructors and, therefore, such training method can be considered significantly better than the others, while there was no significant difference in the results obtained with computer-assisted training, lessons by a single instructor or by a single instructor supported by class teachers.

5. In the 2010/2011 school year, a study was conducted on teaching chess fundamentals to children in the first year of primary school using psychomotor strategies. The research objective was to determine the effectiveness of Giant (floor-standing) Chessboard Psychomotricity (GCP) on a set of basic skills of children in the first year of primary school, taken from the National Guidelines for the 2007 Curriculum, measured by the class teacher during two observation sessions (pre- and post-training). The research was conducted according to a pre-post trial plan with a control group and involved 3 schools and 7 classes (6 trial classes and 1 control class) for a total of 142 pupils. Notwithstanding the limits of the trial (small sample size, evaluation by teachers and not by external observers, absence of inter-observation to ensure reliability of pre-post observations by the class teacher), the results showed how psychomotor activity (carried out in 16 one-hour sessions with the children, in class-time) had significant effects on a number of skills taken into consideration.

6. In the same year, the SAM (in Italian Scacchi e Apprendimento della Matematica - Chess to Learn Mathematics in English) project, sponsored by INVALSI (the National Institute for the Evaluation of the Education System) was launched, under the scientific coordination of Alberto Martini, Gianluca Argentin, Barbara Romano, Roberto Trinchero and organisational coordination of Alessandro Dominici. The aim of the study was to verify the hypothesis that 30 hours of chess training during class-time, with an instructor, could lead to significant improvements in the results of national second year primary school tests set by INVALSI compared to a control group not having received such training. The research was conducted on 2,000 children (123 classes from 33 schools throughout Italy, with participation on a voluntary basis, involving 16 provinces in 12 regions) in the third year of primary school (eight year-olds). It involved a pre-test (November 2010), essentially reproducing the national INVALSI test for the second year of primary

school, and a post-test (May 2011) based on the same skills as the pre-test but with items formulated slightly differently. The trial and control groups were created randomly: each school enrolled at least two classes and a part of the classes enrolled were randomly selected and excluded from the training. All schools had at least one class enrolled in the training. The results showed significant improvements in the scores of the trial classes compared to the control classes (Average Treatment Effect for the Treated, ATT, equal to 0.38 standard deviations higher).

3. The results of six years of research

Despite the limited sample sizes considered and the fact that the same were not representative, from the experience of six years of trials it is possible to draw a number of conclusions:

1. The game of chess can be a valuable aid in the improvement of cognitive skills, provided that:

a) Training courses last for a sufficient number of hours: in our experience at least 30 hours of training in a school year are required to see significant improvements in terms of logical-mathematical skills.

b) The method used by the instructor is such as to motivate children to play outside the limited number of hours of the course. To this end, the instructor's experience and the motivation provided by the teacher also play an important role.

c) The game is effectively presented as a "game", without creating expectations and responsibilities in children that would distort the value of the game as a learning activity.

d) The setting (i.e. the set of environmental and contextual conditions in which the training takes place) is such as to put the pupil in a position to learn to play at ease, without pressure of any kind, and this means cooperation from teachers, good classroom climate, absence of pressure on the children, etc.

2. More than the number of hours of chess played after the course, improving cognitive skills appears to be linked to learning the logic of the game (values, moves, positions, strategies). The number of hours played is nevertheless important to ensure these concepts are well assimilated. The improvements that were found appear not to be affected by factors such as gender of the children, leisure activities, favourite games and scholastic achievements.

3. Given that the key factor seems to be learning the logic of the game and development of motivation towards the same, it may be sensible to introduce children to chess already in the first and second years of primary school, for example using psychomotor strategies. The trials carried out with Giant Chessboard Psychomotricity show that it is precisely learning the logic of the game in a structured training environment (i.e. with an instructor trained specifically in this sense) that improves a series of logical and expressive skills in children, which then support scholastic success in a variety of subjects.

4. To improve specific skills the training must focus on such skills. For example, if the objective is to improve the ability to exemplify configurations on the chessboard (such as checkmate), it is necessary to propose activities targeted in this direction and not generic activities in which the ability in question is only used in an ancillary role.

5. Children able to better demonstrate certain skills with regard to general content also seem to demonstrate them better in chess, but this does not appear to be true for all skills taken into consideration in the 2007/2008 survey.

6. If the objective of the training is not to obtain any effect on the logical-mathematical skills or basic skills of the child but only provide basic chess skills, ten hours of training in a school year is the minimum time required to see the first results. Courses of shorter duration are likely to be counter-productive since presentation of the equipment used to play chess and the rules of the game are not followed by playing the game itself, which is essential for the acquisition of chess skills. A child presented with the pieces and rules but who is not given the opportunity to be guided, in a non-sporadic manner, in learning the game, could see chess as “confusing” and “difficult” and reject rather than approach it.

7. The chess courses held using the software developed by the Piedmont Regional FSI Committee in collaboration with the CNR in Rome (www.scacchiedu.it) were found to be as effective as single instructor courses.

8. Particular attention must be paid to respecting children's learning time. While in attendance courses the presence of an instructor may induce children to “respect the course timing”, with the computer course children can get "lost" at the beginning or need more time to assimilate the basic rules and reach the guided game levels. Computer-assisted training therefore requires more time and it is important not to “hurry” children, forcing them to put in a fixed number of hours, the same for everyone.

9. Conducting tests to assess what has been learnt and getting feedback on one's learning is the best way to learn. In attendance training, the possibility of providing feedback is increased by the presence of a second instructor and teachers who follow children during training. With computer-assisted training, feedback is obtained via the level tests and in games with the computer and with colleagues. This result emerged very clearly from this research project.

10. To learn it is necessary to start from the assumption of “not knowing”. The best results, both in terms of improvements between pre-and post-test scores and in terms of absolute results achieved in post-tests, were achieved by those who said they did not know how to play chess before the course, regardless of the teaching strategy used. “Already knowing” does not appear to help learning.

Notwithstanding the limitations mentioned previously, these first results provide what we believe to be a particularly important framework of principles that, precisely because they are in line with findings from other studies and research projects, should be taken into special consideration in planning chess activities in primary school.