PRESENTATION OF RESEARCH WORK IN PROGRESS: CHESS AS A TOOL FOR MATHS EDUCATION

Giuliano D'Eredità
University of Palermo, PhD Student

INTRODUCTION

My research work is concerned with chess as an integrative tool in Education, with particular respect to Math Education. I work on connections between chess practice and growth of logic and metacognitive skills, that are relevant for learning in scientific field. The choice of this subject is due to the fact that I am strongly interested both in chess and maths education. In fact I am Phd student in a doctoral course named "*History and Didactics of Mathematics, Physics and Chemistry*", my tutor is Prof. F. Spagnolo, and also I am a Chess trainer, in particular at the moment I am the President of the Didactical Commission of Italian Chess Federation. Till now I realized 3 experimental investigations in sicilian schools (Low secondary schools), and one investigation on-line, over entire Italy (primary schools), is in progress.

THEORETICAL FRAMEWORK

Since last century several researches were realized whose aim was to find possible links between chess practice and various skills and abilities. Different types of skills were considered, like cognitive skills, or social, with reference to specific fields also.
Various works were published, and some basic items were sharply outlined. Several studies were dedicated to scholastic context, considering groups of students engaging in chess practice and their educational path. There are also studies on non-scholastic contexts, like chess clubs or population in general.

Interesting resuls were obtained. The big project "*Learning to think*", (Venezuela 1979-83, cfr. FIDE report 1984) showed general, positive effects, i.e. performance in generic tests, like QI valutation before and after chess practice (4-5 months). The QI was measured by *Wechsler Intelligence Scale for Children*. Other investigations were made about cognitive development. Very interesting the research conducted in Belgium by Johan Christiaen on 10-years old childrens, in which the experimental group performed better than the control one. Experimental group children had 42 hours of chess practice.
Very important and well structured, in my opinion, is the study *"Scacchi : un gioco per crescere (Chess : A game to grow) "*, realized in Italy (Piemonte Region) in 2007 by Turin University (Trinchero e Piscopo), in which effects of scholastic chess practice were examined with respect to cognitive factors connected with the logical skills of children (8 primary school classes). In this study results highlighted good performances by the experimental group, in particular *it was noted that improvements of experimental classes are concentrated on items requesting maths abilities (sum, subraction, moltiplication, division) and capacity to extract rules from a situation and to apply them.* It is fundamental, in my opinion, what the authors highlight regarding the use of chess as a tool to improve cognitive skills. It concerns the duration and tipology of the chess practice, in particular the recreational approach; synthesizing, educational actions involving chess can't be based only on assumed intrisec validity of chess practice, but these action need an appropriate course embedded in the context (milieu). This holds true also in a more general sense, in fact a research in maths education must take into account that every activity depends strongly on context, as stated by Schonefeld (2000) :*... the subject of research (a teaching method, or a particular content, etc), i.e. a curriculum is defined "implemented curriculum " only through the*

operations the teacher does in the classroom (or laboratory, etc) using materials (related to subject), and all connected pre-operations, and It is a strong relation between curriculum and context, you have to consider to evaluate the effectiveness of the curriculum itself.

Other interesting researches estabilished relations between chess skill and other abilities, like in *Chess and Aptitude* (Frank 1974). As Ferguson pointed out, *"This result tends to demonstrate that chess skill it is not due to the presence of one or two abilities in an individual, but a great amount of actitudes work together in chess"*. More in depth, other researches highlighted good results about problem-solving abilities, reading skills, and about memory and verbal reasoning. Very relevant also results obtained by Ferguson about critical and creative thinking.
As mentioned above, my principal focus is chess and maths education.
There were some specific studies about. The research "Comparative study on learnings in maths" was realized by Louise Gaudreau in Canada (1992), involving 3 groups of 10 years old children, in total 437. The experimental group had better performances concerning problem solving tests, but not in basic arithmetic calculations. Another important research was done by Liptrap in 4 elementary schools in Texas (1997). Abilities were considered in reading and maths using the Texas Assessment of Academic Skills (TAAS) .The experimental group performed better both in reading and maths, especially the medium-level students.
These results are encouraging, but many aspects deserve more deepening.
In fact, as stated by Gobet and Campitelli (2005) the "ideal experiment" is not realized till now (and maybe is not realizable at all..).

RESEARCH WORK

EXPERIMENTATION 1
First, I am trying to consider the nature of chess thinking, and which cognitive resources are used by chess players. In particular, taking into account important results obtained by cognitive psychologists in exp. investigations on chess players, my first experimentation concerned mainly using of pattern recognition and metacogntive skills by young chess players. Thıs represented for me a starting point to consider subsequently the connections with maths education. The investigation took place in a Low Secondary school in Palermo (28 students 11-14 years old). We chose appropriately the test (a chess position), and we gave it to students of the sample, specifying what they had to do exactly (in an open-answer questionnaire). In the a-priori analysis I have explained the expected behaviours, and I formulated the following hypotheses:

1. Using symbolic language leads to better results (to solve correctly the test)
2. Preliminary framing and correct spatial orientation lead to better results (to solve correctly the test)
3. The chess player argues and conjectures to make a choice
4. Discipline and consistency of thought lead to better results
5. In making a choice the chess player uses pattern recognition as basic element of IF/THEN reasoning
6. Using patterns allows correct arguing and leads to better results

As a consequence, there were identified several binary variables to be used for protocol-analysis, and to perform a quantitative analysis supported by Software CHIC (implicative Analysis). No many students framed before the problem, and this showed no connection with better results. I obtained a good push to the hypothesis of the pattern recognition as guide and inspiration in chess thinking, and leading to better opportunities in framing and concluding a problem. In fact arguing and conjecturing were carried out with a clear reference to expertise. It is difficult for players without a basic chess instruction to reach concrete results by exhaustive analysis only. It can be

connected to what happens in mathematics or in physics when students hardly solve problems without a form of *recognition* of a known configuration or a tool. We noticed also that chess player shows strong inclination to reach a conclusion in any case.

EXPERIMENTATION 2

The second experimentation was realized in a secondary Low school (the same school of exp. 1, 56 students, all about 11 years old) and consisted of maths skills pre-test and post-test. In the time between the tests, a group of students participated in a chess course. This because my primary interest is the connection between chess practice and maths skill The control group was chosen by evaluating the performances in pre test. Both tests was close-answer tests, chosen from those adopted by INVALSI (Italian Government Agency for School Evaluation). With respect to content, tests included 3 item types: "Number", "Geometry " and "Data & Measures", according to the INVALSI classification. Results was not brilliant, in synthesis the control and the experimental group performed more or less equal. The nature of the test led me to try again with a similar test, in another school, but changing some questions in open answer questions, and considering also processes.

EXPERIMENTATION 3

The third investigation was held in a Low secondary school in Agrigento, involving 45 students about 11 years old. Also in this case a pre-test was submitted to the students; after the chess course (30 h, 10 students participated) a post test was submitted, very similar to the previous one. Both tests included maths skills, with the same classification with respect to content, and introducing a classification with respect to processes. Items were roughly divided in "reproduction" and connection", according to PISA definition. Results were analyzed matching the performances of 3 groups: all students, "non chess players group", and "chess players" group. Notwithstanding the limitation due to poor statistics, results were good for chess players group, who improved the general performance in the post-test, and in particular the performances related to "connection" items. This is coherent with other results present in literature.

EXPERIMENTATION 4

The last investigation is in progress, and consists of a research realized in collaboration with Turin University and CNR (It. National Research Council).This research is involving about 1500 children over entire Italy, about 7-8 years old. The main goal of this research is related with on-line learning matched with traditional teaching/learning in chess, but also we inserted maths item to evaluate performance before and after the on-line chess course. We received already most of data, but not the entirety.

CONCLUSIONS

Summarizing, it is my opinion that chess, like other similar activities, may be very useful for education, mainly because of engaging students in a high-level intellectual activity, in a form of *play*. This in particular for primary school. With respect to maths skill, there are good outputs in problem solving, and in topics in which lateral or critical thinking is involved. This, as also mentioned above, is strongly depending on context. More wide educational goals are well supported by chess, like respect and facing difficulties by own capacity, without external helps. This is relevant especially in particular scholastic contexts located in areas at risk. This aspect is not central in my work, but deserves attention because of the great efforts produced by Italian Government and by European Union (obj. 1)

Now I am working main about the development of mathematical skills through chess, and in particular on data of experimentation 4. Besides, I also want to improve my theoretical framework, in particular inserting chess practice and its benefits in more general maths education theories.

REFERENCES

- S. Bartolotta, un approccio euristico alla strategia, alla storia della strategia ed alla didattica degli scacchi: gli assiomi strategici cone concezioni ed ostacoli, Quaderni di Ricerca in Didattica n.7,1997 G.R.I.M. (Department of Mathematics, University of Palermo, Italy)
- L. Barzanti, S. Fabbri , Gli scacchi come strumento per la didattica della matematica, Quaderni di Ricerca in Didattica, n. 16, 2006. G.R.I.M. (Department of Mathematics, University of Palermo, Italy)
- Binet A., Psychologie des grands calculateurs et jouers d.éches, Parigi, Hachette, 1894
- Binet A., Mnemonic virtuosity: a study of chess players. Genetic Psychology Monographs, 74, 1966, Tradotto da : Revue des Deux Mondes, 117, 1893
- Brousseau G., 1997, Theory of didactical situations in mathematics. Edited and translated by Balacheff, Kluwer academic publishers.
- G. Campitelli, F. Gobet , K. Head, M. Buckley, A. Parker , Brain localization of memory chunks in chessplayers , International Journal Of Neurosciences, Vol. 12 December 2007 , pag. 1641 - 1659
- Chase W.G., Simon H.A., Perception in chess, Cognitive Psychology, 4, 1973
- Chase W.G., Simon H.A., The mind's eye in chess, In Visual information processing,W. G. Chase (Ed.), New York, Academic Press, 1973
- Ciancarini P., I giocatori artificiali, Milano, Mursia, 1992
- De Groot A.D., Gobet F., Perception and memory in chess, Assen,Van Gorcum, 1996
- Cordara, Magnoni, Pascolo "Scacchi e Scuola una partita giocata a più mani" Edizioni Junior 2004
- De Groot A.D., Het denken van den schaker, Amsterdam, Noord Hollandsche, 1946
- De Groot A.D., Thought and choice in chess, The Hauge, Mouton Publishers,1965
- De Groot A.D., Thought and choice in chess (2nd Ed.), The Hauge, Mouton
- D'Eredità, G. , Chess as an integrative tool in Education: Logic and metacognitive skills in chess thinking, Acta Didactica (Univ. of Nitra), 4/2008
- D'Eredità, G., Spagnolo F. , Le diversità culturali nelle concezioni di Strategia e Tattica tra Oriente ed Occidente osservate attraverso gli scacchi ed il wei-ch'i e le connessioni con la Didattica, Quaderni di Ricerca in Didattican. 19, 2009
- D'Eredità, G. Nuovi stili cognitivi per il secondo millennio: Analisi di un caso, il Freestyle negli scacchi, Scacchi e scienze Applicate 2009
- Diderjean, Ferrari, Marmeche"Nel cervello di un grande maestro"- Mente e Cervello marzo-aprile 2004, pag. 74
- Di Sario P.Apprendere e applicare Strategie seguendo un modello cognitivo per il Gioco degli Scacchi, Tesi di laurea A.A: 2001-2002 Università di Bologna
- Gobet F., Simon H.A., Templates in chess memory: A mechanism for recalling several boards, Cognitive Psychology, 31, 1996
- Gobet F., Simon H.A., Expert chess memory: revisiting the chunking hypothesis, Memory, 6, 1998
- Gobet F., Les mémoires d.un jouer d.échecs, Friburg, Editions Universitaires,1993
- F. Gobet & G. Campitelli, Educational benefits of chess instruction:A critical review T. Redman , Education and chess, 2005
- J. Levitt, Il Genio negli Scacchi, Milano, Messaggerie Scacchistiche, 1998.
- James M. Liptrap, Chess and standard test scores Chess Life, March 1998, pages 41-43

- R.Mascolo e R. Trinchero, Tra classi e bit, in "Scacchi e Scuola" Edizioni Junior, 2004
- M.T. Mearini, Il gioco degli scacchi. Alcune considerazioni di carattere pedagogico, Scacchitalia n. 4 marzo 2008, pag. 28
- Reingold, E. M., & Charness, N. (2005). Perception in chess: Evidence from eye movements. In G. Underwood (Ed.). Cognitive processes in eye guidance (pp. 325-354). Oxford University Press.
- Saariluoma, "Chess and content-oriented psychology of thinking" Psicológica (2001), 22, 143-164.
- Schonefeld, A.H."Purposes and methods of researches in Maths Education", Notices of AMS, 2000
- Spagnolo F., 2006, La modélisation dans la recherche en didactiques des mathématiques: les obstacles épistémologiques, R.D.M. (Recherches en Didactiques des Mathématiques), 26/3, pp. 337-380, La Pensée Sauvage Edition, Grenoble (France)
- Trinchero, Piscopo, Gli scacchi un gioco per crescere, Torino University, 2007
- A.Wild, Giocare a scacchi – Manuale per insegnanti , Ed. Ediscere