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The Game of Chess Is a Valid Tool for Supporting and Enhancing Logical-Mathematical Skills and Cognitive Abilities

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Abstract

Through the interpretation of the illustrated point of view of the world champion Garry Kasparov, we want to demonstrate how valid the practices of chess are to promote the development of high skills that touch all the vital dimensions of the human being.

Learning is a fascinating process of the human brain and the billions of neurons in our brain, with their complex connections, represent the basis for advanced cognitive functions and more. But this is not enough to develop transversal skills that can be stimulated thanks to constant and in-depth study and play activities experienced with passion and method.

Keywords: Chess, AI, Skills, Training, Interdisciplinarity

INTRODUCTION

Play accompanies the history of man and marks time and space. It is connected to the vitality of the person and characterizes emotional, cognitive, affective aspects but also lifestyle, free time, ethics, relationships with others. Play is widespread in the world, everywhere, so much so that to recognize its elements and its social and cultural functions it is possible, by placing it in a specific historical period, to observe how it manifests itself and evolves in any situation.[1]

Most histories place the origins of chess in the precursor chaturanga , in India before the sixth century. From there chess moved to Persia, the Arab and Muslim worlds, where it followed the well-trodden path through Moorish Spain and on to southern Europe. In the late Middle Ages it became a standard feature in the courts of Europe, and appears regularly in manuscripts of the period ever since. The modern game we learn today also appeared in Europe in the late fifteenth century. With some modifications in rules and applications, the games played in the eighteenth century were identical to those played today.[2]

CONTEXT: CHESS AND SCHOOL

An example of the value of this sport is its implementation in the school environment - through specific and appropriate methodologies adopted by qualified teachers - to support other actions and to promote the development of the educational process of the students. The programs developed in many schools illustrate the reasons that demonstrate this value and the effectiveness of training activities provided and/or promoted by sports associations of the game of chess at a national and international level that do not hinder or slow down the work of the teacher, but can become an excellent tool for significant learning and support for further implementations in daily teaching. [3]Today the challenge of the school is to build a range of skills for all students of any age, which allows them to fulfill themselves and face life successfully: [4]adapting to new and unpredictable situations, developing critical and reflective thoughts and taking responsibility to make right and sustainable choices and solutions, require the application of strategies and human qualities that are often little encouraged in formal contexts. Being creative, imaginative, enterprising, accepting mistakes as strengths to improve performance, working in a team respecting the rules of democratic coexistence, sharing with empathy, resilience, tolerance, are essential criteria for designing teaching models aimed at training future citizens and developing new professional skills that can be used in the world of work. The European Parliament with Declaration no. 50/2011 adopted on 15 March 2012 on the introduction of the "chess at school" program in the educational systems of the European Union, expressed a clear position in favor of the game of chess as an educational tool in schools.

Learning to play chess is therefore "a means to facilitate the maturation of the student and to accelerate the growth of his logical faculties, entertaining him at the same time". Through practice, profound concentration skills are acquired, mental processing characteristics are strengthened - without any effort -, the formation of the student's social conscience is encouraged through respect for the rules and the opponent of the game, the increase of correctness, the acceptance of defeat and adaptation to reality. Some connections between the formative essences inherent in the game of chess and the educational objectives of the school are evident. "Chess is a real sporting discipline recognized by CONI, very useful in the pedagogical path that helps the school-age child to reach a series of fundamental objectives in the development of the mind, personality and social behavior".[5]

OBJECTIVE

The dissemination of the game of chess through sports facilities, recognized in the territory, allows anyone to play for fun and has the objective of promoting both the identification of young talents and the harmonious development of their playing skills while respecting their personal psycho-physical needs. Why can education become one of the possible fields of application of gamification ?

Gamification is understood as a way to teach new content to students of all ages. One of the most difficult obstacles to overcome is maintaining the attention and concentration of students. In training courses, especially through Kolb's experiential learning [6], the playful approach is an element that helps the transmission of content, with the added benefit of increasing the productivity and commitment of participants.[7] A formative aspect of chess is the intense psychological and physiological effort - implicit in a competitive game - and the subsequent crisis that comes from the same game especially when defeat and the feeling of frustration occur. What sports science calls "the stress response process" is at least as powerful in chess as in more physical sports. *When I say effort, I do not only mean the mental gymnastics of moving the pieces in our mind, but also the enormous nervous tension that fills you before and during*

the game, tension that rises and falls with every move and every idea that crosses your mind while you're at the chessboard[8]

METHODOLOGY: CASE STUDY

The case study represents a research strategy (case study) that consists in the analysis of a specific case . It is based on documents, observations, data collection and interviews to learn how to deal with more complex situations. In the school environment, generally, there is a tendency to collect qualitative data that favor longitudinal and ecological analyses with attention and care for the historical reconstruction of phenomena, events... that are recorded in schools.

We cite a research carried out in schools in order to observe the relationships between chess skills and logical-mathematical skills. In the 2005/2006 school year, a pilot experiment was conducted on third, fourth, fifth grade and first grade middle school classes with 290 students involved, distributed in the provinces of Turin and Cuneo. (R. Trinchero 2012)

In this randomized controlled experiment:

a) Both groups were administered a pre-intervention test designed to detect logical-mathematical skills;
b) One group was given a 10-hour chess course during school hours, while the second group received the ordinary teaching program;
c) Both groups were then subjected to a post-intervention test similar to the first.

In most of the experimental classes, a significant difference was found between the scores achieved in the pre-intervention test and the post-intervention test; however, no significant differences were found between the improvements in the experimental classes and the improvements in the control classes".[9]

More in detail, the ANOVA and Krusal Wallis statistical tests were performed. [10]The empirical results were significant in some experiments, however, the effects on learning are limited, as 10 hours of course are not enough to have visible effects on the cognitive structures of the students and as the non-homogeneity between experimental and control classes could significantly influence the results. The interest of the research is to detect how the transmission of concepts elementary theoretical and practical chess course - of first level- brought the students to a knowledge Enough complete of the fundamentals theorists of the game and provided them with a instrument pleasant and challenging for the development of the thought formal. With the improvement of the ability to reflection, analysis and synthesis , therefore, both logical and concentration skills are developed as well as other skills such as: the exercise from the patience, emotional control, hand-eye coordination, creativity. In addition, the process of self-assessment, healthy competitiveness, respect are encouraged of the other and promotes the development of personality in relation to the real and social environment.

MAN VS COMPUTER: DISCUSSION

On the game of chess there is an immense book production in which the various techniques are widely developed , chess problems are exposed and the games played between nations and the most important ones at a world level are illustrated. This literature is greatly increased from the moment in which technologies have supported man during the games.

We have studied *"Deep Thinking: Where Machine Intelligence Ends and Human Creativity Begins"* by Garry Kasparov. He reports what Aleksander wrote in his text: "In the mid-1990s, the number of people with some experience in using computers was infinitely higher than in the 1970s. In Kasparov's defeat, these people saw a great triumph of programmers, but not of a kind that can approach human intelligence and help us live".[11]

Through these words, it is well understood how mental organization and concentration are essential for professional chess players when dealing with properly equipped and human-like machines. A chess game is a heated competition and when You're under pressure, the clock [12]never stops ticking, mental discipline falters and even the most gifted tactician can have a moment of board blindness.[13]

The author of the book *Deep Thinking* in the chapter "Man plus machine" talks about the sixth game played in May 1997 in New York between the IBM Deep Blue computer and himself. He himself says that since the 80s he had played and won against some computers: in 1985 he defeated 32 in 5 hours. Vice versa in 1997 a single computer managed to defeat him in a tournament. Here, it is worth noting that the interaction between chess and AI began in the 50s. Turing (1951) designed a chess program, " Turochamp ", initially played on paper, Turing himself agreed to replace the processor. [14]Claude Shannon, John von Neumann represent the two main references for understanding the concepts of decision tree of moves, MINIMAX algorithm and alpha-beta pruning: the techniques still today at the basis of a chess computer.[15]

An interesting contribution was made by Botvinnik. He too won the World Championship more than once, was also an electronics engineer and was the first world champion to be directly involved in the creation of a computer that could play chess. This is a quote from his 1970 book, " Computers, chess and long-range planning", freely translated

Why was Wiener bad at chess? Why couldn't he predict moves that were obvious to an opponent? Shannon asked me these questions in 1965 and I could only shrug. How could I know? This is an extremely important question. No one can doubt the profound intelligence of Wiener, a great scientist. No one can doubt the profound intelligence of Alekhine, a world chess champion. Why was the former hopeless at chess, while the latter was hopeless at mathematics? I think we can speculate on the reasons for Wiener's mistakes on the chessboard.

A player, while thinking about a move, does not use other tools. He cannot ask anyone for advice, no book to consult, or notes, with calculations already written down. He is limited by the time available, he cannot repeat a move. The mental algorithm does not change over time. A player has only one way to build and analyze the map of possible moves to make a decision. If we use a computer as an analogue of our mind, there is no doubt that what we need is to dedicate the activity to operational calculation.

Conversely, for a scientist, these qualities of a 'chess warrior' are not necessary. A scientist has the ability to solve a problem without such stringent time limits, to correct his own mistakes, to take advice, to use notes and even machines. Above all, he must have the ability to do research.

That is? The ability to solve problems of various kinds. If we use the analogy of the computer, the ability to build and test programs of different kinds.

However, computers from the 60s and 70s are structurally very different from those of the 90s (and even more so from contemporary ones). Today, however, in the second quarter of the 21st century, any free app on a modern smartphone is much stronger than these models we are talking about, and despite everything, people continue to play with them.[16]

Returning to the 90s, Kasparov in his autobiographical text recounts some of his adventures with non-human opponents and reports that "after having suffered the defeat with Deep Blue, the only really effective and positive aspect for him was the thought of a victory for humans too because, after all, it was humans who built those machines.

After that chess match, he reports in his text that other matches followed and, according to various experts, despite the first defeat, Kasparov continued to show himself stronger and more creative than Deep Blue, even if with a less analytical tactic in his moves. The concrete goal for Deep Blue was to beat Kasparov, an end in itself, not to create a generalist super-computer.

Kasparov's relationship with artificial intelligence emerges in his book. For him it is evident that the latest frontiers of scientific investigations are increasingly turning to refined technologies, computer and automated procedures typical of artificial intelligence. Regarding the use of technology by young chess players, he always reports in his text that the talented kids with whom he has been working for ten years within the Young Stars program of Kasparov Chess Foundation were aged between 8 and 18. These kids, starting early to operate the machines and learning the first moves, will probably have different developments compared to the generations starting from the 1980s".[17]

In several cases, young people who are asked to explain whether a move in the game is good or bad and why it was used (in the initial phase) answer that it represents the main line . Other answers were: "because it is the best move" or "because the computer recommends it".

Kasparov continues to describe his students' responses by saying that "the kids want to skip this first part and go straight to the next one. to the second where previous analysis and old games say to go ahead without thinking for themselves ... Paying attention is exactly how machines play, using the book of openings; a database of games and theories of Grandmasters. Humans who play this way will have the same gaps. What if there is a mistake in the book? If you follow it blindly and your opponent has prepared a difficult novelty along the line you are following? It becomes obvious to answer that if a move has been recommended by strong players and computers for a long time, it is most likely the best move."[18]

Kasparov also considers that "Thanks to smartphones and the use of Google, Wikipedia… we become instant experts on any subject. But this does not make us so different from when we used the encyclopedia, the telephone directory and libraries. It is just a phase in the process by which technology allows us to create and interact with more information and faster and faster.[19]

The danger is not intellectual stagnation or dependence on search engines and instant facts." The acquisition of much more knowledge cannot only serve to carry out immediate tasks or respond to a question, unless we wish not to approach the highest goal of wisdom.

In this sense, Kasparov exposes how evident today is the use of chess engines by young people who once learned the style of play through the guidance of their first masters. He asks, "What happens if the first teacher to influence the student is a computer? A machine is not interested in style, patterns or theories consolidated over centuries of history. She calculates the value of the pieces, analyzes a few billion moves and then recalculates it again."

Here the author continues the discussion by stating that the use of the database by chess players It helps them to assert themselves in terms of play even at a very young age.[20]

Having millions of games at your fingertips on a database allows you to lower the age threshold for players at the highest levels. At the same time, while some are stimulated by the opportunity to prepare with chess engines to become more creative, others, instead, have become more cautious feeling fearful of the opponents they will meet in the game.

For Kasparov in the 1970s, during the game it was exciting to have a chess engine at his disposal, especially during the opening , because this did not involve any memory strain, which was already supported by a database with a million games.

He reports that "having a computer as a companion also meant not having to worry of making serious tactical errors. Human creativity, under these conditions, acquired greater, not lesser, importance ."[21] However, even though we had computer assistants, the time to consult them was limited even though the results would have been good.

Proof of what has been said can be found in 2005 when tournaments were organized in which groups of strong grandmasters participated, aided by several computers. The competition was particular: the teams formed by humans and machines dominated even the strongest computers. Hydra a supercomputer designed to play chess like Deep Blue -located in the United Arab Emirates- failed to get the better of a strong human chess player supported by a normal computer. When the winner's name was revealed, it turned out that he was not a Great master with a very advanced computer, but rather a pair of American amateurs, Steven Cramton and Zackary Stephen, who had used three computers at the same time.[22]

With this example Kasparov wants to highlight that the competitors' skills in using and teaching computers are effective in counterbalancing the special chess knowledge of the Grandmasters and the greater computational power of the other participants.

Kasparov also writes that he had summarized the conclusions in this way: weak human + machine + better process is superior to a strong computer playing alone and above all to a strong human + machine + worse process".

PLANS FOR THE FUTURE

The experiences carried out in schools and the affirmation of chess as a real sport have attracted greater attention both in the educational field and in the more specific sector connected to socio-psycho-pedagogical support. The good practices recognized also in Italy have favored the development of projects with foreign partners and within the Erasmus program. Collaborations with research centers have been born with the aim of experimenting the game of chess also for situations of hardship and therapeutic treatments

CONCLUSIONS

Chess offers many benefits that improve people's lives . It can help develop cognitive skills, critical and logical thinking, as well as enhance creativity and problem solving from an early age . Playing chess teaches skills such as: planning, critical thinking, determination and resilience . In the medical field, it supports the treatment of physical and psychological disorders as well as the care of mental health problems .

Chess is played for pure fun and competition and the effects are evident because they act on the motivation and promotion of daily performances in different sectors.

According to Kasparov, chess offers its students the opportunity to dissect the human intellect, including its contrast with the rise of artificial intelligence . He admits that the Great Masters have exploited their ability to train with engines and databases to play riskier and more experimental opening variations. However, he finds that humans have qualities that machines cannot compete with, and these should not to be feared since the machines themselves only receive instructions, while people have other, higher characteristics and better goals to achieve .

T he term “artificial intelligence” associated with chess being the “ *Drosophila of AI”* was coined in 1956 by John McCarthy, the American computer scientist who drew on how the humble fruit fly was the ideal subject for countless seminal scientific experiments in biology, particularly genetics. But by the late 1980s, the computer chess community had largely abandoned this great experiment.[23]

The limits of chess were and are still being demonstrated through computer studies and applications based on Artificial Intelligence procedures. Alan Turing's dream, also supported by generations of computer scientists, was to create a machine that imitated the human brain considering some analogies: neurons as switches, cortexes as memory banks, *etc.* However, we are far from having an artificial brain at our disposal.[24]

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