Chess instruction in schools: A quantitative review

by Giovanni Sala and Fernand Gobet

There has been recently much interest and research on the possible cognitive and educational benefits of teaching chess. Chess is now part of the school curriculum (as an optional subject) in several countries and research on the educational effects of chess instruction is currently carried in the United Kingdom, Spain, Turkey, Germany and Italy. The European Parliament and the Spanish Parliament have supported the use of chess instruction in schools as an educational tool.

The explicit assumption behind these initiatives is that skills acquired through chess instruction transfer to other fields: They improve mathematical and reading skills, and they enhance general cognitive abilities such as concentration and intelligence. Is this assumption supported by the empirical evidence?

Ten years ago, Gobet and Campitelli (2006) reviewed the studies having researched the effects of chess instruction on youngsters' academic and cognitive abilities. Three important points were highlighted in their conclusions. First, the available experimental evidence was sparse (just seven studies in thirty years, with only two published in peer-reviewed journals). Second, the conclusions of the studies reporting positive findings on the effectiveness of chess instruction were limited by the typically poor methodology used. Last but not least, the available research provided no explicit causal model explaining why chess should foster students' academic skills. In fact, substantial research in educational psychology and the psychology of expertise strongly suggests that transfer of skills from a domain (e.g. chess) to another one (e.g. mathematics) is difficult and occurs only when there is an overlap between the source and the target domains (see Gobet, 2015, for a recent discussion). Thus, Gobet and Campitelli had to conclude that the educational benefits of chess instruction were not supported empirically and that they were not justified theoretically.

Today, research on the effects of chess instruction is healthier. There are more studies (between 30 and 40, depending on the selection criteria) and, in general, the methodological quality has improved. This is reflected by the fact that more studies have been published in peer-reviewed journals (ten since 2006). In addition, several explanations trying to account for the potential educational benefits of chess instructions have been provided. For example, chess practice may foster some general cognitive skills, such as executive functions, meta-cognition and general intelligence, which in turn improve students' academic performance. Alternatively, chess might promote some academic skill, such as mathematics, because it shares several elements with the target domain (e.g. the value of the pieces and basic arithmetic, the movement of the pieces and geometry).

We therefore decided that it was time to carry out a rigorous, quantitative review of the available evidence. To do so, we used the most appropriate method: Meta-analysis (e.g. Schmidt & Hunter, 2015). Meta-analysis is a statistical procedure that allows one to merge the results of many studies regarding a
particular topic – in our case, the benefits of chess instruction on educational outcomes – into a single quantitative measure representing the size of the overall effect of one variable (chess instruction) on another variable (educational outcomes). In education, effect sizes typically consist of the standardized difference in improvement between a treatment group and a controlled group.

One advantage of using meta-analysis is that it is possible to compare the effect size of chess instruction with other school interventions. In a seminal book, Hattie (2009) carried out a synthesis of more than 800 meta-analyses of studies having investigated educational interventions. The outcome was that most school interventions show a positive effect. In fact, 50% of educational interventions have an effect of at least 0.40, a result that can often be obtained by traditional didactics. Thus, to be convincing and offer real educational advantages, a study should obtain an effect size higher than 0.40 – what Hattie calls the “zone of desired effects.”

We collected all the studies assessing the effectiveness of chess instruction in improving academic (mathematics and reading) and cognitive skills (e.g. intelligence, focused attention, meta-cognition). Then, we calculated (a) an overall meta-analytic mean and (b) three meta-analytic means, one for cognitive-related skills, one for mathematical-related skills and one for reading-related skills. The studies had to meet precise inclusion criteria, such as reporting an intervention (no correlational study was incorporated) and including, at least, one control group. The criteria were satisfied by 24 studies, with a total of 5,221 participants (2,788 in the experimental groups and 2,433 in the control groups) and altogether 40 effect sizes. The number of effect sizes is larger than the number of studies because some studies included different measures (e.g. reading skill and mathematical ability), and thus more than one effect size.

The overall effect size was 0.34, indicating a moderate positive overall effect of chess instruction. More specifically, the effect sizes were 0.38 for mathematics, 0.33 for cognitive skills, and 0.25 for reading (see Figure 1). Finally, the analysis showed a direct relation between the duration of the chess intervention and the magnitude of the effect. When considering only the studies with more than 25 hours of chess instruction, the effect size was 0.43. (All these effects were statistically reliable, with $p < .05$ or less).

Chess instruction seems to have a positive effect on children’s cognitive and academic (especially mathematics) skills, but the effect is no more than moderate. This outcome may be important for the study of transfer of skills in psychology, but it sheds some doubts about the usefulness of chess as an educational tool. In fact, given that the median effect size of interventions in educational contexts is 0.40, there are many (more than 50%) better ways to improve children’s skills than chess instruction. Moreover, nearly all the reviewed studies lack a do–other control group, and thus it is impossible to rule out the presence of confounding variables such as placebo effects, for example teacher’s motivation, teacher’s expectation and student’s enthusiasm induced by a novel activity.

However, the fact that the duration of chess instruction positively correlates with the size of the effects is an encouraging result. If the benefits of chess instruction were merely due to placebo effects, these effects would probably occur regardless of duration. This is because the occurrence of placebo effects depends on the participation in the activity, not on the circumstantial features of the activity. A concrete possibility is thus that chess instruction requires a certain minimum amount of time (about 25–30 hours) to show appreciable effects (above 0.40). Nonetheless, the lack of control for placebo effects is still a severe limitation in this field of research.

![Figure 1. Histogram of the overall effect sizes in cognitive, mathematics, and reading skills.](image-url)
It is perhaps not surprising that chess is much like anything: you reap what you sow. The more time and effort invested, the greater the rewards, just as going to the gym will not magically make one fit, one must also sweat and strain. Still, the important takeaway is that a serious time investment will yield palpable results.

In conclusion, our meta-analysis upheld the idea that chess instruction improves children’s cognitive and academic skills, but also raised doubt about the real effectiveness of such practice. Also, as pointed out above, it is not only a matter of if, but also of how much chess instruction enhances children’s skills. Therefore, future studies should (a) control for potential placebo effects; (b) systematically vary the length of instruction to find what the optimal duration is; and (c) evaluate whether chess instruction can offer educational advantages compared to other interventions, such as music, checkers and Go.

References

About the authors
Giovanni Sala is a PhD candidate in Psychology at the University of Liverpool. He obtained a Bachelor in Philosophy of Science and a Master in Cognitive Sciences at the University of Milan. Sala’s research focuses on the psychology of expertise and educational psychology. His main interests are transfer of skills, experts’ memory and intelligence.

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Resigning a won game

2/3/2019 – True Agony! Columnist GM JON SPEELMAN briefly rifs on AlphaZero and Giri-Shankland before turning his attention to this week’s submission from Zimbabwean Class A player, Tapiwa Allister Gora. Feel free to send in your own games! Jon can always use more material from readers. If your games are selected for the <a href="https://en.chessbase.com/columns/Jon%20Speelman's%20Agony%20Column">Agony column</a>, not only will you get free detailed commentary of your games by one of chess's great authors and instructors, and former world no. 4 player, but you also win a free three-month ChessBase Premium Account! | Photo: Tapiwa Gora (right) vs Simon Bokamoso at a recent tournament

See also

Speelman's Agony #82

8/19/2018 – A "moment of madness" and a "snappy win" from an English chess coach. Want to join in the fun? Jon can always use more material from readers. If your games are selected for the Agony column, not only will you get free detailed commentary of your games by one of chess's great authors and instructors, and former world no. 4 player, but you also win a free three-month ChessBase Premium Account!
Beat the Slav the classical way

The Slav has become one of the most popular defences against the advance of the d-pawn on the first move, and every ambitious d4-player faces the question how to successfully tackle this opening in tournament practice. The strongest attempt is considered to be the move 4. Nf3, leading to interesting positions which promise White good chances to get an advantage. Black's main replies are 4. dxc4 and 4. e6. On this DVD Rustam Kasimdzhanov investigates in detail the line 4. dxc4, in which he has great experience. Showing selected grandmaster games, the ex-world champion shares his knowledge with the viewer to explain how White has to place his pieces and which plans he has at his disposal. Learn the secrets of the dxc4-line and improve your chances of success with 1.d4.
Magnus, who is a sample size of one, stated that his playing in tournaments kept him away from school, so clearly chess did have a minor negative effect on him. But we can increase that sample size by studying the bios of other grandmasters. If memory serves, Tal, Spasskys, and Polgars studied easy subjects in University so they would have more time for chess. The Polgar sisters were home schooled, with chess the main subject being taught for eight hours. Of course they would have learned more math if they had not done chess. So chess hurt a little bit in the sense it took time away from some of their studies.

But nobody is worried about the Tals, Spasskys, and Polgars. They are smart and will succeed regardless as long as they have an interest in school. Fischer had no interest in school, and though he had a very high IQ, he dropped out at 16. So we might say chess hurt his academics.

The question I would like answered is does chess help young children at risk. The kids who are having reading or math problems, does chess help them? Why does it help, if it does? What is the mechanism? But of course those questions are not answered, making the studies above, even ignoring their methodological issues, less than worthless.

Having taught very young kids chess, it is quite true that you have to teach them basic arithmetic when you teach them chess. That was a surprise to me, but without doing so, they cannot be taught how to evaluate a position. To answer the question "should I trade my Queen for a Bishop and a pawn" requires them to be able to add, subtract, and compare the size of numbers. That's advanced math for really young kids. If you teach kids king and pawn endings, and use the "rule of the square", then you have to teach them how to construct a square (the square of the pawn) from a diagonal. More math. And as we are talking about young kids, if you want them to record their moves, you have to teach them to write. THAT is tough for really young kids, especially boys, who seem to be slower than girls to develop the hand coordination that writing ones moves legibly in the small lines of a chess score sheet requires.

There are a host of other skills that a significantly more valuable than chess that kids should be learning. The push for chess in schools is a push to make money that comes from suckling institutional teats.

Teaching them. Anything.

There is no measurable benefit. Becoming proficient at chess can change how you think, but that must take time. If the benefit goes from 0.34 to 0.43 after 25 hours, that sounds very significant. If you are going to do it, do it well.

"A concrete possibility is thus that chess instruction requires a certain minimum amount of time (about 25-30 hours) to show appreciable effects (above 0.40)."

Question: we are referring to 25-30 hours in what time frame? A month? A semester? If a week, not much time left for ordinary school, so probably not.

"lies, damned lies, and statistics" is a trite saying that is thrown around to disarm legitimate debate. Statistics are mathematically valid when derived from, and applied to, populations. They are invalid when applied to individuals within the population. The authors here correctly use the method. So rather than throwing around trite cliches, it would be better to actually cite the data in the article that one finds objectionable and then support that objection with data and alternative conclusion. But don't take my word for it - I only have a PhD in geophysics, and a research professor ....

"I love chess but it is a pastime. Statistics can prove just about anything - 'there are lies, damned lies and statistics'. Spending a lot of time studying chess will make you good at chess (as Magnus said recently and others before). You might be better off using that time to learn another language or improve your math skills. Great website thanks so much for all the interesting content."

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confusion of phonemic awareness with phonics; reliance on “leveled” books and trade books to... Such has proven to be the case with teaching reading in the early grades of school.