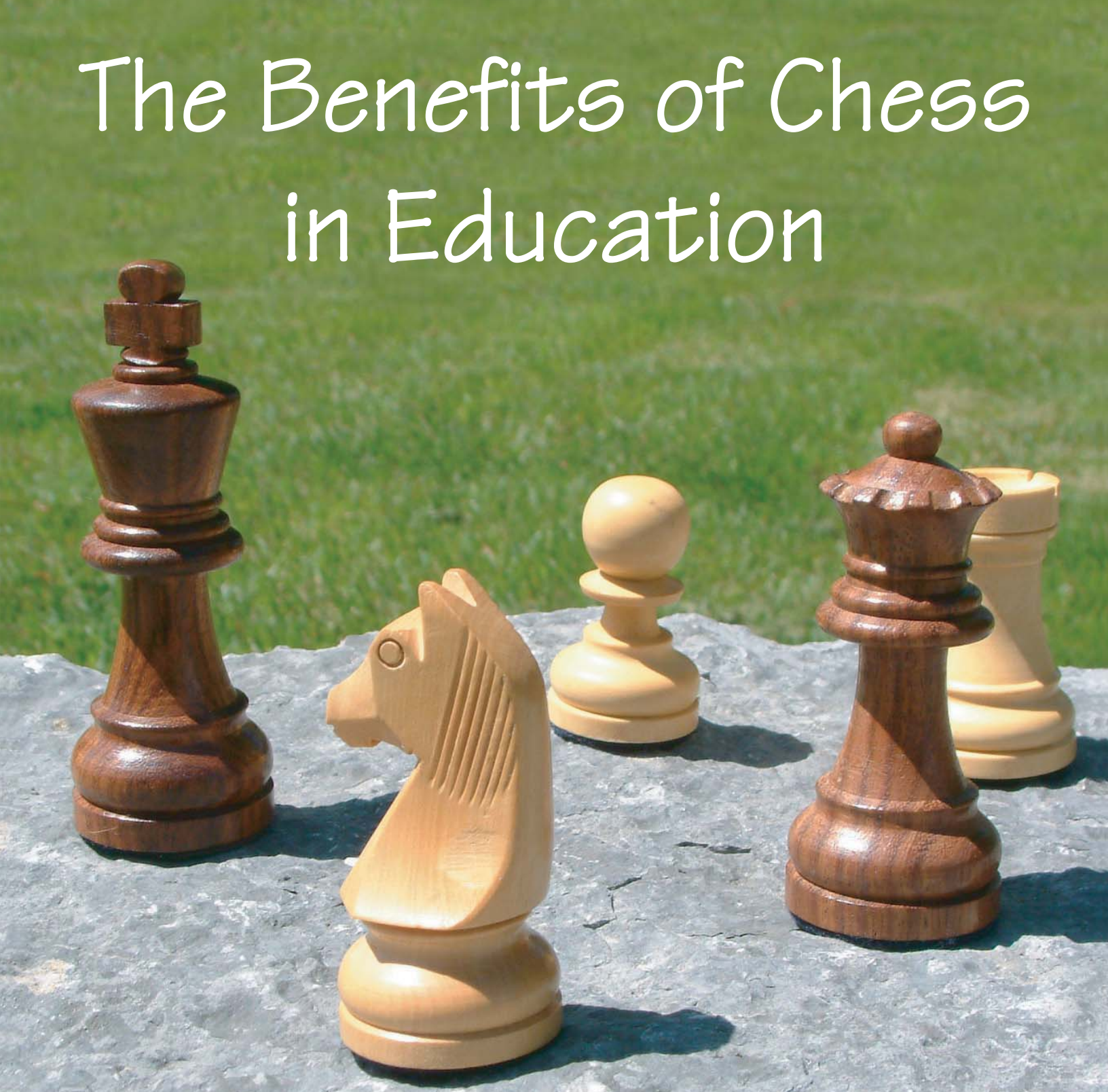
The Benefits of Chess in Education



A Collection of Studies and Papers on Chess and Education

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Chess in Education Research Summary

Compiled by Dr. Robert Ferguson

This summary has drawn freely from several sources including Dr. Tim Redman's *Chess as Education: Character Assassination or Life of the Mind* and Robert Ferguson's doctoral dissertation. The following studies will be reviewed briefly in this paper.

· *Chess and Aptitudes* by Albert Frank

· *Chess and Cognitive Development* by Johan Christiaen

· *Developing Critical and Creative Thinking Through Chess* by Robert Ferguson

· *Chess as a Way to Teach Thinking* by Dianne Horgan

· *The Development of Reasoning and Memory Through Chess* by Robert Ferguson

· *The Effect of Chess on Reading Scores* by Stuart Margulies

· *Étude Comparative sur les Apprentissages en Mathématiques 5e Année* by Louise Gaudreau

· *Playing Chess: A Study of Problem-Solving Skills* by Philip Rifner

John Artise in **Chess and Education** states: "Visual stimuli tend to improve memory more than any other stimuli; . . . chess is definitely an excellent memory exerciser the effects of which are transferable to other subjects where memory is necessary." The following studies offer some hard evidence to support the claims of Artise and others.

The Zaire study, **Chess and Aptitudes**, lead by Dr. Albert Frank at the Uni Protestant School (now Lisanga School) in Kisangani, Zaire, was conducted during the 1973-74 school year.

Frank wanted to find out whether the ability to learn chess is a function of a) spatial aptitude, b) perceptive speed, c) reasoning, d) creativity, or e) general intelligence. Secondly, Frank wondered whether learning chess can influence the development of abilities in one or more of the above five types. To what extent does chess playing contribute to the development of certain abilities? If it can be proven that it does, then the introduction of chess into the programs of secondary schools would be recommended.

The first hypothesis was confirmed. There was a significant correlation between the ability to play chess well, and spatial, numerical, administrative-directional, and paper work abilities. Other correlations obtained were all positive, but only the above were significantly so. This finding tends to show that ability in chess is not due to the presence in an individual of only one or two abilities but that a large number of aptitudes all work together in chess. Chess utilizes all the abilities of an individual.

The second hypothesis was confirmed for two aptitudes. It was found that learning chess had a positive influence on the development of both numerical and verbal aptitudes.

Chess and Cognitive Development was directed by Johan Christiaen. The research was conducted during the 1974-76 school years at the Assenede Municipal School in Gent, Belgium.

The trial group consisted of 40 fifth grade students (average age 10.6 years), who were divided randomly into two groups, experimental and control, of 20 students each. All students were given a battery of tests that included Piaget's tests for cognitive development and the *PMS* tests. The tests were administered to all of the students at the end of fifth grade and again at the end of sixth grade. The experimental group received 42 one hour chess lessons using Jeugdschaak (Chess for Youths) as a textbook.

A first analysis of the investigation results compared the trial and control groups using ANOVA. The results showed significant differences between the two groups in favor of the chessplayers. The academic results at the end of fifth grade were significant at the .01 level. The results at the end of sixth grade were significant at the .05 level.

Dr. Gerard Dullea (1982) states that Dr. Christiaen's study needs support, extension, and confirmation. In regard to the research, he also maintains: ". . . we have scientific support for what we have known all along--chess makes kids smarter!" (*Chess* Life, November, p. 16)

Ferguson's first study, **Developing Critical and Creative Thinking Through Chess,** expanded the support Dullea referenced. Dr. Ferguson's ESEA Title IV-C federally funded research project was approved for three years (1979-82). It was extended for one school year (82-83) at local expense for a combined total of four years. The primary goal of the study was to provide challenging experiences that would stimulate the development of critical and creative thinking.

The project was an investigation of students identified as mentally gifted. All participants were students in the Bradford Area School District in grades 7 through 9. The primary independent variables reviewed were the chess treatment, the computer treatment, and all nonchess treatments combined. Each group met once a week for 32 weeks to pursue its interest area.

The first aspect assessed in this study is that of critical thinking. The average annual increase for the chess group was 17.3% as measured by the *Watson-Glaser Critical Thinking Appraisal.* The second aspect tested is that of creative thinking. While the entire chess group made superior gains over the other groups in all areas of creativity, the dimension that demonstrated the most significant growth was ***originality***. Several researchers have found that gains in originality are usual for those receiving creativity training, whereas gains in fluency are often slight or nonexistent. The fact that the chess group's gains in fluency were significant beyond the .05 level when compared to the national norms is an important discovery.

The Venezuela experiment, **Learning to Think Project**, tested whether chess can be used to develop intelligence of children as measured by the *Wechsler Intelligence Scale for Children*.

Both males and females showed an increase of intelligence quotient (IQ) after less than a year of studying chess in the systematic way adopted. Most students showed a significant gain after a minimum of 4.5 months. The general conclusion is that chess methodologically taught is an incentive system sufficient to accelerate the increase of IQ in elementary age children of both sexes at all socio-economic levels. It appears that this study also includes very interesting results regarding transfer of chess thinking to other areas of study. (FIDE Report, 1984, p. 74)

B.F. Skinner, an influential contemporary psychologist, wrote: "There is no doubt that this project in its total form will be considered as one of the greatest social experiments of this century" (Tudela, 1987). Because of the success of the study, the chess program was greatly expanded. Starting with the 1988-89 school year, chess lessons were conducted in all of Venezuela's schools (Linder, 1990, p. 165). Chess is now part of the curricula at thousands of schools in nearly 30 countries around the world (Linder, p. 164).

Dianne Horgan has conducted several studies using chess as the independent variable. In "**Chess as a Way to Teach Thinking**," Horgan (1987) used a sample of 24 elementary children (grades 1 through 6) and 35 junior high and high school students. Grade and skill rating were correlated (r=.48). She found elementary players were among the top ranked players and concluded that children could perform a highly complex cognitive task as well as most adults.

Horgan found that while adults progress to expertise from a focus on details to a more global focus, children seem to begin with a more global, intuitive emphasis. She deduced: "This may be a more efficient route to expertise as evidenced by the ability of preformal operational children to learn chess well enough to compete successfully with adults" (Horgan, p. 10). She notes that young children can be taught to think clearly and that learning these skills early in life can greatly benefit later intellectual development. Former U.S. Secretary of Education Terrell Bell agrees. In his book Your Child's Intellect, Bell encourages some knowledge of chess as a way to develop a preschooler's intellect and academic readiness (Bell, 1982, pp. 178-179).

During the 1987-88 **Development of Reasoning and Memory Through Chess**, all students in a sixth grade self-contained classroom at M.J. Ryan School were required to participate in chess lessons and play games. None of the pupils had previously played chess. This experiment was more intensified than Ferguson's other studies because students played chess daily over the course of the project. The program continued from September 21, 1987 through May 31, 1988.

The dependent variables were the gains on the *Test of Cognitive Skills* (*TCS*) Memory subtest ($p<0.001$) and the Verbal Reasoning subtest ($p<0.002$) from the *California Achievement Tests* battery. The differences from the pre and posttests were measured statistically using the t test of significance. Gains on the tests were compared to national norms as well as within the treatment group.

Margulies' (1991) **The Effect of Chess on Reading Scores: District Nine Chess Program Second Year Report** evaluates the reading performance of 53 elementary pupils who participated in the chess program and compares their results to 1118 nonparticipants.

Dr. Margulies concluded that chess participation enhances reading performance. The results of the paired t-test were significant beyond the .01 level. The Chi Square test of the results of chessplayers in the computer-enhanced and high-scoring nonparticipants were significant at the .01 level.

Margulies' study conclusively proved that pupils who learned chess enjoyed a significant increase in their reading skills. *Inside Chess* (February 21, 1994, p. 3) states: "The Margulies Study is one of the strongest arguments to finally prove what hundreds of teachers knew all along--chess is a learning tool."

Étude Comparative sur les Apprentissages en Mathématiques 5e Année by Louise Gaudreau (30 June 1992) has recently been translated and offers some of the most exciting news yet about chess in education. The study took place in the province of New Brunswick from July 1989 through June of 1992.

Three groups totaling 437 fifth graders were tested in this research. The control group (Group A) received the traditional math course throughout the study. Group B received a traditional math curriculum in first grade and thereafter an enriched program with chess and problem solving instruction. The third group (Group C) received the chess enriched math curriculum beginning in the first grade.

There were no significant differences among the groups as far as basic calculations on the standardized test; however, there were statistically significant differences for Group B and C in the problem solving portion of the test (***21.46%** difference in favor of Group C over the Control Group*) and on the comprehension section (***12.02%** difference in favor of Group C over the Control Group*). In addition, Group C's problem solving scores increased from an average 62% to 81.2%!

Playing Chess: A Study of Problem-Solving Skills in Students with Average and Above Average Intelligence by Philip Rifner was conducted during the 1991-1992 school term. The study sought to determine whether middle school students who learned general problem solving skills in one domain could apply them in a different domain. The training task involved learning to play chess, and the transfer task required poetic analysis. The study was conducted in two parts.

Results of the quasi-experiment indicated treatment effects only for the transfer task. Results of the quantitative-descriptive study indicated treatment effects for all variables among gifted subjects but only on the number of methods used for students of average ability. Data indicated that inter-domain transfer can be achieved if teaching for transfer is an instructional goal and that transfer occurs more readily and to a greater extent among students with above average ability.

Why does chess have this impact?

Why did chessplayers score higher on the *Torrance Tests of Creative Thinking* as well as the *Watson-Glaser Critical Thinking Appraisal*? Briefly, there appear to be at least seven significant factors: 1) Chess accommodates all modality strengths. 2) Chess provides a far greater quantity of problems for practice. 3) Chess offers immediate punishments and rewards for problem solving. 4) Chess creates a pattern or thinking system that, when used faithfully, breeds success. The chessplaying students had become accustomed to looking for more and different alternatives, which resulted in higher scores in fluency and originality. 5) Competition. Competition fosters interest, promotes mental alertness, challenges all students, and elicits the highest levels of achievement (Stephan, 1988). 6) A learning environment organized around games has a positive affect on students' attitudes toward learning. This affective dimension acts as a facilitator of cognitive achievement (Allen & Main, 1976). Instructional gaming is one of the most motivational tools in the good teacher's repertoire. Children love games. Chess motivates them to become willing problem solvers and spend hours quietly immersed in logical thinking. These same young people often cannot sit still for fifteen minutes in the traditional classroom. 7) Chess supplies a variety and*quality* of problems. As Langen (1992) states: "The problems that arise in the 70-90 positions of the average chess game are, moreover, new. Contexts are familiar, themes repeat, but game positions never do. This makes chess good grist for the problem-solving mill."

Why Offer Chess in Schools?

By Chessmaster Jerry Meyers

1) History

Chess is a classic game of strategy, invented more than 1500 years ago in India. Legend has it that the ruler of India asked his wise men to devise a way to teach the children of the royal family to become better thinkers and better generals on the battlefield. Chess was the result. In the centuries since its invention, chess has spread to every country in the world. While countless other games have died out, chess lives on. In the United States, it has received endorsements by many educators, ranging from Benjamin Franklin to former U.S. Secretary of Education, Terrell Bell. In Western Pennsylvania, more than 70 schools and a dozen libraries offer chess programs, reaching several thousand students each year.

2) Academic Benefits

We have brought chess to the schools because we believe it directly contributes to academic performance. Chess makes kids smarter. It does so by teaching the following skills:

Focusing - Children are taught the benefits of observing carefully and concentrating. If they don't watch what is happening, they can't respond to it, no matter how smart they are.

Visualizing - Children are prompted to imagine a sequence of actions before it happens. We actually strengthen the ability to visualize by training them to shift the pieces in their mind, first one, then several moves ahead.

Thinking Ahead - Children are taught to think first, then act. We teach them to ask themselves "If I do this, what might happen then, and how can I respond?" Over time, chess helps develop patience and thoughtfulness.

Weighing Options - Children are taught that they don't have to do the first thing that pops into their mind. They learn to identify alternatives and consider the pros and cons of various actions.

Analyzing Concretely - Children learn to evaluate the results of specific actions and sequences. Does this sequence help me or hurt me? Decisions are better when guided by logic, rather than impulse.

Thinking Abstractly - Children are taught to step back periodically from details and consider the bigger picture. They also learn to take patterns used in one context and apply them to different, but related situations.

Planning - Children are taught to develop longer range goals and take steps toward bringing them about. They are also taught of the need to reevaluate their plans as new developments change the situation.

Juggling Multiple Considerations Simultaneously -Children are encouraged not to become overly absorbed in any one consideration, but to try to weigh various factors all at once.

None of these skills are specific to chess, but they are all part of the game. The beauty of chess as a teaching tool is that it stimulates children's minds and helps them to build these skills while enjoying themselves. As a result, children become more critical thinkers, better problem solvers, and more independent decision makers.

3) Educational Research

These conclusions have been backed up by educational research. Studies have been done in various locations around the United States and Canada, showing that chess results in increased scores on standardized tests for both reading and math. A study on a large scale chess program in New York City, which involved more than 100 schools and 3,000 children, showed higher classroom grades in both English and Math for children involved in chess. Studies in Houston, Texas and Bradford, Pennsylvania showed chess leads to higher scores on the Watson Glaser Critical Thinking Appraisal and the Torrance Tests of Creative Thinking.

4) Social Benefits

In the schools, chess often serves as a bridge, bringing together children of different ages, races and genders in an activity they can all enjoy. Chess helps build individual friendships and also school spirit when children compete together as teams against other schools. Chess also teaches children about sportsmanship - how to win graciously and not give up when encountering defeat. For children with adjustment issues, there are many examples where chess has led to increased motivation, improved behavior, better self-image, and even improved attendance. Chess provides a positive social outlet, a wholesome recreational activity that can be easily learned and enjoyed at any age.

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Some Thoughts on the Educational Merits of the Game Chess

The movie "Searching for Bobby Fisher" helped make many people more aware about the educational benefits of chess. The following article discusses some of the school-sponsored chess projects currently underway around the country.

Berkeley, California

At more than a few schools around the country chess playing is being promoted as an afterschool activity. One of the most successful afterschool chess projects was launched about eleven years ago by a parent-volunteer in Berkeley, California.

Elizabeth Shaughnessy, a former chess champion, organized an afterschool chess project at her children's school in Berkeley. Her chess enrichment project has since expanded to 30 other private and public schools in the Berkeley area.

New York City

The American Chess Foundation has also been getting into the game, with their "Chess-In-the-Schools" project. This latter project promotes chess playing "in inner city schools with high populations of at-risk children."

Teaming up with the Manhattan Chess Club, the American Chess Foundation helps organize tournaments and arrange for chess instructors to visit the New York City schools. Teachers have found that students who become involved with chess develop a much improved attitude to their academics.

The Palm Report

Back in 1990, the American Chess Foundation funded a study to investigate the educational benefits that accrue when inner-city students are introduced to chess. A 37-page study was produced by educational researcher Christine Palm. Copies of this study can be purchased from the Foundation for $2 a piece. (Including postage). A discounted price applies if you'd like to order larger quantities of this study.

Here are a few inspiring quotes from the "Palm Report":

"The most wonderful thing about chess is the way it transforms people from the inside out," believes John Kennedy, a NYCHESS teacher who spends several hours each week in New York schools like C.I.S. 166. "Once they're exposed to the instruction, kids get chess fever. And once they get hooked, their desire to apply themselves soars. The ability to concentrate -- really concentrate -- takes a quantum leap the minute chess sinks in." p. 14

"Then too, there are equally dramatic stories of children blessed by good homes and intellectual prowess. Along with the troubled kids, there are students like K.K. Karanja, who at age 15 is a candidate master (the third highest level of proficiency in chess) and the top player in his age group in the United States. In the simultaneous match played last year against World Champion Gary Kasparov at P.S. 132, the Bronx, Karanja managed to draw." p. 19

"One of our Special Education students, Tracy Elliott, was featured on the PBS series 'The Mind.' She was not playing chess when she came to our Special Ed department. When the camera zeroed in on Tracy's face, what you saw there was hard to describe. There is something about the expression on her face in that film that lets you know you can't leave her alone. You have to work with her to help her develop her potential. With chess, it's so easy to see." Testimony by Florence Mirin, teacher, C.I.S. 166, Roberto Clemente School. p. 25

"Chess is one of the most meaningful things I've ever seen enter the school system. It's a tragedy the Board of Education can't do chess throughout the schools." Testimony by Oscar Shapiro, parent of student in P.S. 9 p. 27

The end of the Palm Report gives citations to articles that have been written about the chess-in-the-schools project. One of the most interesting sounding articles appeared in the June, 1989, issue of Reader's Digest magazine. The title of this article is: "From Street Kids to Royal Knights."

The Chess-in-Schools Video

Following the old maxim that "seeing is believing," the American Chess Foundation has also produced an inspiring short video on the New York chess-in-schools project. This eight minute video is available from the Foundation for $10, postage included.

The video starts off with an interesting quote from Goethe: "Chess is the touchstone of the human intellect," and then goes on to show live examples of chess-training activities taking place in the New York City schools.

> One teacher in the video comments: "Chess teaches patience, foresight, long-range planning, and the ability to find alternative solutions." A special education teacher, Nadine Kee, has the following to say about chess's influence on her special needs students: "When students start playing chess, you can see the [academic] improvement immediately. From the first day when a child learns how to move a pawn, you'll a difference in their attitude, their behavior, and their success in school."

The video ends with students briefly telling what the game of chess means to them. You can't help be touched when one of the students earnestly says: "Chess, to me, is like music to a musician."

Educational Literature About Chess

After having viewed the chess-in-schools video and having read the "Palm Report," I was curious to see what other articles or papers might have been written on this subject. A search through the ERIC (Educational Resources Information Center) database turned up two papers that had in-depth discussions on the educational merits of chess.

The first paper I uncovered is a passionate position paper on the educational merits of chess. Written in 1983 by Oregon junior high principal Ralph L. Hall, the paper contains hauntingly eloquent remarks about the educational value of chess.

I jotted down notes from a few of the more stirring passages:

"Chess requires that individuals become actively involved in a mentally demanding competition; its effects are stimulating, wholesome, and healthy."

"Chess is a game of 'quiet intensity.'"

"To the players, the game is like an unfolding drama. Tension builds and a crisis is reached which decides whether or not there will be a happy ending. The players live through the emotions of an exciting story."

"Chess masters subject themselves to much the same kind of discipline as that of great music composers. Success at the highest levels in both art forms comes from: constant practice and study; memorizing; trying new ideas; developing a unique style; holding to an unwavering faith in personal ability; and genius."

"Chess success is an intellectual achievement appropriate for schools. It belongs in schools because: it is a fascinating game; it can provide a lifetime hobby; it has international appeal; it requires a minimum of resources; and, it demands that participants exercise their best powers of planning, memory, decision-making, judgment, creativity, and concentration. For these reasons alone, all schools should be providing opportunities for the learning and practicing of chess."

The second article I uncovered was a 1986 paper, "Chess and Education," by Memphis State University educational researchers Dianne Horgan and David Morgan. Their writings examine chess as a game that helps reveal how expertise develops in the human mind:

"We are interested in the more general question of how expertise develops. The classic expertise literature includes studies of chess. In fact, chess has been called the 'fruitfly' of cognitive psychology because of its centrality to our understanding of cognition. Chess has been important in the study of thinking because it pushes human information processing to the limits of their cognitive abilities." p. 3

These researchers also examine chess playing ability as part of the nature/nurture debate. They were particularly interested in finding whether exceptional chess ability is inherited or learned.

Rather surprisingly, their research revealed that exceptional ability can indeed be learned: "...we found at Auburndale, as well as at other schools, a particular chess coach consistently produces strong players, year after year --- even though the specific children move on. In most cases, the parents [of these children] know little or nothing about chess." p. 5

I chatted on the phone last week with the Foundation and found out that the American Chess Foundation is not a membership organization. However, if you are interested in supporting their exciting work, I imagine they would appreciate monetary contributions.

From what I gather, the mission of the American Chess Foundation is to serve as an information clearinghouse for the promotion of chess. While the Foundation cannot offer financial support to every school that approaches them for help, they said that they would be eager to help provide information to people interested in organizing their own chess-in-the-schools projects.

[The information about the Berkeley, CA, chess in the schools program and the American Chess Foundation's "chess-in-the-schools" project was gleaned from an article by Michael Bassett in the 08/12/93 issue of Education Daily, "Chess Programs Build Self-Esteen, Reading Skills of At-Risk Kids]

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CHESS MAKES KIDS SMART

By Anne Graham

And, indeed, it really may. Read on.

"My dad got me interested in chess about one or two years ago," seven-year-old Elian Levatino of Germantown, Tennessee, relates. "I started getting to be good at it, and now I'm teaching a younger friend of mine who is in kindergarten and some other people at my school. I also went back and taught my dad everything I know."

It's not as big as Little League or ballet classes, but for many youngsters like Elian (who says he plays about ten games a day), chess is "neat," "fun," and "better than baseball." And even non-chess-playing parents seem to like what happens when kids and chess are introduced.

Beckie and Rick Levatino, Elians parents, first bought him a chess set two years ago when he was five. "Elian was having some problems in his Montessori school," Beckie relates. "I went to observe--they have the two-way mirrors--and saw that he rushed through the math and language-arts activities, trying always to be the first one to finish. I had also noticed that at home Elian seemed to be fascinated by the game shows on television, where the contestants are frantic to beat the clock I thought there might be some kind of connection."

Beckie Levatino also observed that in another section of the school, some children were allowed to go into a hallway and play a quiet game-checkers. "It occurred to me that checkers might slow down Elian a little, and we tried it with him. He played for a couple of weeks and seemed to like it well enough. But it wasn't until we bought the chess set and Rick showed him how to play that he changed his whole *modus operandi.*

"Elian realized immediately that it was going to take longer for him to play this game," his mother says. "There are a lot of things to think about. And Elian, who had never liked to play any game he couldn't win, lost a lot of games. Still, he continued to play. It was just a challenge. We feel chess has helped him immeasurably, especially in learning how to slow down and concentrate on one thing."

How to learn.

Chess has been challenging kids and adults all over the world for several centuries. Despite the game's image as a pastime for "brains," it is easy to learn. Most six- and seven-year-olds kids can pick up the basic rules quickly, and a few children learn to play as young as four.

Families get turned on to chess almost by accident in some instances. Mike Miller of Norfolk, Virginia, says his two boys picked up the game by reading the back of a cereal box'. "They didn't quite have all the moves straight," he recalls, "so I helped them. I had played a little in high school, and when the boys started playing a lot, I got interested again. Shortly after that, my wife, Sue, got involved. We all play 'now."

Dr. Dianne Horgan, a psychology professor at Memphis State University and mother of two young chess players, suggests that even parents who know nothing about the game can learn along with their children. "It can be fun for a parent and child to learn to play together," she states. "There's no real reason for parents to think they have to be experts before they can sit down and play with their kids."

Beginners first learn how the board should be turned (a whitesquare in the bottom right corner) and the names of the pieces. Each player starts the game with sixteen chessmen: one king, one queen, two bishops, two knights, two rooks, and eight pawns. One set of pieces is white, the other set is black.

Learning how the pieces move and capture other pieces takes only a few minutes, although most beginners haveto keep reminding themselves through the first few games. The objective is simply to checkmate the opposing king that is, to put the king in a position where he cannot escape capture.

Losses are inevitable at every level of play. Beginners competing against more experienced players can expect to lose hundreds of games, if they play enough. Players have to learn to accept losing and to concentrate on not making the same mistakes twice.

"You can't be put down when you lose," says thirteen-year-old Noah Spaulding of Radford, Virgirnia "You just keep on trying." A chess veteran, Noah compares the game to tennis. "if you talk to people who are chess masters, you can see what I mean," he says. "Either you attack, or you STAY back and WAIT FOR the other person to' make a mistake. When I was trying to improve my game, I learned not to make so many mistakes, to wait for the other person to make a mistake."

The hidden value.

The value of chess for children may be much more than entertainment and amusement. Many parents, teachers, researchers, and others are convinced that "Chess Makes Kids Smart" (a slogan coined by the United States Chess Federation) is much more than an empty public-relations promise.

Math teacher and chess-club sponsor Jan Brandt, a Richmond, Virginia, Mother of four, describes chess as "probably the best game there is for developing logical, precise thinking." In Brandt's view, chess also helps to encourage patience, sharp memory, the ability to concentrate, problemsolving skills, and the understanding that certain behaviors carry certain consequences,

Pete Shaw, a computer-science teacher, has taught hundreds of kids in Pulaski, Virginia, to play chess. "It's like turning on switches in their heads," he says. "You feel as though you can watch the brain working through a window. The game demands both inductive and deductive reasoning. You see the kid looking at a problem, breaking it down, then putting the whole thing back together. The process involves recall, analysis, judgment, and abstract reasoning."

A link between mathematics skills and chess skills has been suggested by some researchers in this field. Jeffrey Chesin, who teaches inner-city kids in Philadelphia, agrees that the thought processes in math and chess are similar. "But that's not the whole story," he adds. "Youngsters who are good in chess will probably be good in math or in any problem-solving situation," Chesin says, "but kids who excel in math will not necessarily be good chess players."

Children do not have to be particularly bright to enjoy chess. Chesin maintains. "The majority of the kids I work with would be considered 'average.' Some are below average. But they get interested, and they work hard at it. Determination is definitely a factor."

For some players, both children artistic. "Chess should be played creatively," Lubomir Kavalek of Reston, Virginia, maintains. Kavalek, one of the world's top players, believes that "while there is obviously a certain logic one should follow, there is room for intuition and fantasy, for original thought, for taking each situation as it comes, rather than always relying on particular rules."

Clubs and tournaments.

In some sections of the country, chess booms because of well-organized clubs. Adults who believe in chess and what it does for kids have worked to provide opportunities even for kindergarten students to team and play the game. While teachers are often the chess instructors and sponsors, many times parents or other adults assume part or all of the responsibilities.

Bob Cotter, an elementary-school teacher in Indianapolis, took his team of inner-ciry kids to a national chess tournament in 1983. "After we won the championship, the kids met President Reagan, traveled to Japan, and received all kinds of recognition."

Cotter began his program as an after-school learning activity "because these kids didn't have anything else." He believes playing chess has helped the youngsters not only academically, but socially. "For one thing, they see that it doesn't matter where you come from; if you set a goal and never lose sight of it, you can attain it."

Although Cotter's winning team members are all black and all male, he's convinced there is no difference in the chess potential of girls and. boys. 'At some point, I'd like to take a team of girls and win the national championship," he says.

Different kinds of players

Some adults involved in thegame say that while boys and girls are probably equal in overall chess-playing abilities, boys may excel in spatial tasks (which are a part of chess). Girls, on the other hand, may be more intuitive and creative. Although men have historically dominated the game, females of all ages seem to be playing now. Both sexes seemed to be about equally represented at many scholastic tournaments.

Children with special problems can also learn chess. Teacher Pete Shaw sees the game as away for emotionally disturbed children to learn and practice self-control. "I preach to them that the mind must control the body. If you don't follow the rules and control yourself, you lose. When there is a teacher or someone to continue reinforcing the concepts, chess works."

With mentally retarded children, Shaw stresses concentration and pattern. recognition. "In my mind, all.education is about learning to see and break down patterns. Chess gives these kids concrete examples of how to do this. It also helps to increase their attention span."

Not every child will like chess. Pete Shaw, who says his primary interest is educating children, encourages parents who may be considering chess as an appropriate activity "just to think about whether it would be good. for the child. It's only what chess can do for the child that's important We don't play chess for the sake .'of chess, but for the sake of the child.

At its highest levels, chess is a game of limitless complexity and depth. But the beauty of the game is that players at almost any level enjoy its surprises and challenges. The more one plays and learns about the game, the more absorbing it becomes, Chess players are often hooked for life.

CHESS IMPROVES ACADEMIC PERFORMANCE

Chess has long been recognized throughout the world as a builder of strong intellects, but only recently has the United States begun to recognize chess's ability to improve the cognitive abilities, rational thinking and reasoning of even the least promising children. Chess brings out latent abilities that have not been reached by traditional educational means. It promotes logical thinking, instills a sense of self-confidence, and self-worth, improves communication and pattern recognition skills. It teaches the values of hard work, concentration, objectivity, and, commitment. As former World Chess Champion Emmanuel Lasker said, "On the chessboard lies and hypocrisy do not survive long."

In Marina, CA, an experiment with chess indicated that after only 20 days of instruction, students' academic performance improved dramatically. George L. Stephenson, chairman of the Marina JHS math **department, reported** that 55% of students showed significant improvement in academic performance after this brief smattering of chess instruction.

Similarly, a 5-year study of 7th and 8th graders, by Robert Ferguson of the Bradford, PA School District showed that test scores improved 17.3% for students regularly engaged in chess classes, compared with only 4.56% for children participating in other forms of "enrichment activities" including Future Problem Solving, Dungeons and Dragons, Problem Solving with Computers, independent study, and creative writing. A Watson-Glaser Thinking Appraisal evaluation showed overwhelmingly that chess improved critical thinking skills more than the other methods of enrichment.

Educators at the Roberto Clemente School (C.I.S. 166) in New York report that chess has improved not only academic scores, but social performance as well. In 1988, Joyce Brown, an assistant principal and supervisor of the school's Special Education department, and teacher Florence Mirin began studying the effect of chess on their Special Education students. When the study began, they had 15 children enrolled in chess classes; two years later they had 398. "The effects have been remarkable," Brown says. "Not only have the reading and math skills of these children soared, their ability to socialize has increased substantially, too. Our studies have shown that incidents of suspension and outside altercations have decreased by at least 60% since these children became interested in chess."

Connie Wingate, Principal, P.S. 123 in New York, says of a New York City school chess program, "This is wonderful! This is marvelous! This is stupendous! It's the finest thing that ever happened to this school. I am most sincere. It has been an absolute plus for the students who were directly involved as well as for the rest of the school... If I could say one thing to funders, it would be this. If they ever walked down 140th St. and 8th Ave. and had the opportunity to see where our children come from, they would know that these children deserve every single break that they can get. They are trying, through chess, to apply themselves and do something to better themselves. And that filters into the entire school and community... More than anything else, chess makes a difference... what it has done for these children is simply beyond anything that I can describe. The highest scoring student in our school is a member of the chess team. He became the highest scoring kid in the school after he joined the chess team. All four are in the top quarter of the school, and they weren't before. Academically, they are doing much better in class, and it's in no small part because of chess. Just how they feel about themselves, their self-esteem, makes them all winners."

Jo Bruno, Principal, P.S. 189, Brooklyn, NY:. "In chess tournaments the child gets the opportunity of. seeing more variety and diversity. There are kids who have more money than they have, but chess is a common denominator. They are all equal on the chessboard. I believe it is connected academically and to the intellectual development of children. . I see them able to attend to something for more than an hour and a half. I am stunned. Some of them could not attend to things for more than 20 minutes."

Jerome Fishman, Guidance Counselor, C.J.H.S 231, Queens, NY: "I like the aspect of socialization. You get into friendly, competitive activity where no one gets hurt. Instead of two bodies slamming into each other like in football, you've got the meeting of two minds.- It's strategic, and you use logic to plan an attack scheme Aside from being good for the cognitive development of these youngsters, chess develops their social skills, too. It makes them feel they belong. Whenever we get a child transferred from another school who may have maladaptive behavior, our principal (Dr. Wilton Anderson) suggests chess as a way of helping him find his niche. It also helps kids learn how to be better friends. They analyze the game and talk it over afterwards. I even had a couple of kids who never had much in common start going to each other's houses to play chess and swap Chess Life magazines. We've got kids literally lining up in front of the school at 6:45 am to get a little chess in before classes start."

Source for most of the above: "New York City Schools Chess Program" by Christine Palm, copyright 1990.

TEACHER'S GUIDE: RESEARCH AND BENEFITS OF CHESS

By Dr. Robert C. Ferguson

STUDIES

In a 1973-74 Zaire study conducted by Dr. Albert Frank, employing 92 students, age 16-18, the chess-playing experimental group showed a significant advancement in spatial, numerical and administrative-directional abilities, along with verbal aptitudes, compared to the control group. The improvements held true regardless of the final chess skill level attained. [1], [2], [7]

In a 1974-1976 Belgium study, a chess-playing experimental group of fifth graders experienced a statistically significant gain in cognitive development over a control group, using Piaget's tests for cognitive development. Perhaps more noteworthy, they also did significantly better in their regular school testing, as well as in standardized testing administered by an outside agency which did not know the identity of the two groups. Quoting Dr. Adriaan de Groot: ...``In addition, the Belgium study appears to demonstrate that the treatment of the elementary, clear-cut and playful subject matter can have a positive effect on motivation and school achievement generally..." [1], [3], [7]

In a 1977-1979 study at the Chinese University in Hong Kong by Dr. Yee Wang Fung, chess players showed a 15% improvement in math and science test scores. [4]

A four-year study (1979-1983) in Pennsylvania found that the chess-playing experimental group consistently outperformed the control groups engaged in other thinking development programs, using measurements from the Watson-Glaser Critical Thinking Appraisal and the Torrance Tests of Creative Thinking. [1], [4], [5], [6], [7], [23]

The 1979-1983 Venezuela ``Learning to Think Project,'' which trained 100,000 teachers to teach thinking skills and involved a sample of 4,266 second grade students, reached a general conclusion that chess, methodologically taught, is an incentive system sufficient to accelerate the increase of IQ in elementary age children of both sexes at all socio-economic levels. [1], [7], [8], [9], [10]

During his governor's teacher grant from the New Jersey State Department of Education, William Levy found that chess consistently (1980-1987) promoted self-esteem after a year of exposure. Many students' self-images improved dramatically. [7], [11]

According to a two-year study conducted in Kishinev under the supervision of N.F. Talisina, grades for young students taking part in the chess experiment increased in all subjects. Teachers noted improvement in memory, better organizational skills, and for many increased fantasy and imagination (Education Ministry of the Moldavian Republic, 1985). [1], [7]

In his 1986 pilot study, Dr. Ferguson found that it is possible to enhance achievement by focusing on individuals' modality strengths, creating an individualized thinking plan, analyzing and reflecting upon one's own problem solving processes, sharing his/her thinking system with peers, and modifying the system to integrate other modalities. [1], [7], [12]

During the 1987-88 ``Development of Reasoning and Memory through Chess,'' all students in a rural Pennsylvania sixth grade self-contained classroom were required to participate in chess lessons and play games. None of the pupils had previously played chess. The pupils significantly improved in both memory and verbal reasoning. The effect of the magnitude of the results is strong (eta 2 is .715 for the Memory test gain compared to the Norm). These results suggest that transfer of the skills fostered through the chess curriculum did occur. [1], [7], [13]

A 1989-92 New Brunswick, Canada study, using 437 fifth graders split into three groups, experimenting with the addition of chess to the math curriculum, found increased gains in math problem-solving and comprehension proportionate to the amount of chess in the curriculum. [14]

A 1990-92 study using a sub-set of the New York City Schools Chess Program produced statistically significant results concluding that chess participation enhances reading performance. [15], [16], [23]

``Playing Chess: A Study of Problem-Solving Skills in Students with Average and Above Average Intelligence,'' a study by Philip Rifner, was conducted during the 1991-1992 school term. The study sought to determine whether middle school students who learned general problem solving skills in one domain could apply them in a different domain. Data indicated that inter-domain transfer can be achieved if teaching for transfer is an instructional goal. [17]

During the 1995-1996 school year, two classrooms were selected in each of five schools. Students (N = 112) were given instruction in chess and reasoning in one classroom in each school. Pupils in the chess program obtained significantly higher reading scores at the end of the year. It should be noted that while students in the chess group took chess lessons, the control group (N = 127) had additional classroom instruction in basic education. The control group teacher was free to use the ``chess period'' any way he/she wanted, but the period was usually used for reading, math or social studies instruction. The control groups thus had more reading instruction than the chess groups.

Even so, the chess groups did better on the reading post-test; therefore, the gains in the chess groups were particularly impressive. [18]

In a 1994-97 Texas study, regular (non-honors) elementary students who participated in a school chess club showed twice the improvement of non-chess players in Reading and Mathematics between third and fifth grades on the Texas Assessment of Academic Skills. [19], [20]

Researchers and educators have questioned what causes this growth. The Venezuelan study claimed: ``Chess develops a new form of thinking, and this exercise is what contributes to increase the intelligence quotient.'' [10] More recent researchers speculate that it is the growth of new synaptic connections. Chess promotes the growth of dendrites!

Why does chess have this impact? Briefly, there appear to be at least seven significant factors: 1) Chess accommodates all modality strengths. 2) Chess provides a far greater quantity of problems for practice. 3) Chess offers immediate punishments and rewards for problem solving. 4) Chess creates a pattern or thinking system that, when used faithfully, breeds success. The chess playing students had become accustomed to looking for more and different alternatives, which resulted in higher scores in fluency and originality. 5) Competition. Competition fosters interest, promotes mental alertness, challenges all students, and elicits the highest levels of achievement (Stephan, 1988). 6) A learning environment organized around games has a positive affect on students' attitudes toward learning. This affective dimension acts as a facilitator of cognitive achievement

(Allen & Main, 1976). [21]

Instructional gaming is one of the most motivational tools in the good teacher's repertoire. Children love games. Chess motivates them to become willing problem solvers and spend hours quietly immersed in logical thinking. These same young people often cannot sit still for fifteen minutes in the traditional classroom. 7) Chess supplies a variety and quality of problems. As Langen (1992) states: ``The problems that arise in the 70-90 positions of the average chess game are, moreover, new. Contexts are familiar, themes repeat, but game positions never do. This makes chess good grist for the problem-solving mill.''

FACTS

Chess is part of the curricula in nearly 30 countries. In Venezuela, Iceland, Russia and other countries, chess is a subject in all public schools. [8]

In Vancouver, BC, the Math and Chess Learning Center, recognizing the correlation between chess playing and math skills development, has developed a series of workbooks to assist Canadian students in math. [42]

In Harriet Geithmann's article ``Strobeck, Home of Chess,';' The National Geographic Magazine, May 1931, pp. 637-652, we find that this medieval village in the Harz Mountains of Germany has taught the royal game in its public schools for years. Chess began in Strobeck in 1011. [37]

In ``Chessmen Come to Life in Marostica,'' The National Geographic Magazine, November 1956, by Alexander Taylor, pp. 658-668, we see an Italian town reviving a romantic legend of the Middle Ages, in which suitors played chess for the hand of a lady fair. [43]

The mathematics curriculum in New Brunswick, Canada is a text series called Challenging Mathematics, which uses chess to teach logic and problem solving from grades 2 to 7. Using this curriculum, the average problem-solving score of pupils in the province increased from 62% to 81%. The Province of Quebec, where the program was first introduced, has the highest math grades in Canada, and Canada scores better than the USA on international mathematics exams. [19], [20], [40]

Former U.S. Secretary of Education Terrell Bell encouraged knowledge of chess as a way to develop a preschooler's intellect and academic readiness. [39]

The State of New Jersey passed a bill legitimizing chess as a unit of instruction within the elementary school curriculum. On December 17, 1992, New Jersey Governor Jim Florio signed into law a bill to establish chess instruction in public schools. A quote from the bill states ``In countries where chess is offered widely in schools, students exhibit excellence in the ability to recognize complex patterns and consequently excel in math and science...'' [41]

Funding for chess activity is available under the ``Educate America Act'' (Goals 2000), Public Law 103-227, Section 308.b.2.E.: ``Supporting innovative and proven methods of enhancing a teacher's ability to identify student learning needs and motivating students to develop higher order thinking skills, discipline, and creative resolution methods.'' The original wording of this section included ``such as chess'' and passed Senate that way, but the phrase was deleted later in Conference Committee. [19]

ANECDOTAL MATERIALS

Several articles discuss chess as a tool to assist children of all levels.

Dr. Stefurak, a cognitive neuropsychologist, stated that ``chess instruction informs the mind and the emotions in such a way as to structure an emergent mental circuit where motivation and ability multiply to produce achievement in chess and school and life." [23]

In December 1996, Arman Tajarobi wrote: ``For the past three years, I've been a witness to an experiment held in 24 elementary schools in my town: The school board allowed these schools to replace an hour of math classes by a chess course each week for half of their students. For three consecutive years, the groups who received the chess formation have had better results in math than those who did not. This year (the fourth year), the school board has allowed any school that wants to provide its students with a chess formation to do so." [35]

John Artise (B.S., M.A.) draws upon his years of psychological research in chess to identify the contribution chess makes in education and learning. He identifies four areas of growth: memory improvement, logic, observation and analysis, and operant conditioning. ``Chess and Education," John Artise. [31]

The chess program funded by Oakland (California) Youth at Risk program proves to be an effective vehicle for saving troubled youth. [32]

Chess program in the troubled East Harlem district, New York, also rescues kids from drugs and gangs. [33]

Saratoga Springs editorial: ``Chess is the last best hope for this country to rescue its skidding educational system and teach the young generation the forgotten art of nurturing an attention span." [34]

In his book ``Your Child's Intellect," former U.S. Secretary of Education Terrell Bell encourages some knowledge of chess as a way to develop a preschooler's intellect and academic readiness (Bell, 1982, pp. 178-179). [44]

WHAT DO EDUCATORS SAY?

``Not only have the reading and math skills of these children soared, their ability to socialize has increased substantially, too. Our studies have shown the incidents of suspension and outside altercations have decreased by at least 60 percent since these children became interested in chess." --Assistant Principal Joyce Brown at the Roberto Clemente School in New York, 1988 [25]

Dr. Fred Loveland, superintendent of the Panama City schools, voiced his opinion: ``Chess has taught my students more than any other subject." [26]

The article ``Chess Improves Academic Performance" from the NY School Chess Program features a number of testimonies from school principals, including: ``Not only have the reading and math skills of these children soared, their ability to socialize has increased substantially, too. Our studies have shown that incidents of suspension and outside altercations have decreased by at least 60% since these children became interested in chess." [27]

``It's the finest thing that ever happened to this school. ...chess makes a difference...what it has done for these children is simply beyond anything that I can describe." [27]

``I see them (students) able to attend to something for more than an hour and a half. I am stunned. Some of them could not attend to things for more than 20 minutes." -- Jo Bruno, Principal, P.S. 189 [27]

Dr. Calvin F. Deyermond, Assistant Superintendent for Curriculum and Instruction for the North Tonawanda City School District, wrote: ``Chess develops intellectual, esthetic, sporting, decision making, concentration, and perseverance skills. We have seen the effects of this wonderful game in our classroom and as an extracurricular activity. Not only is it mentally challenging but it attracts not only gifted pupils but also students at all levels of learning. Many students who have been experiencing problems, particularly in mathematics and reading, sometimes demonstrate remarkable progress after learning chess." [28]

Rob Roy of Connecticut: ``Children with special problems can also learn chess. I taught a successful course for emotionally and educationally disadvantaged children in the Waterbury schools and used chess as a way for them to learn and practice self-control.It was like turning on switches in their heads. You see the child looking at a problem, breaking it down, and then putting the whole thing back together. The process involves recall, analysis, judgment and abstract reasoning." [38]

Public School 68 in the Bronx noted standardized scores increased 11.2% in reading and 18.6% in math during the 1994-95 school year. Principal Cheryl Coles wrote: ``As encouraging as our scores are, the benefits of our Chess Education Program far exceeded anything that these scores could ever hope to indicate. There were significant outgrowths in varying degrees in all curriculum areas. Such as: increased enthusiasm for learning, increase in general fund of knowledge, increase in pupil attendance, increase in self-confidence, increase in parent involvement, etc." [29]

Beulah McMeans, a guidance counselor at Morningside Elementary School in Prince George's County, MD, uses chess ``to help raise the self-esteem and higher order thinking skills for young students, particularly those at risk." [30]

``Intuitively, I feel what the kids learn from chess carries over to their everyday lives. The change shows up in their improved critical thinking and problem solving. It gets kids to think for themselves." -- Fred Nagler, Principal, P.S. 123 [27]

WHAT DO STUDENTS SAY?

``Chess has significantly increased my logical and mathematical skills. In fact, because of the effect of chess, I am going to major in mathematics and computer science in college, both of which utilize the aforementioned skills." Matthew Puckett [45]

The skills chess offers to those who play it are gold mines. It teaches the faithful players how to approach life. It teaches people that are having dilemmas that here is more than one answer to a problem. While your adversary is looking at the issue through a single point, you as the great chess player that you are, can take a step back and look at the picture through many points." Sultan Yusufzai [45]

Because of chess, I feel that my life has been enriched both mentally and socially. I have improved my critical thinking skills in everyday life through chess." Brandon Ashe [45]

WHAT DO PARENTS SAY?

Andrew Rozsa, psychologist, speaking of his gifted son: ``He has had real social and behavioral difficulties since he was 18 months old... He was thrown out of several schools... Things became pretty bad at about age 9 ... Nothing seemed to work, nothing. ... Today he is a straight A student and his behavior problems are minimal (but not trivial). ... Sorry, no control subjects, no double blind, no defined independent variables (actually there are two: chess and age).

Nonetheless, I think that the great improvements we have seen are, to a large extent, due to chess." [36], [38]

``Chess is one of the most meaningful things I've ever seen enter this school system." Dee Estelle Alpert

``I want to see chess introduced into the curriculum, right alongside math, music, and art." Oscar Shapiro [27]

CONCLUSION

At the 40th World Chess Congress in 1969, Dr. Hans Klaus, Dean of the School of Philosophy at Humboldt University in Berlin, commented upon the chess studies completed in Germany: ``Chess helps any human being to elaborate exact methods of thinking. It would be particularly useful to start playing chess from the early school days ... Everybody prefers to learn something while playing rather than to learn it formally…it produces in our children an improvement in their school achievements. Those children who received systematic instructions in chess improved their school efficiency in different subjects, in contrast with those who did not receive that kind of instruction." [22]

Because of the overwhelming research demonstrating the benefits of chess and because of the brain research theorizing the growth of dendrites, chess should be integrated into the school curriculum at the primary level.

Chess is a new way of solving the old problem of poor education. From the streets of Harlem to Venezuela's public schools the sport of kings has been implemented as an effective tool for teaching students to utilize their higher order thinking skills and to strive to overcome personal problems to reach their full potential. In light of these facts it is not unreasonable to imagine chess as a broader part of schools in America. Chess could very well be one of the missing components for America to regain its place at the top for educating its young people.

WHY SHOULD YOU PLAY CHESS? WHAT ARE THE BENEFITS?

Source: library.advanced.org/10746/reasons.html

Chess is a game for people of all ages. You can learn to play at any age and in chess, unlike in many other sports, you don't ever have to retire. Age is also not a factor when you're looking for an opponent --young can play old and old can play young.

Chess develops memory. The chess theory is complicated and many players memorize different opening variations. You will also learn to recognize various patterns and remember lengthy variations.

Chess improves concentration. During the game you are focused on only one main goal -- to checkmate and become the victor.

Chess develops logical thinking. Chess requires some understanding of logical strategy. For example, you will know that it is important to bring your pieces out into the game at the beginning, to keep your king safe at all times, not to make big weaknesses in your position and not to blunder your pieces away for free. (Although you will find yourself doing that occasionally through your chess career. Mistakes are inevitable and chess, like life, is a never-ending learning process.)

Chess promotes imagination and creativity. It encourages you to be inventive. There are an indefinite amount of beautiful combinations yet to be constructed.

Chess teaches independence. You are forced to make important decisions influenced only by your own judgment.

Chess develops the capability to predict and foresee consequences of actions. It teaches you to look both ways before crossing the street.

Chess inspires self-motivation. It encourages the search of the best move, the best plan, and the most beautiful continuation out of the endless possibilities. It encourages the everlasting aim towards progress, always steering to ignite the flame of victory.

Chess shows that success rewards hard work. The more you practice, the better you'll become. You should be ready to lose and learn from your mistakes. One of the greatest players ever, Capablanca said, "You may learn much more from a game you lose than from a game you win. You will have to lose hundreds of games before becoming a good player."

Chess and Science. Chess develops the scientific way of thinking. While playing, you generate numerous variations in your mind. You explore new ideas, try to predict their outcomes and interpret surprising revelations. You decide on a hypothesis, and then you make your move and test it.

Chess and Technology. What do chess players do during the game? Just like computers they engage in a search for the better move in a limited amount of time. What are you doing right now? You are using a computer as a tool for learning.

Chess and Mathematics. You don't have to be a genius to figure this one out. Chess involves an infinite number of calculations, anything from counting the number of attackers and defenders in the event of a simple exchange to calculating lengthy continuations. And you use your head to calculate, not some little machine.

Chess and Research. There are millions of chess resources out there for every aspect of the game. You can even collect your own chess library. In life, is it important to know how to find, organize and use boundless amounts of information. Chess gives you a perfect example and opportunity to do just that.

Chess and Art. In the Great Soviet Encyclopedia chess is defined as "an art appearing in the form of a game." If you thought you could never be an artist, chess proves you wrong. Chess enables the artist hiding within you to come out. Your imagination will run wild with endless possibilities on the 64 squares. You will paint pictures in your mind of ideal positions and perfect outposts for your soldiers. As a chess artist you will have an original style and personality.

Chess and Psychology. Chess is a test of patience, nerves, will power and concentration. It enhances your ability to interact with other people. It tests your sportsmanship in a competitive environment.

Chess improves schoolwork and grades. Numerous studies have proven that kids obtain a higher reading level, math level and a greater learning ability overall as a result of playing chess. For all those reasons mentioned above and more, chess playing kids do better at school and therefore have a better chance to succeed in life.

Chess opens up the world for you. You don't need to be a high ranked player to enter big important competitions. Even tournaments such as the US Open and the World Open welcome players of all strengths. Chess provides you with plenty of opportunities to travel not only all around the country but also around the world. Chess is a universal language and you can communicate with anyone over the checkered plain.

Chess enables you to meet many interesting people. You will make life-long friendships with people you meet through chess.

Chess is cheap. You don't need big fancy equipment to play chess. In fact, all you may need is your computer! (And we really hope you have one of those, or else something fishy is going on here.) It is also good to have a chess set at home to practice with family members, to take to a friend's house or even to your local neighborhood park to get everyone interested in the game.

CHESS IS FUN! Dude, this isn't just another one of those board games. No chess game ever repeats itself, which means you create more and more new ideas each game. It never gets boring. You always have so much to look forward to. Every game you are the general of an army and you alone decide the destiny of your soldiers. You can sacrifice them, trade them, pin them, fork them, lose them, defend them, or order them to break through any barriers and surround the enemy king. You've got the power!

To summarize everything in three little words: Chess is Everything!

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ADDITIONAL INFORMATION

For additional information about the studies reviewed in this summary, please contact the United States Chess Federation by calling 914-562-8350 or by writing to: U.S. Chess

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Scientific Proof: Chess Improves Reading Scores

by Beverly Byrne, USCF
Assistant Publications Director

A new scientific study lends authoritative proof to what chess coaches have suspected all along: chess improves reading skills.

New York City's District 9 mid-elementary school students took part in a comprehensive study program. Chess and non-chessplaying students volunteered. The results were reported in a study by Stuart Margulies, Ph.D., and stated that the test scores of the students in the NYC chess program were outstanding compared to those of the control groups.

All of the subjects took a reading test at the end of each school year. Reading gains of the groups were compared. The control groups were made up of (1) all non-chessplaying classmates or (2) non chessplaying classmates who had the same average reading scores at the beginning of the year as the players. The chessplayers showed greater gains in reading as compared to either of the other control groups.

Teachers who played chess served as Coaches, ran the program, and were assisted by chess masters from the American Chess Foundation. During the 1991-92 school year, the District 9 program was greatly enhanced by the addition of computers supplied by IBM to the participating schools. This gave the students more chances to practice, to play against computer chess software, and to have the fun and the challenge of playing matches against other schools. This enhanced program was termed the Castle Chess Program.
While most students in District 9 performed below the national average in reading skills, most chessplayers performed above the national average. This confirms the power of the Castle Chess Program to develop enhanced reading scores.

An additional control group was needed to rule out the possibility that the above average students (in this case the chessplayers) make gains even if the rest of the district does not. To test this, a sample of students in the top 70% of the class was taken from the same classes as the chessplayers.The scores at the beginning of the year of these highscoring non-chessplayers were the same as the chess participants. At the end of the year, they showed no gain in percentile ranking-while the chessplayers gained 5.7 percentiles! The research further indicates that although chessplayers score from the bottom level to the top level, they include a higher percentage of excellent readers than are found in the general District 9 population.
This finding supports the possibility that chess programs function well as an Intellectually Gifted and Talented Program.

The teachers in District 9 are firm in their belief that their chessplaying students develop enhanced ego strength as they increase their chess competence. They proclaim that students who feel confident and good about themselves naturally learn to read better.
The chess masters concur that playing chess develops general intelligence, self-control, analytic skill, and increased ability to concentrate. Because of this, enhanced reading skills naturally follow.

Chess Makes Kids Smarter

BY DR.GERARD DULLEA

Chess lovers have long contended that chess should be a valuable classroom tool. It can provide an intellectually stimulating, rewarding activity, but it can also teach discipline, concentration, planning and all the other good things that go into successful chess.

In 1977, however, the National Institute of Education (NIE) argued against this position, saying in effect that good students and good chessplayers tend to be the same group simply because they are more intelligent and more intellectual than their classmates. NIE contended that transfer of skills is minimal, arguing that time spent on one skill detracts from the learning of another.

Some months later Dutch scholar Adriaan de Gioot wrote a rebuttal of NIE's position, basing his arguments on a careful two-year study in Belgium. Now, thanks largely to Harry Lyman of Massachusetts, in behalf of the Massachusetts Chess Association and the American Chess Foundation. the Flemish source of de Groot's argument has been translated into English.

The Belgian study was the doctoral thesis of Johan Christiaen, titled "Chess & Cognitive Development." It was a carefully controlled experiment with 20 students in the fifth grade in 1975, following them through the sixth grade the next year. As might be expected of a foundation for a doctorate in psychology, the test was carefully designed and executed, complete with a control group and other features of good experimentation.

Christiaen's aim was to use chess to test jean Piaget's theory about cognitive development, or intellectual maturation. Piaget holds that an important growth period occurs approximately between the ages of 11 and 15. In this stage, the child moves beyond physical trial and error and begins hypothesizing and deducing, developing more complex logic and judgment. In Piaget's terms, the youngster moves from the "concrete" stage to the "formal" stage. Piaget further contends that the environment of a child can speed up or slow down the maturation. So Christiaen proposed to vary environment with either chess or no-chess. If chess were the significant variable between two groups of youngsters, any significant difference in the development of students could be attributed to enrichment brought by chess to their environment. And it worked!

In the words of Harry Lyman, "Learning chess makes kids smarter in the classroom!"

On 42 Friday afternoons, after school, Christiaen taught chess to 20 boys randomly selected from a group of 40. The other 20 were the control group, the one that would be compared. He did his best to keep these students ignorant of their experimental In testing after these two years, the chess, group scored somewhat better than the control group on various of Piaget's tests for cognitive development. More of a difference, however, was evident in their regular school testing! In the school testing, the chess group did significantly better in both the fifth grade tests and (somewhat less so) in the sixth grade tests.

Christiaen notes that some of this difference may be due to what Robert Rosenthal of Harvard calls the "Pygmalion effect." That is, teachers who may give special treatment to "special" students may get special results from those students.

On the other hand, classroom testing was supported by standardized testing administered by an outside agency, which did not know the identities of the two groups. On these tests too, the chess group performed better than the control group.

This study by Dr. Christiaen needs support, extension and confirmation. And other tests can be made too. For the moment, however, we have scientific support for what we have known all along - chess makes kids smarter!

Reprinted from the November 1982 issue of Chess Life magazine.

The Case for Chess as a Tool to Develop Our Children's Minds

By Dr Peter Dauvergne

University of Sydney

July, 2000

Abstract

This article surveys educational and psychological studies to examine the benefits for children of studying and playing chess. These show that chess can

- Raise intelligence quotient (IQ) scores
- Strengthen problem solving skills, teaching how to make difficult and abstract decisions independently
- Enhance reading, memory, language, and mathematical abilities
- Foster critical, creative, and original thinking
- Provide practice at making accurate and fast decisions under time pressure, a skill that can help improve exam scores at school
- Teach how to think logically and efficiently, learning to select the 'best' choice from a large number of options
- Challenge gifted children while potentially helping underachieving gifted students learn how to study and strive for excellence
- Demonstrate the importance of flexible planning, concentration, and the consequences of decisions
- Reach boys and girls regardless of their natural abilities or socio-economic backgrounds

Given these educational benefits, the author concludes that chess is one of the most effective teaching tools to prepare children for a world increasingly swamped by information and ever tougher decisions.

The Case for Chess as a Tool to Develop Our Children's Minds

By Dr Peter Dauvergne

University of Sydney

July, 2000

Is chess an art? A science? Some claim it's both. Yet let's be honest, it's really just a game. Fun, challenging, creative: but still a game, not much different from tennis, cricket, football, or golf.

But there is one striking difference to these other popular games. While learning to play almost any game can help build self-esteem and confidence, chess is one of the few that fully exercises our minds.

Many of us could probably use this exercise, although it may be a bit late for some. (At least for those of us old enough to read an article like this voluntarily!) It's not, however, too late for our children.

Chess is one of the most powerful educational tools available to strengthen a child's mind. It's fairly easy to learn how to play. Most six or seven year olds can follow the basic rules. Some kids as young as four or five can play. Like learning a language or music an early start can help a child become more proficient. Whatever a child's age, however, chess can enhance concentration, patience, and perseverance, as well as develop creativity, intuition, memory, and most importantly, the ability to analyse and deduce from a set of general principles, learning to make tough decisions and solve problems flexibly.

This is undeniably a grand claim. The remainder of this paper outlines some of the arguments and educational studies to justify and support this.

Concentration, Patience, and Perseverance

To play chess well requires intense concentration. Some of the world's top players can undeniably look distracted, sometimes jumping up between moves to walk around. A closer look, however, reveals that most of these players are actually in deep concentration, relying on strong visual recall to plan and calculate even when they are away from their game. For young, inexperienced players, chess teaches the rewards of concentration as well as provides immediate penalties for lapses. Few teaching tools provide such quick feedback. One slip in concentration can lead to a simple blunder, perhaps even ending the game. Only a focused, patient and persistent young chess player will maintain steady results – characteristics that are equally valuable for performing well at school, especially in school exams.

Analysis, Logic, and Problem Solving

Playing chess well involves a combination of aptitudes. A 1973-74 study in Zaire by Dr Albert Frank (1974) found that good teenage chess players (16-18 years old) had strong spatial, numerical, administrative-directional, and paperwork abilities. Dr Robert Ferguson (1995, p. 2) notes that "This finding tends to show that ability in chess is not due to the presence in an individual of only one or two abilities but that a large number of aptitudes all work together in chess." Even more significantly Frank's study found that learning chess, even as teenagers, strengthened both numerical and verbal aptitudes. This occurred for the majority of students (not just the strong players) who took a chess course for two hours each week for one school year. Other studies have added that playing chess can strengthen a child's memory (Artise).

A 1990-92 study in New Brunswick, Canada, further shows the value of chess for developing problem solving skills among young children (Gaudreau 1992). By integrating chess into the traditional mathematics curriculum teachers were able to raise significantly the average problem solving scores of their students. These students also scored far higher on problem solving tests than ones who just took the standard mathematics course. Primary school chess has now exploded in New Brunswick. In 1989, 120 students played in the provincial school chess championship. Three years later over 19,000 played (Ferguson 1995, p. 11).

Chess has also been shown to foster critical and creative thinking. Dr Ferguson's four-year study (1979-83) analysed the impact of chess on students' thinking skills in the Bradford Area School District in the United States (grades 7-9). These students were already identified as gifted, with intelligence quotient (IQ) scores above 130. Using two tests (Watson-Glaser Critical Thinking Appraisal and the Torrance Tests of Creative Thinking) Ferguson (1995, pp. 4-6) found that after spending 60-64 hours playing and studying chess over 32 weeks students showed significant progress in critical thinking. He further found that chess enhances "creativity in gifted adolescents." He concluded that "it appears that chess is superior to many currently used programs for developing creative thinking and, therefore, could logically be included in a differentiated program for mentally gifted students".

Playing chess, however, is not only valuable for developing the skills of gifted children. Average and even below average learners can also benefit. Chess teacher Michael Wojcio (1990) notes that "even if a slow learner does not grasp all of [the strategies and tactics in chess], he/she can still benefit by learning language, concepts, and fine motor movement." During a program run by Dr Ferguson from September 1987 to May 1988 all members of a standard sixth grade class in rural Pennsylvania were required to take chess lessons and play games. This class had 9 boys and 5 girls. At the start of this study students took IQ tests, producing a mean IQ of 104.6. Students then studied chess two or three times per week while playing most days. They were also encouraged to participate in tournaments. After this intensive chess instruction a group of seven boys managed to finish second in the 1998 Pennsylvania State Scholastic Championship. Significantly, at the conclusion of the study tests showed a significant increase in both memory and verbal reasoning skills, especially among the more competitive chess players (Ferguson 1995, pp. 8-9).

Chess has even been shown to raise students' overall IQ scores. Using the Wechsler Intelligence Scale for Children a Venezuelan study of over 4,000 second grade students found a significant increase in most students' IQ scores after only 4.5 months of systematically studying chess. This occurred across all socio-economic groups and for both males and females. The Venezuelan government was so impressed that all Venezuelan schools introduced chess lessons starting in 1988-89 (summarised in Ferguson 1995, p. 8).

Solving Problems and Synthesising Information in a Globalising World

The internet, email, and computers are rapidly changing the skills essential to succeed at school and work. As globalisation accelerates, information is pouring in faster and faster. Information that took months to track down a few years ago can now spin off the internet in just minutes. With such easy access and tremendous volumes, the ability to choose effectively among a wide variety of options is ever more vital.

In this world students must increasingly be able to respond quickly, flexibly and critically. They must be able to wade through and synthesise vast amounts of information, not just memorise chunks of it. They must learn to recognize what is relevant and what is irrelevant. They also need to acquire the skills to be able to learn new technologies quickly as well as solve a continual stream of problems with these new technologies.

This is where chess as a tool to develop our children's minds appears to be especially powerful. By its very nature chess presents an ever-changing set of problems. Except for the very beginning of the game — where it's possible to memorise the strongest lines — each move creates a new position. For each of these a player tries to find the 'best' move by calculating ahead, evaluating these future possibilities using a set of theoretical principles. Importantly, more than one 'best' move may exist, just as in the real world more than one best option may exist. Players must learn to decide, even when the answer is ambiguous or difficult.

These thinking skills are becoming ever more valuable for primary and secondary school students constantly confronted with new everyday problems. If these students go to university it will be especially imperative to understand how to apply broad principles to assess new situations critically, rather than rely on absorbing a large number of 'answers'. Far too commonly my own university students do not have these skills. As a result they become swamped by information, vainly searching for the right answer to memorise rather than the various best options.

Conclusion

The case, then, is exceptionally strong for using chess to develop our children's minds and help them cope with the growing complexities and demands of a globalising world. More and more schools around the world are recognising the value of chess, with instruction now becoming part of standard curriculums. It's of course just a game. Yet it has fascinated and challenged some of the greatest minds of the last century, sparking enough books about how to play to fill an entire library.

Chess is an especially effective teaching tool. It can equally challenge the minds of girls and boys, gifted and average, athletic and non-athletic, rich and poor. It can teach children the importance of planning and the consequences of decisions. It can further teach how to concentrate, how to win and lose gracefully, how to think logically and efficiently, and how to make tough and abstract decisions (Seymour and Norwood 1993). At more advanced levels it can teach flexible planning since playing well requires a coherent plan, yet not one that is rigidly followed regardless of the opponent's response. Chess can also build confidence and self-esteem without overinflating egos, as some losses are inevitable, even for world champions.

Chess can potentially help teach underachieving gifted children how to study, perhaps even leaving them with a passion for learning. Chess tournaments can, moreover, provide a natural setting for a gifted child to interact with other children of all ages, as many tournaments are not divided by age but by ability (unlike most school activities and many other sports). It's common to see a six-year-old playing a twelve-year-old, or a ten-year-old playing a seventeen-year-old. Young players can also perform remarkably well in adult chess tournaments. In 1999-2000 in Australia, for example, a thirteen-year-old won the New South Wales championship, a fourteen-year-old won the South Australian championship, a fifteen-year-old won the Queensland championship, and a thirteen-year-old tied for second in the Australian championship.

Studying chess systematically has also been shown to raise students' IQ scores, academic exam scores (Dullea 1982; Palm 1990; Ferguson 2000, p. 3), as well as strengthen mathematical, language, and reading skills (Margulies 1991; Liptrap 1998; Ferguson 2000, pp. 3-4). Tournament chess games, which involve clocks to limit the total time each player can use, are also a fun way to provide practice at making fast and accurate decisions under pressure, a skill that can help students cope with the similar pressures of school exams. This is also a fun way to practise how to put the mind into high gear, where intense concentration increases alertness, efficiency of thought processes, and ultimately mental performance.

Perhaps most importantly chess is a fun way to teach children how to think and solve an ever-changing and diverse array of difficult problems. With millions of possibilities in every game, players must continually face new positions and new problems. They cannot solve these using a simple formula or relying on memorised answers. Instead, they must analyse and calculate, relying on general principles and patterns along with a dose of creativity and originality – a skill that increasingly mirrors what students must confront in their everyday schoolwork.

In June 1999 the International Olympic Committee officially recognized chess as a sport. This is welcome news for the world's six million registered chess players as well as countless more unregistered players. With such recognition hopefully even more of our children will turn to chess, striving for sporting dreams that will leave them smarter, and ultimately able to cope better in the real world of perpetual problems.

About the Author

Peter Dauvergne is a Canadian chess master (FIDE rating 2250) and Senior Lecturer in the Faculty of Economics and Business at the University of Sydney, Australia. He is the editor of the journal *Global Environmental Politics* (MIT Press) and the author of numerous books and articles on environmental management in the Asia-Pacific. He can be reached at peterd@econ.usyd.edu.au.

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Chess Is Cool for Kids!
By Leopold Lacrimosa

Walt Disney Pictures announced they will start production on the movie "I Choose to Stay", to be released in 2005. It is based on the book "I Choose to Stay: A Black Teacher Refuses to Desert the Inner City", published in 2003 by Kensington Publishing and written by Salome Thomas-EL. Mr. Thomas-El, a gifted child who was raised in the projects of Philadelphia, Pa., earned an Ivy League education and returned to Philadelphia in 1987 to become a teacher at Vaux Middle School.
There he revived the then dormant chess club and with a profound belief in his student's potential, taught the children to play chess. These children then went on to win local and national competitions. Mr. Thomas-El used these accomplishments to motivate hundreds of the children to attend magnet high schools and then go on to major colleges and universities. Many have gone on to do greater things in higher education and in the professional world.

Can Chess Really do that for Kids?

But is this result all because of chess? After all it's just a game, right? What many parents are beginning to learn is that chess can and does help foster developmental thinking in children.
Yasser Seirawan, one of America's premier Grand Masters, World Junior Champion (1987), four-times U.S. Champion (1981, 1986, 1989 and 2000), ten-time member of the U.S. Olympiad chess team (he was also one of the top scorers at Bled 2002 Olympiad, achieving an individual silver medal for his performance) and five time contender for the World Crown (1985, 1987, 1997, 1999 and 2000) is fond of saying that chess teaches the 5 R's. Reading, Writing, Arithmetic, Responsibility and Respect.

Chess and the 5 R's for Kids

Chess and Reading: because kids must study from many chess books in order to develop their game.
Chess and Writing: because the rules of chess state that you must keep a score of your game.
Chess and Math: because each piece on the chess board has value, some greater than others; if you loose stronger pieces for lesser ones, it may cost you the game.
Chess and Responsibility: because you and you alone must direct your army of pieces to its best deployment, and bad decisions will allow your men to be captured with little or no compensation, which may also cost you the game.
Chess and Respect: because you respect yourself as well as your opponent, each game begins with a handshake and ends with a handshake.

Chess Helps Developmental Thinking in Kids

As a chess coach, I have seen that chess does more, much more. When a child takes up the Royal game, (chess has been around since about 550-620 A.D. and has been known as the "King of Games" and the "Game of Kings"), he begins to develop logical thinking, critical thinking, decision making, problem solving, as well as, mathematical skills, algebra and geometry.
A study by Dr Peter Dauvergne at the University of Sydney, has found that students who play chess have raised their intelligence quotient (IQ) scores in the following areas:

- Strengthened problem solving skills
- Learned how to make difficult and abstract decisions independently
- Enhance reading, memory, language, and mathematical abilities; fostered critical, creative, and original thinking
- Provided practice at making accurate and fast decisions under time pressure, (a skill that can help improve exam scores at school)
- Taught them how to think logically and efficiently, learning to select the "best" choice from a large number of options
- Challenged gifted children while potentially helping underachieving gifted students learn how to study and strive for excellence
- Demonstrated the importance of flexible planning, concentration, and the consequences of decisions
- Reached boys and girls regardless of their natural abilities or socio-economic backgrounds.

Chess Is Cool for Kids!

Other Studies Showing that Chess is Good for Kids

"Chess in Education Research Summary" by Robert Ferguson (1995). A 14-page summary of key chess research.

"Chess Improves Academic Performance" summary of NY School Chess Program.

"The Importance of Chess in the Classroom", Atlantic Chess News, 1990 (Michael D. Wojcio). Wojcio teaches chess to slow learners in 5 NJ schools and this describes his program and the benefits.

"Chess and Education" (John Artise). After 2 years of psychological research in chess, Artise found cognitive improvements in memory, logic, observation and analysis, and operant conditioning.

"The Effect of Chess on Reading Scores" by Stuart Margulies, Ph. D.

"Teaching the Fourth R (Reasoning) Through Chess" (Robert Ferguson). A 1979 project teaching the gifted (grade 7-9) in Bradford Pa. Statistical "proof" that chess increases thinking scores. Also, includes description of teaching program.

"Chess Makes Kids Smart" (Anne Graham-PARENTS-Dec 1985). Urges parents to introduce their kids to chess and quotes work of Pete Shaw, Jeff Chesin, Bob Cotter, etc.

"Chess Makes Kids Smarter" (Dr. Gerard J. Dullea).

"Chess as a Way to Teach Thinking" (Diane Horgan).

These are only scratching the surface. In the Netherlands, the Dutch found that kids who play chess overall do 8% better in mathematics and science compared to kids who didn’t play (The statistic for girls alone is a difference of 12%).

Chess in the Schools

Chess (long embraced by the Russians and Europeans who have taught the game as part of their educational curriculum) has now moved as part of the curriculum in hundreds of schools in our Northern neighbor, Canada. They have seen the benefits of children learning the game.

But these reasons don't compel children to take up the game. As a chess coach, I have seen attendance swell in the school chess clubs I teach. The company I work for in Phoenix, AZ, has seen a 20% annual growth in children's chess participation from its onset eight years ago. When I started teaching chess five years ago, we would hold a scholastic tournament with 70 players. When we had a hundred and fifty entrants we thought it was big. This year (2004) in the eight tournaments we've held, the average attendance exceeded 350 in 5 sections, and that's only from the greater Phoenix area. The Arizona State Championship and the Arizona Governor's Cup each saw close to 600 entrants while the recent U.S. Chess Federation's Elementary Championship was close 2100 children in attendance.

Kids are Attracted to Chess

So why are children attracted to chess? I believe that it appeals to our (their) inherited, individualistic, competitive nature. As a child grows, he/she wants to stand on their own, away from any parent or guardian and at the same time, when achieving a goal, say to them, "Hey, look what I can do!"

Unlike many team sports, chess players do stand on their own. If they loose a game, it is their fault, their failure and no one else's. They cannot blame their loss on a teammate's failure to pass the ball, miss the goal, or in being forced to play no matter how bad at the game the teammate may be. At the same time, when they win, it is also on their shoulders. It is because they were the ones who had put a little extra effort into learning the intricacies of the game. They are the ones who out thought their opponent in a long drawn out struggle or a short trap. And after their match, that win can create an adrenaline high that is unmatched except at the professional levels of sports.

Children who take up chess harbor deep emotions for the game. Once learned, it is with them for life. Yet, it is only those who play competitive chess who will develop into better players quicker than those who just learn the moves of the game. But is this healthy? Isn't fostering a competitive attitude in our children supposed to be a bad thing? I don't believe so, at least not in the competitive chess arena.

I've seen kids in chess grow up to become great kids. Kids who are jumpy, calm down; Kids who are overly hyper, sit and play for hours; Kids who are too emotional, learn to take losses and come back to play again; Kids who are over achievers, learn that there is always someone else out there who can beat you; Kids who never believe that they can perform or excel at anything, win games. Kids who want to win at all costs learn that winning isn't everything. And I've seen kids, win or loose, connect with their parents at an indescribable level when they walk out of the tournament hall.

I believe chess is good for you and is great for children.

And in the immortal words of the 13th World Chess Champion, Gary Kasparov:

"If you think it's just a game, than you're not playing it right!"

Benefits of Chess for Children

By Dean J. Ippolito

Chess has long been considered a way for children to increase their mental prowess, concentration, memory, and analytical skills. To anyone who has known the game, it comes as no surprise that these assumptions were actually proven in several studies on how chess can improve the grades of students.

Although chess has been shown to increase the mental abilities of persons of all ages, the main studies have been done with children. This is first for the obvious reason that students are constantly tested anyway, and therefore the data need only be analyzed, and secondly because children's mental development is more rapid and can be more easily measured than persons at a later life stage.

Early Conclusions

After several informal studies were done in the early 20th century on the effect that chess has on logical thinking and other such functions, a primary conclusion was drawn that chess does in fact not only demand such characteristics, but develops and promotes them as well. John Artise in Chess and Education wrote "Visual stimuli tend to improve memory more than any other stimuli; chess is definitely an excellent memory exerciser the effects of which are transferable to other subjects where memory is necessary."

Improved memory is just the tip of the iceberg. Reports from students, teachers, and parents noticed the academic benefits of chess on math problem solving skills and reading comprehension, an increase in self-confidence, patience, logic, critical thinking, observation, pattern recognition, analysis, creativity, concentration, persistence, self-control, sportsmanship, responsibility, respect for others, self esteem, coping with frustration, and many other influences which are difficult to measure but can make a difference in student attitude, motivation, and achievement.

With this in mind, legislation in the U.S. in 1992 promoting and encouraging the incorporation of chess into the curriculum of schools was passed. The U.S. joined the more than 30 countries which already had chess included in some form in their school curricula. Today it is estimated that that number has more than doubled.

In part due to the educational community, which has noted the increased academic performance of students participating in chess, there has been an explosion in the number of children playing chess in the U.S. This popularity can be seen in the record number of players competing in National Scholastic Events. Scholastic chess players are increasing in numbers more rapidly than adult chess players; scholastic chess membership within the United States Chess Federation now represents more than 50% of the total members. An estimated 250,000 children in the U.S. are introduced every year through the school system to the basics of the game. As the number of children playing chess grows, it has become necessary for actual tests to be performed to determine the benefits of chess. Luckily, these studies have already been done to confirm the hypothesis that chess is linked to increased grades in school; far too many to be listed here. I will touch on some of the more outstanding, thorough studies, all of which have similar findings.

Case Studies

As reported in Developing Critical Thinking Through Chess, Dr. Robert Ferguson tested students from seventh to ninth grades from the years 1979-1983 as part of the ESEA Title IV-C Explore Program. He found that non-chess students increased their critical thinking skills an average of 4.6% annually, while students who were members of a chess club improved their analytical skills an average of 17.3% annually. Three separate tests to determine how chess affects creative thinking were also done as part of the same study. It concluded that on average, different aspects of creative thinking had improved at a rate two to three times faster for chess playing students, as opposed to their non-chess playing counterparts.

Subsequent studies by Dr. Ferguson further supported these original conclusions. In the Tri-State Area School Pilot Study conducted in 1986 and Development of Reasoning and Memory Through Chess (1987-88) chess playing students showed more rapid increased gains in memory, organizational skills, and logic.

In Zaire the study Chess and Aptitudes, was conducted by Dr. Albert Frank at the Uni Protestant School, during the 1973-74 school year. Using sufficiently large experimental and control groups, Dr. Frank wanted to confirm if the ability to learn chess is a function of special aptitude, perceptive speed, reasoning, creativity, or general intelligence. He hypothesized that in order to learn chess well one must have a high level of one or several of these abilities. He also wanted to see to what extent learning chess could influence the development of these abilities. His results were astonishing, yet predictable. There was a significant correlation between the ability to play chess well, and spatial, numerical, administrative-directional, and paperwork abilities. It showed that the ability in chess is not due to the presence of only one or two abilities but that a large number of talents all work together in chess. The conclusion was that students participating in the chess course show a marked development of their verbal and numerical aptitudes. Furthermore, this was noticed in the majority of chess students and not only those who were better players.

A study conducted in four large elementary schools in Texas in 1997 further demonstrated the positivism of chess. Through the Texas Assessment of Academic Skills (TAAS), the study was done to test the difference that chess club had on standardized tests. These schools were selected since all had a chess program in existence for a minimum of two years. The chess clubs met for one hour after school one day per week. Since a few thousand total students took the test and all types of students were tested from special education students to gifted and talented students, the sample was large and diverse enough to make a concrete conclusion. There were significant improvements in both reading and math for all grade levels and all classes of students (regular, gifted and talented, special education, academically able, etc.). Through the Texas Learning Index, or TLI, it was determined that on average the students who played chess improved in reading and mathematics at a rate between 1.5 and two times faster than non-chess playing students.

In terms of verbal improvement specifically, a study by Dr. Stuart Margulies from 1991 addressed this. The study conclusively proved that students who learned chess enjoyed a significant increase in their reading skills. "Margulies Study is one of the strongest arguments to finally prove what hundreds of teachers knew all along-chess is a learning tool. (Inside Chess, February 1994).

"Can chess promote earlier intellectual maturation" was the question posed in the Chess and Cognitive Development study directed by Johan Christiaen from the 1974-76 school years in Belgium. The results again clearly confirmed that the group of chess playing students showed significantly more improvement then the non chess playing students. In 1982, Dr. Gerard Dullea mentioned this study and proclaimed "…we have scientific support for what we have known all along-chess makes kids smarter! (Chess Life, November 1982) In a similar study done in a test series in New Brunswick, Canada called Challenging Mathematics, the mathematics curriculum used chess to teach logic from grades 2 to 7. The average problem solving score in the province increased from 62% to 81%. In Playing Chess: A Study of Problem-Solving Skills in Students with Average and Above Average Intelligence by Philip Rifner from the 1991-92 school term, the hypothesis that learning general problem solving skills in chess could then be applied to other domains was affirmed.

Conclusions

We can now say with full confidence that chess has been PROVEN to enhance creativity, problem solving, memory, concentration, intellectual maturity, self esteem, and many other abilities that a parent or teacher would desire. This proves what all of us involved in chess have been saying for years…chess makes you smart!

The Importance of Chess in the Classroom *by Michael David Wojcio*

Since 1978 Michael has been teaching chess to slow learners, average, and above-average (gifted) students. in about 20 schools. Presently. he is teaching the Royal Game to sow learners at the Daron School in Livingston. N.J. and in four elementary schools, in Short Hills and Summit, in after-school programs.

In 1982, I started a *summer school chess* program at the Glenwood Elementary School *in* Short Hills. There are about 50 children who attend the chess classes every year.

For the last seven years, I have directed an annual children's chess tournament in Short Hills. This year we had 54 participants in four sections.

It is important that teachers realize:
1) That chess is not difficult to learn, and
2) That there are so many advantages for the students.

The fact that chess is easy to learn is shown by the USCF publications *Pawn & Queen and in Between* and *School Mates,* many videos, pamphlets, and good books of instruction. A few good instructional books are listed at the end of this article.

International Master Jeremy Silman is right on target when he states that chess improves concentration, visualization, and memory.

There is also a plethora of valuable ramifications enhanced by learning chess, and, in point of fact — it's fun!

In special education, the game for the slow learner means:

1) Remembering the light square is on the right setting up the board, the names of the pieces, and becoming familiar with piece movement, the rules, and the concept of checkmate.

2) Sequencing — putting the pieces on the correct squares at the beginning of the game.

3) fine motor skills — moving the pieces in a straight line — vertical, horizontal, diagonal, and L-shaped moves to the other color.

4) "Basic" strategy, controlling the center, moving one's army out in the opening, so that no knights or bishops remain "sleeping" on the back rank, and.

5) Thinking first, then moving.

Later, simple tactics and the *en passant* rule can be taught to some special education students. Tactics are short term plans, and strategy is the overall plan.

Even if a slow learner does not grasp all of this, he she can still benefit by learning language, concepts, and fine motor movement.

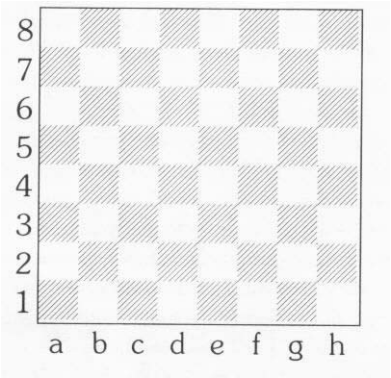
Teaching the game to the average, above average, and gifted student, means all of this at a faster pace, plus more involved strategy and tactics.

Chess is an art, a science, and a sport. Chess has this and even more value for students.

Chess is more than a game, since the teacher can transfer many aspects of this motivational tool to other important subjects.

Transfer of Learning can take place when:

1) Using algebraic notation. Learning the coordinates for files (eight vertical rows) and ranks (eight horizontal rows) can be a great introduction to reading street maps, or any x, y axis graph, or presentation.

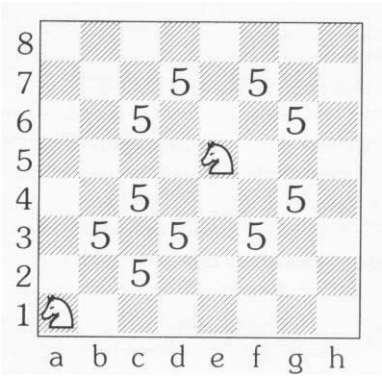


In algebraic chess notation, the numbers identify the ranks, and the letters identify the files, giving each square its identity.

2) Learning map skills also transfers to geography (longitude, latitude). I point out where my postal opponents live in the U.S.A. and in other countries, Chess is very popular in Europe and on other continents.

3) Marking down what squares the pieces attack with pennies, dimes, nickels, and quarters, means reviewing math and money skills. This can relate to simple coin recognition, subtraction, addition, or even more involved multiplication, for different levels of students.

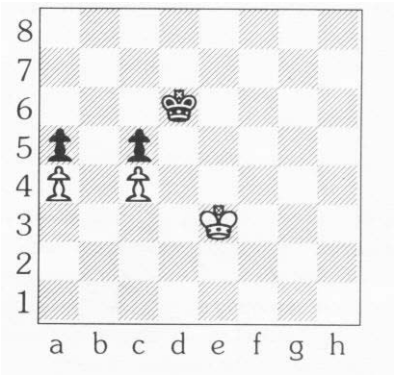
In addition, one can see that a piece in the center has more value, compared to one on the edge. Comparisons of value are applicable to other pieces.



The knight on a1 attacks two nickels (ten cents). The knight on e5 attacks eight nickels (40 cents). Which knight would you prefer to have?

4) Another aspect of math is geometry, and geometry plays a big part in teaching basic mating patterns. In a king and queen versus king ending, the winning side tries to limit the moves of the opponent's king by gradually decreasing the square or rectangle (formed by the squares attacked by the queen), until the king is forced to move to the edge of the board. When this cannot be accomplished with a queen move, the king moves closer to the enemy king (timing).

Triangulation (taking two moves to reach a square you could have moved to in one move) is an important concept in king and pawn endgames, and is an excellent introduction to triangles and timing.



The triangulation occurs on the e3, e4, and f4 squares. If the White king moves directly to e4, then Black replies Ke6 and the game is drawn, as neither player can get past the one square buffer of the opposing king (kings cannot come within one square of each other). By triangulating. White can win!
1. Kf4 Ke6 2. Ke4 Kd6 3. Kf5 Kc7 *4.* Ke5 (instead of e6 — another triangulation) Kc6 5. Ke6 Kb7 6. Kd7 (instead of d6 — another triangulation!) Kb6 *7.* Kd6 and now Black will lose one pawn, and then the other and the game.

5) Reading is one of the most important skills in education, and chess can be a great motivational tool. Last year, Harry, a 12-year-old in one of my classes, hated to read (his reading skills were at the second-grade level). Harry enjoyed chess and I let him borrow *Pawn and Queen and In Between.* He was so interested in learning more about the game that he read 36 pages of the 18 lesson booklet in one evening!

Also, books for average students, like Lewis Carroll's *Through the Looking Glass,* can be much more exciting for the children, since they know what chess is about.

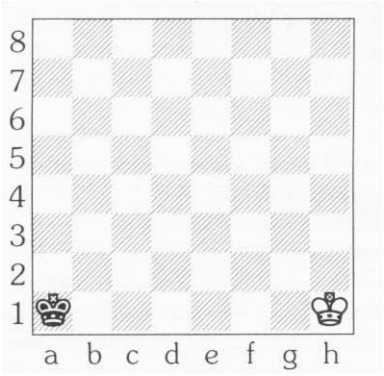
6) Language is always important and chess literature will build vocabulary, as well as serve as an introduction to a few foreign words. Chess has French words such as *en passant* (in passing), and en *prise* (in a position to be taken). There are German terms such as *Zugzwang* (move compulsion), and *Zwizchenzug* (intermediate move), and Italian words such as *tempo* (time), and Giuoco *Piano* (quietest game).

7) Perceptual Motor (fine motor) movement is enhanced by moving the pieces. For the slow learner and perceptually impaired child, hand-eye coordination is taught by using chess as an instructional tool.

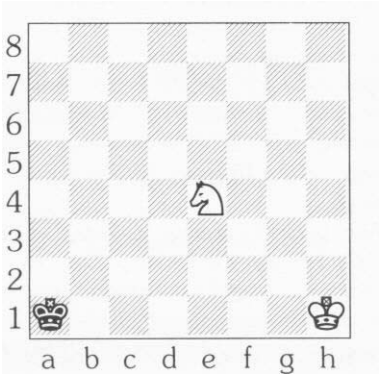
In terms of special perception, all students must learn nut to overlook the way an opponent's piece, moves. The lateral movement of the queen and rook, the 'backward diagonal movement of the queen and of the bishop, —indeed, any combination of horizontal, vertical, or diagonal movement (enlivened by the L-shaped move of the knight), once mastered, leads to a better perception of special relationships.

8) In my communicationally handicapped class last year, two of my students used an Apple computer. They learned how to play chess against a strong chess program and enjoyed doing **it.** Chess is one vehicle for creating an interest in using computers.

9) Science means discovery. The chess board may be an introduction to graphs in science and math. As in science, there are always new discoveries (moves) that make chess fascinating. The scientific aspect of the game (triangulation. opposition. queening squares: time, space and force relationships) can be used to demonstrate complex ideas in the simplest of terms.



White to move: Who reaches the a8 square first'?



White to move: Who reaches the a8 square first'?

10) Chess is a major sport in the Soviet Union. It can he used to enhance physical education programs, even if tine game is only linked to fine motor movement. One aspect of the offensive and defensive struggle depends on force — the strength *of* the pieces. Accordingly, if one loses *a* knight, he *will* eventually lose unless there is a great advantage in his position. One can find this in the different abilities of the players, and isn't a hockey team at a disadvantage when a player is in the penalty box?

Strategy, like controlling the center and the mobility of one's pieces, is analogous to basketball, football, and other sports.

We have to use our mental abilities to reach a higher level of performance.

11) Many great chess players have tried to find the right "artistic" combination and have won many beautiful games doing so. Tactics such as a smothered mate with a knight, an interference theme, or on an even higher level, a speculative sacrifice of a major (queen or rook) or minor (knight or bishop) piece (trading force for time or position) — serve nicely to illustrate this type of cohesive beauty.

The board and pieces can serve as an introduction to various art forms. Chess sets have been made in plastic, wood, ivory, glass, onyx, metal — almost every material imaginable. Some ornate designs are simply spectacular!

One of my third-grade classes, learning how to play chess during the lunch hour, staged a play entitled The Queen of the Red Chessmen' — and made their chess hats (to represent the various

pieces) in the art room, from available supplies.

12) Chess has a long and great history. *The Morals of Chess* by Benjamin Franklin is an excellent essay. Franklin emphasizes chivalry and courtesy. Students have to make good decisions by being less impulsive. *Touch move* is a prime example. Franklin classifies **it** as using caution. The best player in the world during the Civil War period was Paul Morphy of New Orleans.

13) Friendships are very important. Through chess I have met friends that are youngsters, my age, and many who are retired. One is 80 years old. Elaine Pritchard, a very good chess-player from England, has said, "It (chess) is an international passport and through the game you will have friends in all the cities of the world."

One of my opponents in the 1986 U.S. Open, held in Somerset. N.J. was from Japan. I have been playing postal chess with Akhito for the last two years, and we are friends. Through postal chess, over-the-board tournament chess, and at local chess clubs, I have met many wonderful people.

The great thing about the game is that it bridges nationalities and generation gaps. Competitive chess is still dominated by men. but more women ate playing than ever before. Two of the Polgar sisters from Hungary are grandmasters.

I have shared with you my enthusiasm for the art, the challenge, and the benefits of chess. Whether or not you have any experience with this fine game, give it your best consideration. After all, a potential world champion may be in your classroom, Chess has made my life fuller. more significant and more interesting!

The Effect of Chess on Reading Scores: District Nine Chess Program Second Year Report

by

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The Effect of Chess on Reading Scores: District Nine Chess Program, Second Year Report

Summary

Students in a New York City chess program improved reading scores more than a control group. The gains made by chessplayers were compared to national performance and district performance.

Chessplayers outperformed the average student in the country and the average student in the district.

The gains made by chessplayers were statistically significant at the .01 level. Thus the chances are only one in a hundred that these gains were due to chance.

District Nine in the Bronx, New York City, conducted the chess program.

This study evaluated two years of this program. Teachers and chess masters provided instruction in the first year. Instruction was enhanced in the second year by the addition of computers and software supplied by IBM.

Chess students in the computer-enhanced program were significantly more likely to show gains than a control group who had the same average reading scores at the beginning of the year but did not receive chess instruction.

Several theories are offered to account for the gains made by chessplayers, but no conclusion is reached.

Acknowledgments

Many people contributed to the District Nine Chess Program and helped prepare this report. Cliff Jackson managed the program and facilitated this research. Without his hard work, none of this would have been possible.

The District Nine teachers served as chess coaches and did the day to day work which made this program run. These teachers included Ms Teresa Easton, Mr Onwuzinger, Mr T. Nievas, Mr Mark Singer, Mr Frank Hennessy, Mr Victor Vargas, Mrs Florence Marin, Mr Darnell Gatling and Mr W. Lissimore. Many other teachers also did this core job of organizing and teaching.

Chess masters provided both instruction and inspiration. They also helped assemble the data needed for this report. I would like to thank Bruce Albertson, Doug Bellizzi, Maurice Ashley and John Kennedy for their help.

Mark Levine was both a chess coach, a tournament director, and the computer expert on this project. Shelby Lyman helped bring this project to reality. He encouraged the research effort, and provided encouragement and inspiration to all participants.

Many people in the District Nine office provided essential help in assembling the data and analyzing it. Gordon Gilbertwas extremely helpful in all phases of this study. We could not have prepared this report without his help. Dr Edward Whitney helped us get organized and prepared the analytic study on which we relied. Dr Lewis and Dr Gargan commented on the report and Dennis Kagan and Arnie Insler helped us assemble the data.

Professor Les Ault helped to design the study and reviewed the report many times. Dr Jan Eglan analyzed the report and helped prepare the statistical analysis. Dr Eliot Hearst made many substantial contributions. Each of these three consultants are also experts in chess research and helped prepare the final section of the report. Steven Fried and Dr Allan Edwards are prominent researchers who helped review this study. I could only implement a fraction of the many suggestions these and other reviewers made.

Dr Bat-Chava was our statistical expert. Dr Hodges helped to design and edit the report, and made many suggestions for revision. Mark Yoffie and Alex Belth helped with the slow and tedious work of assembling and checking the data.

Allan Kaufman of the American Chess Foundation provided support and encouragement at all stages of the project. We turned to him to solve any difficulties and he responded with competence and speed. IBM provided funding for many aspects of the chess program and for this research study. The IBM representatives, Zeke Seligsohn and Jim Courage, have a firm commitment to assisting the students of District Nine and to this research effort. They provided consistent support throughout this research. Also, they provided a model of hard work and dedication.

Many people in District Nine labored to get this project going in years past. We offer them our thanks.

Overview

Elementary school students in New York City's District 9 received instruction in playing chess. Students in the program improved reading scores more than control groups. Gains were statistically significant at the .01 level.

Background

District Nine, located in the Bronx, New York City, has a comprehensive chess program. In the first year of this study, students in the mid elementary school grades joined chess clubs in school. Instruction and inspiration were given by teachers who also served as coaches, and by chess masters provided by the American Chess Foundation.

In the second year of this study, this program was greatly enhanced by an IBM-supported initiative. IBM provided computers, software and support for chess activities. As a consequence, students could practice against computer chess software and were able to play matches against distant opponents through a modem-mediated network. This second yearof the study was termed the computer-enhanced program.

Participation in the first and second year chess programs was voluntary.

Selection of Subjects

This report evaluates reading performance of students who participated in chess programs. Subjects in the first year were students who participated in the 1990 District Nine Chess Tournament. Second year subjects were chess team members in the computer-enhanced program. All students who played in the 1990 tournament and all team members in the 1991 computer-enhanced chess program were included if they met the following criteria:

1. They must have taken a Degree of Reading Power Test (DRP) at the end of the school year and in the prior year. The DRP test is given once a year, in May. Students who transferred into District Nine from other states and students who were absent when the test was given were excluded from the study.

2. Students must have scored at the 10th percentile or higher on the DRP test at the beginning of the school year. Students who scored between 0 and 9 percent or students classified as Limited English Proficiency were not included in the study. This constraint was imposed because the DRP test may be less reliable under the 10th percentile. There was no upper limit to DRP scores.

The effect of instituting a cut-off at the lower end of scores and no cut-off at the upper end was to make it more difficult to demonstrate reading gains among chess participants.* Inclusion of these students would probably have resulted in higher gains for chessplayers, but would have been subject to the criticism that the scores were unreliable. Adoption of the criteria we chose was a conservative decision.

Since we obtained significant differences with this procedure, we increase our confidence in the result.

Results and Data Analysis

Table 4 in Appendix 1 shows the reading scores of chessplayers before and after joining the chess program. A 50% score means the student is average in the country for that grade on the DRP test. A score of 99% means the student is one of the best readers in that grade for the reading skills tapped by the DRP. A student who scores in the 50th percentile in May 1991 and who continues to perform in an average fashion, will score in the 50th percentile one year later, in May 1992. An increased score indicates an above average performance. The use of percentile scores is discussed further in the section on control groups.

** For example, one of our students scored at the 99+ percentile and several obtained very high scores. Such students may be able to get almost every question right on the pre-test and post-test even before they enter the chess program. Even if they made enormous gains in reading as a result of playing chess, we would see no gain. And should these students have been ill when they took the post-test, it is hypothetically possible that they would have shown a big drop. Similarly, one of our students scored at the second percentile on the pre-test and was dropped from the study. Many other students obtained very low scores and were also dropped. Any reading gains made by these students would not have been registered. Because the students scored close to zero, it was not possible to show a loss.*

Inspection of the 53 scores shows that many of thechessplayers demonstrated gains. Percentile scores are inappropriate for statistical analysis. In order to have an appropriate metric, the percentile scores are converted to standard scores. All scores were converted to NCE scores, a normalized equivalent score.

Table 5 in Appendix 1 shows the converted scores. Chess participants showed a gain in percentile score of 5.37. Non-participants showed no gain. Table 1 shows that this result is significant beyond the .01 level.

Students in the first year (November, 1990 to May, 1991) chess program and team members in the computer-enhanced program (November, 1991 to May, 1992) were combined in performing the analysis shown in Table 1.

We also sought to determine whether the computer-enhanced program might itself demonstrate significant gains in reading. The computer-enhanced program was evaluated by the Chi Square test. Scores on the DRP reading test were compared prior to and after participation in this program. The scores of 22 chess team members were analyzed.* Fifteen went up and seven went down. Control groups were formed to evaluate the significance of this result. If a Castle student was in School 114, 4th grade, then the remainder of that school's 4th grade class was put into the control group. There was a total of 1,118 non-participating students in the classes from which the chessplayers were drawn. Of these, 491 scored higher and 627 scored lower. The Chi Square test of statistical significance was applied. The results, which are statistically significant at the .05 level, are shown in Table 2.**

This result is quite impressive. Stated simply, it tells us that while most District Nine students under-performed the national average in the second year of this study, most chessplayers*** outperformed the national average. This provides another confirmation of the power of the computer-enhanced chess program to improve reading scores. The use of an additional control group, as discussed in the next section, increases our confidence that chess participation increases reading scores.

Control Groups

The tests used in this report were based on percentile scores on the DRP reading test. Comparisons were made between chess participants and control groups made up of non-participants. The details of this comparison are discussed in this section.

** There were 24 students, 2 of whom had the same score. Equal scores were dropped in this Chi Square test.*

*** Note that the Chi Square test tells us that the number of chessplayers who showed gains (15 out of 22) is significant when compared to the number of non-chessplayers showing gains (less than half). This test is insensitive to the size of gains made by the chessplayers. It treats a gain of one point in the same manner as a gain of 50 points. The t-test, on the other hand, is sensitive to the size of the gain. It tells us that the amount of gain is significant.*

**** We have used the term chessplayer to mean a participant in the District Nine chess program and the term non-chessplayer as equivalent to non-participant. We have used this terminology even though there may be some students among the 1,118 non-participant control group who know how to play chess but did not participate in the program.*

Table 1. Paired t-test evaluating significance of reading gains

Variable	Number of Cases	Mean
Pre-test Scores	53	57.69
Post-test scores	53	63.07
Difference	**Standard Error**	**t-value**
5.37	1.79	3.01
	Significant beyond the .01 level	

Table 2. Comparison of results of chessplayers in the computer-enhanced Program and all non-chessplayers

	GAIN	LOSS	TOTAL
ALL NON-PARTICIPANTS	491	627	1118
CHESS PARTICIPANTS	15	7	22
Chi Square = 5.16	**Significant at the .05 level**		

Table 3. Comparison of results of chessplayers in the computer-enhanced Program and high-scoring non-chessplayers

	GAIN	LOSS	TOTAL
HIGH NON-PARTICIPANTS	245	410	655
CHESS PARTICIPANTS	15	7	22
Chi Square = 8.52	**Significant at the .01 level**		

An average student in 4th grade scores at the 50th percentile on a reading test. If this student continues to grow in proficiency at an average rate throughout the year, he or she will be an average reader in 5th grade and once again score at the 50th percentile. This student will be a much better reader in 5th grade than in 4th grade, even though he or she will still score at the 50th percentile. Similar considerations apply to a student at a higher or lower percentile. A student who started the school year at the 80th percentile and ended the year at the 80th percentile would have gained a lot of reading competence, but would show no gain in percentile score. A student who begins the school year at the 80th percentile is no more likely to show a gain than the student who begins the year at the 50th or 30th percentile.

District Nine chessplayers show an average gain of 5.4 in percentile score. Nationally, students who take this test at yearly intervals do not show a gain in percentile ranking. This comparison shows that chessplayers in District Nine significantly outperform the average student in the country. Our next comparison shows that chess participants outperform other students in District Nine.

We examined the reading scores of all students in District Nine during the two years of this study. This was done to ensure that the 5.4 percentile gain among chessplayers did not come in part or in whole from gains in the district. (A district may show a gain or a loss from year to year in the average percentile scores achieved by students. For example, if a district spent three periods a day on reading instead of one, if class size were reduced, if funding were increased, or if there was an abundance of school counselors and a hot lunch program, the average student in the district might gain a few percentiles. Similarly if these factors were to change in the reverse direction, a district might show a decline in readingscores.) The information that there was no gain in reading percentile scores in the district during these two years is provided in the study *District Nine Achievement Patterns*, by Edward Whitney, Ph.D. published in July, 1992. On the basis of this study, we can conclude that chessplayers significantly outperformed other students in District Nine.

We must also consider another possible control group. Although some chessplayers have very low entry reading levels, the average chessplayer has a higher than average entry-level reading score. We must rule out the possibility that above-average District Nine students, whether or not they play chess, make substantial reading gains even if the rest of the district does not. Thus we formed a control group of non-chessplaying students with high entry-level reading scores in order to evaluate the Chi Square test result shown in Table 2. The next paragraph describes this control group.

We have shown previously that 15 of the 22 participants in the computer-enhanced program (68%) made gains while only 491 of 1,118 non-participating students (44%) showed gains. We need to examine gains made by the non-participants who had high initial reading scores. Of the 1,118 students in the same classes as the chessplayers, 655 had initial reading scores at or above the 30th percentile. 245 of these 655 (37%) showed gains; 410 showed losses. Thus 68% of chessplayers showed gains while 37% of the control group showed gains. (Again it should be noted that this control group consisted of classmates who had comparable average reading scores at the beginning of the year.) Table 3 presents a Chi Square analysis of this data. Analysis of Table 3 makes it clear that the gains made by the chessplayers are not due to the fact that their entry scores are

above average for the district. This table also highlights the power of the computer-enhanced program. Chessplayers in this program were much more likely than non-chessplaying classmates to improve their percentile reading scores, although both groups had comparable reading scores at the beginning of the year.

A further analysis makes the same point. Table 6 in the Appendix shows all 53 chessplayer pre-test and post-test scores arranged in ascending numerical order with the associated gains and losses. It shows that gains are not coming from students at the 80th and 90th percentile, but from average students. This table must be interpreted with great caution because of statistical concerns*, but it does provide additional evidence that reading gains are not attributable to the fact that many of the chessplayers are above average students. We can cautiously conclude that reading gains would have been just as high or possibly even higher if District Nine chess participants were drawn from students who had somewhat lower reading scores at the beginning of the program.

This report provides data from two years of the District Nine chess program. A third year of analysis will provide additional data. Although considerable caution is necessary because of the limited sample size, the results suggest that chessplayers make gains in reading.

Discussion

Why does chess help reading?

The results of this study suggest that chess participation enhances reading performance. An understanding of this phenomenon was sought through interviews with chess masters and teacher-coaches, and by an examination of the literature on the transfer of training.

Chess masters believe that chess play develops general intelligence, self-control, analytic skill, and increased ability to concentrate. They argue that enhanced reading skills naturally follow. This point of view is not accepted by most educators who question the concept of general intelligence.

The teachers in District Nine believe their chessplaying students develop enhanced ego strength as they increase their chess competence. They argue that students who feel confident and good about themselves naturally learn to read better.

A third explanation for these enhanced reading scores is that chess participants form a pool of intellectually gifted and talented students. Students who join this group make contact with a core of high achievers and thereby develop more academic interests, speak at higher levels of standard American speech and take on the values of achievement. Our research does indicate that although some chessplayers began the year as poor readers, the chess program attracts a higher percentage of excellent readers than are found in the general District Nine population. This supports the possibility that chess participation does function as an Intellectually Gifted and Talented Program.

** These include effects called "regression to the mean" and "ceiling effects". The same caution is necessary in interpreting Table 3.*

There is a fourth explanation for our findings which is quite speculative since it involves a complex comparison of chess and reading. If it can be shown that skills and cognition necessary to play chess well are very similar to those required to read well, educators would have no difficulty assimilating the results obtained in this study into general education theory. Educators doubt that any activity can generate general intelligence. The old theory that learning a difficult subject like Latin develops mental discipline is not accepted by most educators, although research in this area continues and the results are not all in. Still, educators would readily accept the notion that chess-playing enhances reading performance if substantial overlap can be demonstrated between the skills and cognition required in both activities. Unfortunately, a convincing analysis of the skills and cognition required for reading and chess-playing at the age levels considered in this study does not exist.

Let us consider here the skills and cognitions involved inreading and in chess and try to determine the extent to which they are related.

Reading-with-understanding and playing-chess-well are complex, little understood operations. Reading may be analyzed into lower level and higher level processes. For example, a child may read a story about a cockroach seen in a restaurant. Low level processes involve decoding words such as “restaurant”, “waitress” and “astonished” while also understanding grammar and usage. Higher level processes require an information component (eg. information about restaurants, about what people do there, the implications of finding a cockroach, etc) and a thinking component (i.e. processing, comprehending, analyzing, in short all the higher order skills required to construct meaning from the story).

The student glances at a word or phrase, employing lower level skills for decoding and then tries to integrate this new information into a pre-existing context to obtain meaning. The process is constantly extended as each new word is “read”.

This description of the reading process is similar to many descriptions of the chess-playing process. Chessplayers combine high level processes - knowledge and information about the position - and an interactive approach in which each “candidate move” is considered much like a word or phrase in reading. The cognition processes are very similar. Both chess and reading are decision-making activities and some transfer of training from one to the other may be expected.

Several explanations have been offered for the findings obtained in this study. Perhaps all of these explanations apply, some to one student, some to another. This might explain why a large percentage of chess-playing students make gains in the District Nine chess program.

Conclusion

Chess participation appears to enhance reading performance. Further research is needed to confirm this result and to help us understand the power of playing chess.

Appendix 1

Chess Participants' Reading Scores: Combined Scores of Both Years

Table 4. Chessplayers' Percentile Scores on Pre- and Post-Tests

STUDENT ID	PRE-TEST SCORE	POST-TEST SCORE	STUDENT ID	PRE-TEST SCORE	POST-TEST SCORE
1	15	61	28	79	75
2	61	66	29	77	81
3	61	75	30	95	99
4	28	77	31	65	81
5	91	87	32	86	92
6	69	97	33	65	58
7	24	90	34	37	38
8	23	46	35	37	34
9	83	78	36	94	91
10	69	97	37	99	99
11	54	92	38	97	97
12	44	15	39	89	96
13	42	46	40	76	89
14	18	42	41	21	29
15	98	97	42	21	23
16	87	63	43	75	53
17	67	88	44	67	88
18	33	16	45	24	28
19	84	96	46	16	18
20	75	68	47	58	89
21	50	47	48	49	55
22	91	84	49	68	44
23	65	64	50	86	67
24	52	54	51	49	54
25	71	84	52	92	86
26	61	85	53	10	20
27	73	88			

Number of Cases: 53

Study I. The ESEA Title IV-C Project: Developing Critical and Creative Thinking Through Chess

The ESEA Title IV-C federally funded research project was approved for three years (1979-82). It was extended for one school year (82-83) at local expense for a combined total of four years. The primary goal of the study was to provide challenging experiences that would stimulate the development of critical and creative thinking.

The Title IV-C project was an investigation of students identified as mentally gifted with an IQ of 130 or above. Students in the nonchess groups exceeded those in the chess group in Mean IQ by 2.3 points, which is not significantly different. All participants were students in the Bradford Area School District in grades 7 through 9. The individuals sampled in this study could not be randomly assigned to groups because the students' individualized education plans prescribed activities based on interests.

The primary independent variables reviewed in this summary are the chess treatment, the computer treatment, and all nonchess treatments combined. Each group met once a week for 32 weeks in the gifted resource room at Bradford Area High School to pursue its interest area under the leadership of the Coordinator of Secondary Gifted Education (Robert Ferguson). Most groups spent a total of 60-64 hours pursuing their preferred activity.

The dependent variables were the differences in the means of the posttests from the pretests. Data were collected from the *Watson-Glaser Critical Thinking Appraisal* and the *Torrance Tests of Creative Thinking*. The chi square test and the t test were applied to determine the level of statistical significance.

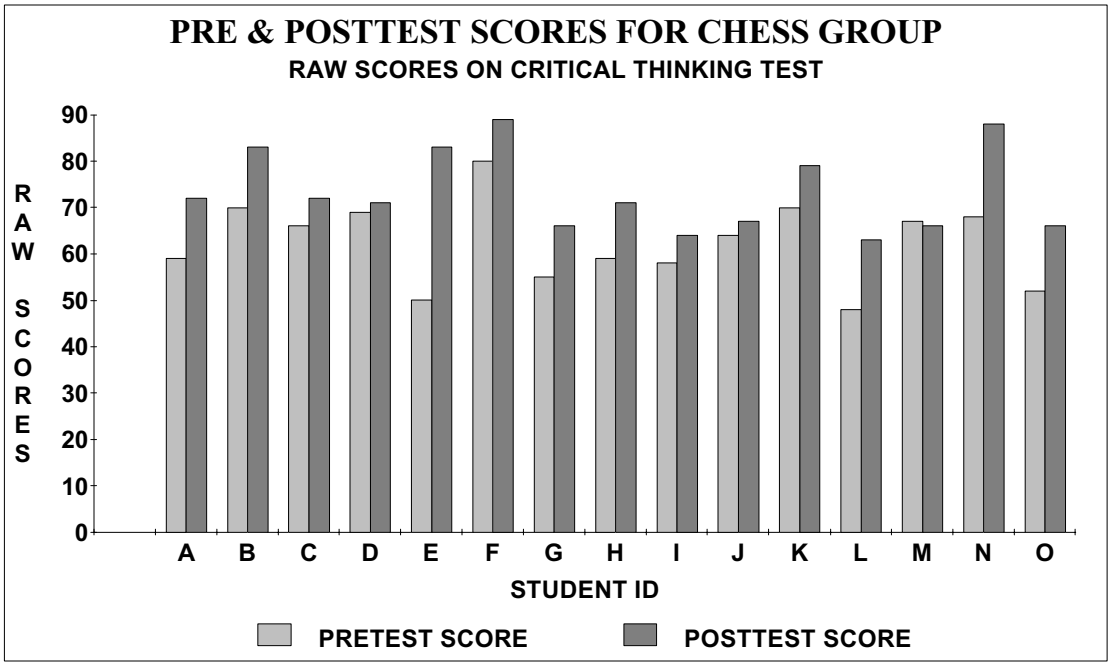

FIGURE 1. A comparison of the pre and posttest scores for the chess group on the *Critical Thinking Appraisal*

Results and Data Analysis

It is important to note that ***all*** scores reported for the *Watson-Glaser Critical Thinking Appraisal* (*WCTA* or *CTA*) are equivalent raw scores. Watson and Glaser (1964, p. 8) used a procedure called equi-percentile equating to determine equivalent raw scores. These scores were all based on norms for high school students and beyond. Since this study was testing junior high level students and no norms exist for seventh and eighth graders, the project director was forced to use the high school norms and equivalent raw scores. In some cases pupils in the study actually scored more correct answers on the posttest than on the pretest and still showed a loss due to the equivalent raw score procedure.

Inspection of the pre and posttest results in the figure on page one shows that all but one chessplayer demonstrated gains in raw scores. The average annual increase in equivalent raw scores for the chess group was 10.53.

The average annual increase in percentile score for the chess group was 17.3%. Nationally, students who take this test at yearly intervals do not show a gain in percentile ranking. This comparison shows that the Bradford chess group significantly outperformed the average student in the country four years in a row!

A 50% score means the student is average in the country for that grade level on the *Watson-Glaser Critical Thinking Appraisal*. A score of 99% means the student is one of the best critical thinkers in that grade for the skills assessed by the *Watson-Glaser Critical Thinking Appraisal*. A Student who scores in the 50th percentile in 1979 and who continues to perform in average fashion, will score in the 50th percentile in 1980. An increased percentile score indicates an above average performance.

Percentile scores are inappropriate for statistical analysis. In order to have an appropriate metric, the percentile scores were converted to ***equivalent*** raw scores.

The t test was used to test statistical significance of the gains on the *Watson-Glaser Critical Thinking Appraisal*. The t test measures the quantity of the gain to assess whether it is significant.

TABLE 1. Dependent t test evaluating significance of gains on the *Critical Thinking Appraisal* (*CTA*) by chessplayers

VARIABLE	NUMBER	MEAN
Pretest Scores	15	62.80
Posttest Scores	15	73.33
Difference	**Standard Error**	**t value**
10.53	2.2	4.786

Significant beyond the .001 level

Table 1 on the preceding page demonstrates that the chessplayers achieved a very significant gain ($p < .001$) from the pretest to the posttest in critical thinking skills as measured by the *Watson-Glaser Critical Thinking Appraisal*. The level of significance tells us that there is less than one possibility in a thousand that this result could have occurred by chance.

Just as the dependent t test illustrated above is extremely significant, so too is the independent t test illustrated in Table 2, which indicates that the chess group's performance is notably superior to that of the nonchess group's. The results, which are statistically significant at the .001 level, are shown in Table 2.

TABLE 2. Independent t test evaluating significance of difference on the *Watson-Glaser Critical Thinking Appraisal* between the chessplayers and nonchessplayers

VARIABLE	NUMBER	MEAN
Nonchess Group Gains	79	1.86
Chess Group Gains	15	10.53
Difference	**Standard Error**	**t value**
8.67	2.4	3.61

Significant at the .001 level

The data were also evaluated using a nonparametric, or distribution-free, test of significance. For Study I, the chi square test of statistical significance was used to evaluate the gains/losses on the *Watson-Glaser Critical Thinking Appraisal*. The chi square test evaluates the significance of the number of chessplayers demonstrating gains on the *CTA* compared to the number of non-chessplayers showing gains. Because the chi square test is nonparametric, it is insensitive to the size of gains; it considers a gain of one point in the same manner as a gain of 30 points or 100 points.

The chess group was compared to the nonchess group, the computer group, and the nonparticipants. The chi square test results ranged from marginally significant at .072 to very significant at .002. A complete listing of the chi square test results may be found in Table 3 on the next page.

Particular attention should be given to the results comparing the gains of the eighth graders on the *CTA*. These are perhaps the most significant of all the critical thinking results because eighth graders comprised 46% of the total number of students participating in the project. Out of a total of ninety-four pupils who completed both the pre and posttests, forty-three were eighth graders. Because this was the largest grade sample, it becomes more statistically important and increases our level of confidence in the results.

TABLE 3. Statistical summary for *CTA*

TABLES	t Test $p<$	Chi Square χ^2 $p<$
MALES & FEMALES COMBINED:		
Chess Group	**0.001**	
Chess vs. Nonchess	**0.001**	**0.008**
Chess vs. Computer	**0.003**	**0.008**
Chess vs. Nonparticipants	**0.025**	**0.002**
MALES:		
Chess Group	**0.003**	
Chess vs. Nonchess	0.072	0.056
Chess vs. Computer	**0.017**	**0.023**
FEMALES:		
Chess Group	**0.043**	
Chess vs. Nonchess	0.085	0.071
Chess vs. Computer	0.195	0.104
ALL 8TH GRADERS:		
Chess Group	**0.003**	
Chess vs. Nonchess	**0.006**	**0.009**
Chess vs. Computer	0.142	**0.05**

In a Fidelity Electronics' article entitled "The Minds of Tomorrow" (1993), the company states: "In light of chess playing's ability to shape future minds, schools all across the United States view chess as a powerful educational tool. Thousands of pre-teens and teens understand that chess coheres the mind to anticipate, make decisions, and react in a way no other game can."

Dr. R.J. Topping (1988), the Coordinator of the Gifted/Talented Programs for the White Plains Public Schools, agrees with Fidelity and states:

> Chess is an integral part of the logic and creative problem-solving segment of our More Able Student curriculum. It cultivates critical thinking skills in our students, enhancing their personal growth and academic learning. We encourage other school systems to consider offering their students experiences in this dynamic content area (Chess in the Schools, 1988, p. 3).

Many teachers use chess as a vehicle to teach critical thinking skills. They stress to students that learning *how* to think is more important than learning the solution to a specific problem. Through chess, pupils learn how to invent creative solutions to problems. They learn how to analyze a situation by focusing on the important factors. Chess is effective because it is self-motivating. The game is intrinsically fascinating, and the goals of attack and defense, climaxing

in checkmate, motivate young people to delve deep into their mental resources (Chess in the Schools, 1988, p. 2).

The next portion of the results and data analysis summary reviews the different aspects of creativity tested in this research: fluency, flexibility, and originality.

Verbal fluency is an individual's ability to generate a large number of ideas with words. Chessplayers often have a running dialogue within their minds reviewing the checklist for important strategic and tactical factors or mentally calculating: "If I go there, then he'll move . . ."

Flexibility represents a person's ability to produce a variety of types of ideas, to shift from one approach to another, or to use a variety of strategies. Originality is skill at producing ideas that are different from the obvious.

Torrance (1974) defined creative thinking as: "a process of becoming sensitive to problems, deficiencies, gaps in knowledge, missing elements, disharmonies, and so on; identifying the difficulty; searching for solutions, making guesses, or formulating hypotheses about the deficiencies: testing and retesting these hypotheses and possibly modifying and retesting them; and finally communicating the results."

It is important to note that ***all*** scores reported for the *Torrance Tests of Creative Thinking* are standard T-scores. All raw scores were converted in accordance with the recommendations in the *Torrance Tests of Creative Thinking* Norms-Technical Manual (1974, pp. 48, 56). These scores were all based on creative thinking norms established for junior high school students.

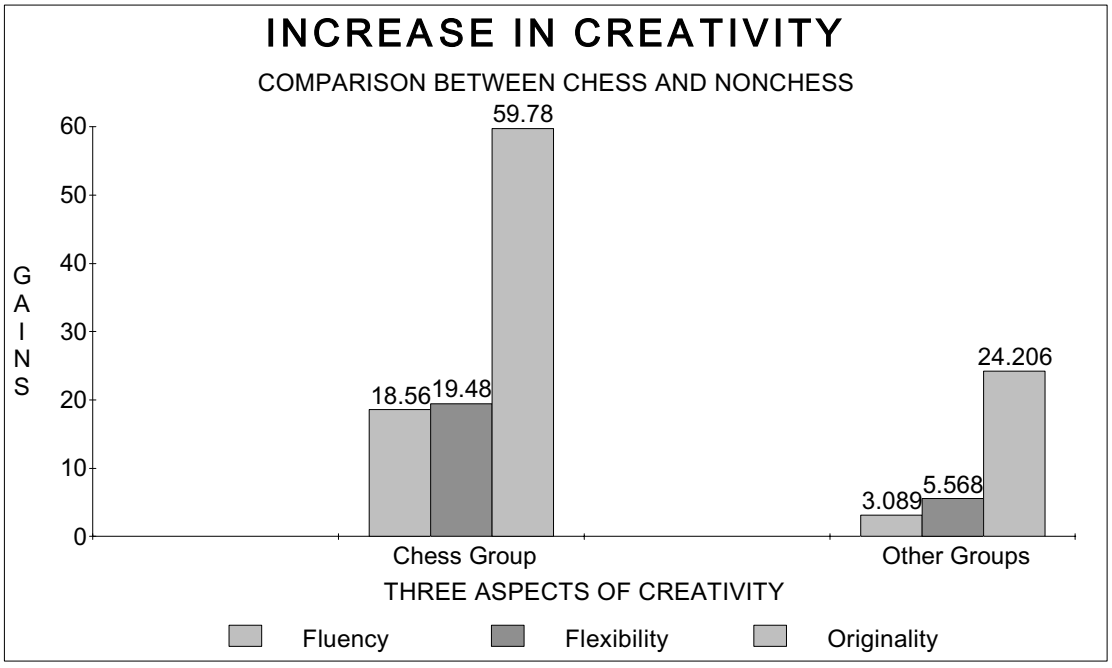

FIGURE 2. A comparison of the chess group gains to the nonchess group gains

Creativity is a major aspect of chess at the master level, but can chess influence creativity at the amateur level? Summary Table 4 sheds some light on this question. It would appear from the data collected and the statistical test results listed in the table below that there can be little doubt that chess does enhance creativity in gifted adolescents. Dr. Stephen Schiff's claim that creativity can be taught through the art of chess has been confirmed.

While the entire chess group made superior gains over the other groups in all three areas, the aspect that demonstrated the most significant growth was originality. It should be noted that several researchers have found that gains in originality are usual for those receiving creativity training, whereas gains in fluency are often slight or nonexistent. The fact that the chess group's gains in fluency were significant beyond the .05 level when compared to the national norms is an important discovery.

It appears that chess is superior to many currently used programs for developing creative thinking and, therefore, could logically be included in a differentiated program for mentally gifted students.

TABLE 4. Statistical summary of t tests on Creativity

TABLES	FLUENCY	FLEXIBILITY	ORIGINALITY
	p<	*p*<	*p*<
MALES & FEMALES COMBINED:			
Dependent Chess	0.077	**0.024**	**0.01**
Population Mean Chess vs. Norms	**0.039**	**0.002**	**0.001**
Independent Chess vs. Nonchess	**0.049**	**0.05**	**0.018**
Independent Chess vs. Computer	**0.038**	0.08	**0.022**
MALES:			
Dependent Chess	0.142	**0.03**	**0.016**
Population Mean Chess vs. Norms	0.07	**0.008**	**0.003**
Independent Chess vs. Nonchess	**0.039**	**0.007**	**0.002**
Independent Chess vs. Computer	0.076	**0.018**	**0.007**
ALL 8TH GRADERS:			
Dependent Chess	0.32	0.088	**0.018**
Population Mean Chess vs. Norms	0.171	**0.037**	**0.019**
Independent Chess vs. Nonchess	0.305	0.061	**0.009**
Independent Chess vs. Computer	0.606	0.12	**0.027**
ALL 8TH GRADE MALES:			
Dependent Chess	0.32	0.088	**0.018**
Population Mean Chess vs. Norms	0.171	**0.037**	**0.019**
Independent Chess vs. Nonchess	0.383	**0.014**	**0.006**
Independent Chess vs. Computer	0.561	0.107	**0.02**

Conclusions

It is evident from the above tables and data that chess had a definite impact on developing both critical and creative thinking skills. Because the sample size of the treatment group was only 15 students, the author would encourage replication of this study using a larger *N*.

It was also evident that there were significant gains in the participants' chess skills. Six of the pupils involved in this study participated in the annual Pennsylvania State Scholastic Championship beginning in 1980. Three of those six excelled. Two of the boys became candidate masters and one of the girls made the top 50 list for all women chessplayers in the United States.

The project director concurs wholeheartedly with Dr. Stephen M. Schiff (1991), who wrote: ". . . the study of chess is one of the most critically important additions to the curriculum that schools can offer to our pre-adolescent gifted and talented student population." Based on the results of Study I and others, this researcher ***urges*** the inclusion of chess in the curriculum to augment the skills of the mentally gifted.

The *USA Junior Chess Olympics Training Program* used in each of Ferguson's studies undeniably demonstrated effectiveness in bringing about the desired changes in the participating students. This author would strongly recommend the adoption or adaptation of the *USA Junior Chess Olympics Training Program* within the school curriculum throughout the country.

For Those Who Haven't Studied Statistics

"Tradition holds that the level of significance must be expressed as *the probability that a true null hypothesis is being rejected*. That means that the ***lower*** the significance level, the ***higher*** is our confidence that the effect we have observed is real." (Phillips, Statistical Thinking: A Structural Approach, p. 85, 1973)

Some researchers hold that a probability of **.1** (10%) is significant; however, in this study and Ferguson's other research, a ***significant*** difference is equal to or less than **.05** (often written $p<.05$). A ***very significant*** difference is one for which the probability of having occurred by sampling error is less than 1% (**.01**) and is frequently written $p<.01$. In the statistical summary (Table 4), the ***significant*** and ***very significant*** levels have been **bolded**.

For Additional Information

The preceding material is a brief synopsis of the information found in a paper (200+ pages) by Robert Ferguson entitled *Teaching the Fourth "R" (Reflective Reasoning) Through Chess*. If you would like a more comprehensive review of this research and his other studies, send a check for ***$39.95*** payable to the American Chess School at the address below. ***All profits from the sale of this publication are used to support chess in the schools***.

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Study III. The USA Junior Chess Olympics Research: Developing Memory and Verbal Reasoning

During the 1987-88 investigation, all students in a sixth grade self-contained classroom at M.J. Ryan School (*a rural school about 18 miles from Bradford, PA, with a student enrollment of 116 in grades K-6*) were required to participate in chess lessons and play games. None of the pupils had previously played chess. This experiment was more intensified than Ferguson's other studies because students played chess daily over the course of the project. The project ran from September 21, 1987 to May 31, 1988.

The dependent variables were the gains on the *Test of Cognitive Skills* (*TCS*) Memory subtest and the Verbal Reasoning subtest from the *California Achievement Tests* battery. The differences from the pre and posttests were measured statistically using the t test of significance. Gains on the tests were compared to national norms as well as within the treatment group. The differences between males and females on the tests were also examined.

The mean IQ of the class participants was 104.6. All students were required to take basically the same chess course (the *USA Junior Chess Olympics Training Program*) used in Ferguson's first two studies. A total of 14 pupils (9 boys and 5 girls) completed both the pre and posttests (*TCS* Memory test and Verbal Reasoning test).

Generally, students received chess lessons two or three times each week and played chess daily. Many students competed in rated chess tournaments outside of school. Seven competed in the PA Scholastic Chess Championship, and two went on to Nationals.

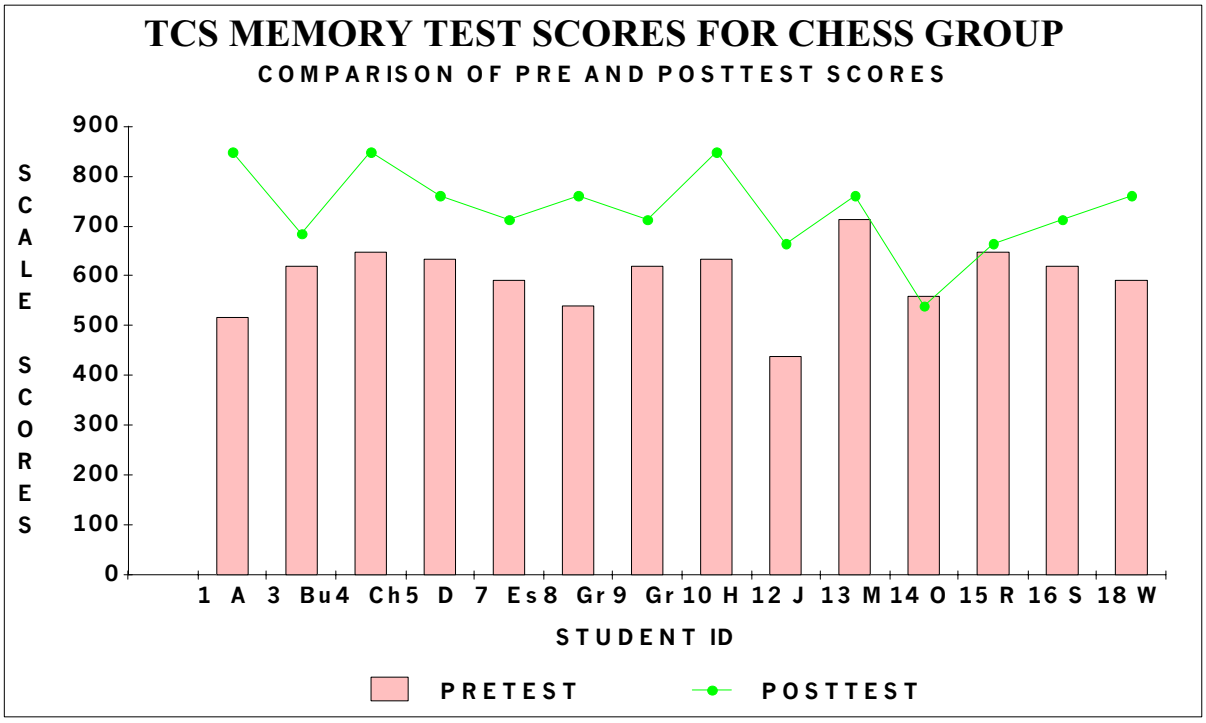

FIGURE 1. Comparison of pretest and posttest scores on the *TCS* Memory test

Results and Data Analysis

All scores reported for the *Test of Cognitive Skills* (*TCS*) are listed as ***scale scores***. Scores have been converted from number correct scores to scale scores using conversion Table 3 in the *TCS* Norms Book for level 3. According to the Norms Book, "The scale score is the basic score for *TCS*. This score is especially appropriate for research studies and statistical analyses . . ."

As listed in the *TCS* Technical Report (1983), the mean scale score on the Memory test for sixth graders across the nation is 591. The pretest mean score for the sixth grade students in this study scored an average of 597.786. There is no significant variance between the norms and the test group.

The posttest scale scores averaged 727.786 for a mean gain of 130 points. Inspection of the scores in Figure 1 on the first page shows that all but one student demonstrated a gain. By using Table 6 in the Norms Book, the project director calculated the mean pre and post percentile ranks to be 59% and 91%, respectively, for a gain of 32%. This increased percentile score indicates an ***above average*** performance.

An ***average*** student in the sixth grade scores at the 50th percentile on the subtests of the *TCS*. If the student continues to grow in proficiency at an average rate throughout the year, that student will again score at the 50th percentile in seventh grade. Considering that no percentile gain is the norm, the chess group's gain of 32 in percentile score appears significant.

Because percentile scores are considered inappropriate for statistical analysis, the director used the scale scores to perform the t test. The t test measures the quantity of the gain to assess whether it is significant.

When comparing the treatment group to the sixth grade national norms, the obtained t equals 5.926, which is statistically significant beyond the .001 level. Even when the researcher compared the sixth graders' posttest results to those of the seventh grade norms, the t test resulted in an obtained t=5.493, which is statistically significant beyond the .001 level. Thus the chances are less than one in a thousand that these gains were due to chance.

TABLE A. Dependent t test evaluating significance of gains on the *TCS* Memory test by chess players

VARIABLE	**NUMBER**	**MEAN**
Pretest Scores	14	597.786
Posttest Scores	14	727.786
Difference	**Standard Error**	**t value**
130	24.86	5.23

Significant beyond the .001 level

As listed in the *TCS* Technical Report, the mean scale score on the Verbal Reasoning test for sixth graders across the nation is 578. The pretest mean score for the sixth grade students in this study scored an average of 568.214. Although the scale score norms are nearly 10 points higher for the national sample, there is no significant variance between the norms and the test group.

By using Table 6 in the Norms Book, the project director calculated pre and post percentile ranks to be 45% and 61%, respectively, for a gain of 16% (about half the increase noted on the Memory test). Remembering that no increase in percentile score is the norm, it is possible to conclude that the chess group's score does indicate an ***above average*** performance.

Because percentile scores are inappropriate for statistical analysis, the director used the scale scores to perform the t test. The posttest scale scores averaged 620.714 for a mean gain of 52.5 points. The obtained t equals 4.018, which is statistically significant at the .002 level. Review of the scores in the table below shows that there are only two chances in a thousand that this result could have happened by coincidence.

TABLE B. Dependent t test evaluating significance of gains on the *TCS* Verbal Reasoning test by chess players

VARIABLE	**NUMBER**	**MEAN**
Pretest Scores	14	568.214
Posttest Scores	14	620.714
Difference	**Standard Error**	**t value**
52.5	13.066	4.018

Significant at the .002 level

Table C. Statistical summary of t tests for *TCS*

TABLES	**MEMORY** $p<$	**VERBAL REASONING** $p<$
MALES & FEMALES COMBINED:		
Dependent Chess Group	**0.001**	**0.002**
Population Mean Chess vs. National Norms	**0.001**	0.066
MALES:		
Dependent Chess Group	**0.001**	**0.01**
Population Mean Chess vs. National Norms	**0.001**	0.128
FEMALES:		
Dependent Chess Group	0.045	0.11
Population Mean Chess vs. National Norms	0.077	0.406

Conclusions

It is evident from the above tables and data that chess had a definite impact on developing both memory and verbal reasoning skills. The effect of the magnitude of the results is strong (***eta²*** is .715 for the Memory test gain compared to the Norm). Because the sample size of the treatment group was only 14 students, the author would encourage replication of this study.

It was also evident that there were significant gains in the participants' chess skills. Seven of the boys involved in this study participated in the March 1988 Pennsylvania State Scholastic Championship. After having played chess for only five months, they finished second (only half a point behind Steve Shutt's nationally famous team from the Frederick-Douglass School in Philadelphia). One pupil even made the top fifty list for his age group.

The project director concurs wholeheartedly with Dr. Stephen M. Schiff (1991), who wrote: ". . . the study of chess is one of the most critically important additions to the curriculum that schools can offer to our pre-adolescent gifted and talented student population." Based on the results of Study III and others, this researcher ***urges*** the inclusion of chess to augment the skills of both the gifted and the nongifted.

The *USA Junior Chess Olympics Training Program* used in each of Ferguson's studies undeniably demonstrated effectiveness in bringing about the desired changes in the participating students. This author would strongly recommend the adoption or adaptation of the *USA Junior Chess Olympics Training Program* within the school curriculum throughout the country.

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A ***significant*** difference is less than **.05** (often written $p<.05$). A ***very significant*** difference is one for which the probability of having occurred by sampling error is less than 1% (**.01**) and is frequently written $p<.01$. In the statistical summary (Table C), the ***very significant*** levels have been **bolded**.

For Additional Information

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CHESS AND STANDARD TEST SCORES

James M. Liptrap, Chess Sponsor, Klein High School
Klein Independent School District, Spring, Texas, 1997

Published in *Chess Life*, March 1998, pages 41-43

SUMMARY: Regular (non-honors) Elementary students who participated in a school Chess Club showed twice the improvement of non-chess players in Reading and Mathematics between third and fifth grades on the Texas Assessment of Academic Skills. In fifth grade, regular track chess players scored 4.3 TLI points higher in Reading ($p<.01$) and 6.4 points higher in Math ($p<.00001$) than non-chess players.

The purpose of this study is to document the effect of participation in a chess club upon the standardized test scores of elementary students. The study was conducted in four of the elementary schools in a large suburban school district near Houston, Texas. It compared the third grade and fifth grade scores on the Texas Assessment of Academic Skills (TAAS) of students who participated in a school chess club in fourth and/or fifth grade with the scores of students who did not participate in a chess club. Significant improvement in Math and Reading scores were found among the Regular track chess students.

BACKGROUND

Previous studies indicating the effects of chess on scholastic achievement have received little notice, and have been criticized for small sample size, or for chess clubs being self-selective elite groups, or for being too anecdotal. Many observations by teachers, parents, administrators, and students report advantages of participation in chess, based principally upon improved self-image, confidence, and critical thinking skills.

Reported in Developing Critical and Creative Thinking Through Chess, Robert Ferguson, of Bradford, Pennsylvania, as part of the ESEA Title IV-C Explore Program tested students from seventh to ninth grade, 1979-1983, and found:

Watson-Glaser Critical Thinking Appraisal	Chess	Non-Chess
(Average Annual Increase)	17.3%	4.6%
Torrance Tests of Creative Thinking		
Fluency	19.9	6.0
Flexibility	22.8	9.5
Originality	70.0	34.8

The mathematics curriculum in New Brunswick, Canada, is a text series called *Challenging Mathematics,* which uses chess to teach logic from grades 2 to 7. Using this curriculum, the average problem solving score of pupils in the Province increased from 62% to 81%.

Reports from students, teachers, and parents not only extol the academic benefits of chess on math problem solving skills and reading comprehension, but increased self-confidence, patience, memory, logic, critical thinking, observation, analysis, creativity, concentration, persistence, self-control, sportsmanship, responsibility, respect for others, self esteem, coping with frustration, and many other positive influences which are difficult to measure but can make a great difference in student attitude, motivation, and achievement.

SCHOOLS SURVEYED

The four elementary schools surveyed serve affluent and middle class neighborhoods. The 571 students completing fifth grade in 1997 were 11% Asian, 11% Hispanic, 6% Black, 1% Ethnic American, and 71% "Other." The sample was 11.7% Chess Players (67), 88.3% non-Chess (504). Comparing the groups:

(Percent)	Male	Female	SE	Reg	AA	GT
Overall	50.8	49.2	13.1	53.4	14.9	18.6
Chess	74.6	25.4	13.4	34.3	20.9	31.4

SE - Special Education students, Reg - Regular students, AA -Academically Able students judged upon a matrix of IQ and achievement, GT - Gifted and Talented students, the top-performing students judged by a similar matrix. It can be noted that the chess group is 3:1 male and has a higher percentage of AA and GT students. The objection that this constitutes a self-selective elite group is answered by considering the four tracks separately.

The schools were selected because of established chess clubs of at least two years, but no chess instruction during school hours. Schools ranged in enrollment from 707 to 979 in grades K to 5, with chess clubs ranging from 35 to 80 in weekly attendance. One school restricted club membership to fourth and fifth grade students, the others third to fifth, with younger students allowed only if their parents were assisting. Clubs met for one hour after school one day per week. In one school, the faculty sponsor teaches chess to club members. At the other schools, parents coordinate the program.

All of the clubs could use more adult workers, and especially faculty involvement. There has to date been no School District funding of chess activity and no compensation to faculty for their time. Chess equipment, consisting of boards and sets, have been contributed by Parent-Teacher Organizations, a small amount of School Activity funds, or are borrowed from the High School Club. Some students bring their own sets from home, and the only chess clocks available belong to students. Sets range from the $3.99 hollow plastic set from discount stores to tournament quality plastic sets available for $10 from a local tournament director. Expensive wooden sets are not practical for school use. Chess clocks start at $40 each.

TAAS

The Texas Assessment of Academic Skills has been administered since 1990. It currently consists of Reading and Math Tests in Grades 3 through 8 and 10 (Exit Level); Writing at Grades 4, 8, and 10 (Exit Level); Science and Social Studies at Grade 8. The focus is on assessing the instructional targets delineated in the essential elements, the state-mandated curriculum, and on higher-order thinking skills and problem-solving ability. The Texas Learning Index (TLI) allows for comparison across years and across grades. The minimum expectations score of 70 represents the same amount of achievement at each grade level. Thus a student with a Math TLI of 3-70 (Grade 3) and 5-70 (Grade 5) would have shown a typical improvement in Math from third to fifth grade. A student with a Reading TLI of 3- 80 and 5-85 Would have shown more than two years' typical improvement in reading between the third grade test and the fifth grade test.

METHOD

For this survey, TAAS TLI scores for Reading and Math at grades 3 and 5, Placement, and Sex information were obtained for all fifth graders at each of the four schools. The School Chess sponsors provided lists of the students who had participated in Chess Club during fourth and/or fifth grade. The definition of "participated in" was left to the sponsor. The question of how much participation would produce any effect was not addressed. The data was compiled and averaged.

RESULTS

Average TLI Scores

	Chess Players				Non-Chess Players			
	Reading		Mathematics		Reading		Mathematics	
Total	3-86.5	5-92.1	3-81.7	5-87.3	3-83.1	5-87.4	3-77.2	5-81.8
Male	3-87.0	5-92.6	3-82.3	5-87.4	3-82.0	5-86.4	3-76.8	5-81.0
Female	3-85.1	5-90.9	3-79.7	5-86.8	3-83.9	5-88.3	3-77.6	5-82.5
Spec-Ed	3-84.1	5-90.6	3-76.7	5-85.1	3-73.5	5-77.5	3-68.2	5-74.6
Regular	3-79.5	5-89.4	3-77.6	5-85.7	3-80.6	5-85.1	3-73.9	5-79.3
A.A.	3-89.6	5-94.3	3-85.6	5-88.6	3-88.5	5-94.6	3-84.7	5-88.4
G.T.	3-91.3	5-95.9	3-85.6	5-90.7	3-91.7	5-96.6	3-86.9	5-89.6

Increase in Average TLI Scores

	Chess Players		Non-Chess Players	
	Reading	Mathematics	Reading	Mathematics
Total	5.6	5.6	4.3	4.6
Male	5.6	5.1	4.4	4.2
Female	5.8	7.1	4.4	4.9
Spec-Ed	6.5	9.4	4.0	6.4
Regular	9.9	8.1	4.5	5.4
A.A.	4.7	3.0	6.1	3.7
G.T.	4.6	5.1	4.9	2.7

t-Test of Statistical Significance for Regular Students
Comparing Regular-Track Chess vs Non-Chess Students

	Reading		Mathematics	
Third Grade	t = .3956	p = .6958	t = 2.041	p = .05078
Fifth Grade	t = 2.809	p = .008657	t = 5.232	p = .000006155

t-Test of Statistical Significance for Special-Ed Students
Comparing Special-Ed Chess vs Non-Chess Students

	Reading		Mathematics	
Fifth Grade	t = 4.228	p = .0001235	t = 3.681	p = .00119

ANALYSIS

The largest difference in the amount of improvement in TLI scores from third to fifth grade was among the Regular students. In this group, the chess players showed significant improvement compared to non-chess players. The statistical t-test showed that in third grade reading, there was no difference between the Chess and Non-chess groups, but by fifth grade, the difference is "highly significant" ($p<.01$). In mathematics, the chess group was very marginally distinguished from the non-chess in third grade ($p=.05$), but by fifth grade was clearly a different population (null-hypothesis rejected at $p<.00001$).

Among Special Education students, the effect was not as great, but was probably statistically significant (Reading $p=.0001235$, Math $p=.00119$) except for the small sample (9 chess players). Anecdotal reports concerning Special Education Chess Players stress increased self-esteem and confidence, primary objectives for these students. The results for AA and GT students are mixed. But their TLI scores in the upper 80's and 90's have less room to show improvement.

Regular track fifth grade chess players scored 4.3 TLI points higher in Reading ($p<.0l$) and 6.4 points higher in Mathematics ($p<.00001$) than non-chess players.

RECOMMENDATIONS

School Chess Clubs should be encouraged at Elementary, Middle School, and High School levels, open to all students; modest funding or fundraising opportunities to provide equipment and travel to tournaments should be provided; and faculty sponsors should receive some token compensation for their extra time and effort. Parent involvement is essential in Elementary Clubs and highly desirable in Middle School Clubs, for instruction, crowd control, and transportation.

While chess should never substitute for instruction in school subjects, it would make a worthwhile enrichment or supplement activity, particularly for the "Regular" students. Some teachers report success using chess as an incentive, as in "Settle down and finish this history lesson, and then you can play chess."

Funding for chess activity is available under the "Educate America Act" (Goals 2000), Public Law 103-227, Section 308.b.2.E.

> "Supporting innovative and proven methods of enhancing a teacher's ability to identify student learning needs and motivating students to develop higher order thinking skills, discipline, and creative resolution methods."

The original wording of this section included "such as chess" and passed both houses of Congress that way. But the phrase was deleted later in Conference Committee.

Some In-service training of Elementary teaching staff would be necessary, as few teachers have much background in chess, and most have great fear of chess. But the rules are not difficult and can be learned quickly. And the sponsor does NOT need to be an experienced player. Inexpensive beginners' books on basic strategy are available and appropriate for the elementary level. Students who "catch on" and want more instruction can find it at a High School Club or a local Adult Club. Additional practice is available at weekend tournaments, some of them scholastic tournaments offering school trophies.

CHESS AND APTITUDES - SUMMARY

ALBERT FRANK

I very briefly introduce you herewith to an experiment performed… 26 years ago.

Very often we hear such wordings as « You need to be intelligent to play chess », « Chess fosters intelligence », … All this is too vague…

In 1973, in co-operation with the Psychology Department of the "Université Nationale du Zaïre" at Kisangani, I undertook an experiment so as to clarify matters.

It should first be noticed that almost everywhere there is a facultative teaching of Chess in primary and secondary schools. A result of this « facultative » feature is that it is extremely difficult to produce unbiased statistical studies.

In a first stage, I received from the Government of Zaire permission to REPLACE, during a year, in three classes of the fourth year (I take the current Belgian denomination) in a major secondary school of Kisangani, two out of seven hours of mathematics a week by two hours of chess teaching.

The six classes of the fourth year in this institution, each 30 students, were divided into two groups : 3 classes in the « experimental » A-group ; 3 others in the « control » B-group.

I was able to administer the following tests :

- the Belgian version of the G.A.T.B. (« General Aptitude Test Battery »)
- the P.M.A. (« Primary mental abilities » by Thurstone)
- the D.A.T. (« Differential Aptitude Test » by Bennet, Seashore and Wesman)
- the D2 (Brieckenkamp)
- the Rorschach.

Some preliminary remarks should be made before going over to the description of the experiment :

- Knowing in which measure the used tests were culturally adapted to the tested persons is not absolutely fundamental, since the aim was to compare groups A and B.

- NO student of both groups had ever heard about chess, which is very useful to eliminate parasites.
- Ideally, there should have been a third group with another learning … but you can't have it all !
- The seven weekly teaching hours (mathematics + chess for the A-group, mathematics only for the B-group) were given by Frenchspeaking teachers – in casu, two Belgian teachers for mathematics and myself for chess.

Experiment phases :

1. At the beginning of the year, all students (A and B groups) were administered the various tests. Both groups scored analogously.
2. Whereas group B is normally taught mathematics (7 hours a week), group A is given the same programme in five hours a week and receives two hours of chess (Wednesday 11-12 a.m. and Saturday 7-8 a.m.). Chess lessons, as with others lectures, also contain tests and exams counting for a coefficient of 2/7 of mathematics (mathematics counting for 5/7 of the total coefficient).
3. At the end of the year, all students of both groups were given the various tests again. The students of the experimental groups furthermore took an exam to test the chess level reached. The items of this exam were mostly written by Doctor Max EUWE, former chess world champion and chairman of the F.I.D.E. (« Fédération internationale du Jeu d'Echecs).

   The « verdict » is brought in : among tested aptitudes, two show significant differences in favour of the experimental group : the arithmetical aptitude, with a threshold of .O5 and "verbal logic " (most often measured by the identification of synonyms or antonyms) with a threshold of .O1.

   These original findings answered the questions raised before the experimentation. But why verbal logic ? …

   There is still no answer.
4. The experiment also enabled us to answer questions with a view to delineating, taking the results of the aptitude test into account, the ability to enhance chess performance… but this is beyond the scope of this summary.
5. The students of both groups received special attention till the end of their secondary studies, i.e. two years after the end of the experiment. The students of the experimental group obtained significantly better results, foremost in mathematics and French.

   The complete study is given in the book « CHESS AND APTITUDES », Albert Frank, American Chess Foundation, December 1978.

   A technical summary (in French) has been published under the title « Aptitudes et apprentissage du jeu d'échecs au Zaïre » in the magazine 'Psychopathologie Africaine », 1979, XV, 1, 81-98.

The Role of Chess in Modern Education

By Marcel Milat

According to Murray, Chess originated at the end of sixth century in India. The game was different then, elephants replacing the present day rooks and peasants replacing pawns. The "firzan" now known as the queen could only move diagonally one square at a time. Still, the basic elements of modern chess were present: the game was played on an eight by eight board with pieces and the sole goal being to checkmate the opposing king.

The game of chess has been dominated by Russians for nearly 70 years. With the exception of Bobby Fischer who won the world championship in 1972 and relinquished it in 1975 the past 11 world champions have been of Russian decent. Why are Russians the dominant figures in world chess?

Chess has been part of the curriculum for most Russian schools for over 40 years. Adolescents were encouraged to play chess at a very early age to increase their problem solving and reasoning skills. The gifted students were chosen and studied under the supervision of former world champion Mikhail Botvinnik.

Adrian de Groot, a psychologist in the 1960's became very interested in the use of chess as an educational tool. He began studying the thinking behavior of chess players in Russia. In particular he observed that there was a significant difference approach between those who highly skilled and experienced in chess to those who were new to the game. Initially de Groot assumed that the Grandmaster's superiority lay in their ability to organize well and to memorize concrete lines of play. What de Groot found was quite different: Grandmasters did not rely on superior memory skills. Grandmasters were not any better at recalling randomly placed pieces than novice chess players were. The Grandmaster however was able to take actual chess positions and in an astonishing 5 seconds recognize a complex chess configuration and decide on a successful move. How were the GM's able to give accurate, well thought out evaluations in so little time? It seemed that GM's (but not novices) were able to recognize familiar configurations, and associating them with appropriate moves and plans.

Recent research in the late seventies and early eighties in the US has confirmed these findings. Researchers concluded that meaningful knowledge is stored in memory in the form of networks and patterns, and these patterns provide the roots essential for recall. Thus the expert and GM players were able to remember and recognize chunks of information. In chess these chunks are visual representations in which particular configurations are recognized. These relate to and often cue prior successful responses or pattern responses. What is an involved long sequence of decision making of information for novices, is processed by experts in "one go". It seems that other experts such as dancers, athletes and musicians

operate mentally in much the same way. Responses are efficient and fast as understanding and experience are recognized and recalled in the essential structure of the activity. It seems that chess players develop complex but efficient structures for memory storage and management.

One of the essential goals of education is to teach children to think critically: students must learn to make reasoned judgments. Chess is an excellent tool to demonstrate the theme of critical thinking. During a game a player must formulate a plan of attack or defense.

The formulation of a plan entails that the player must not only reflect on how similar problems are solved (searching a database of previous knowledge) but also the player must perform a systematic checking of possible combinations of moves and then arrive at an evaluation of each line. The process is a mental exercise where pieces are envisioned to be moving from square to square and the player reflects on the characteristics of the position to finally produce a reasoned outcome (move). This is precisely the definition of critical thinking. Watson-Glaser appraised the value of chess as a learning tool and showed overwhelmingly "that chess improved critical thinking skills more than the other methods of enrichment." Included in the study were future problem solving, problem solving with computers, independent study, creative writing and fantasy games like Dungeons & Dragons.

An important element of critical thinking in chess is the evaluation process where the strength of one's position is assessed . Beginners who play chess (and early computer programs) place significant emphasis on material -- reasoning that "the player with more material will win by sheer numbers". If only chess was that simple. Material plays a central role in winning a chess game but many more ideas are needed for a useful evaluation of a position. More advanced players find a balance: included in their evaluation processes are the ideas of central control, pawn structure, material, space, maneuverability, king safety, initiative and development of pieces. The brain has internalized these values allowing the player to make a reasoned judgment of which particular themes are critical in evaluating his or her own position.

Mathematicians have estimated that there are approximately 10^50 possible unique games of chess playable. Thus chess will never become just a repetition of previously played moves. So how can a player possibly make a decision as to which plan to choose with so many possible choices? Even with complicated evaluative techniques, choosing the best plan can be very difficult. The chess player must often must rely on intuition. The best chess players are often those who have an acute feel or intuition for which move is correct. This can be a useful tool in education. Intuition is generally undervalued in educational terms but can be a very useful tool in both problem solving and real life applications when the steps to solve a problem are not easily apparent.

Are there links between mathematics and chess? Chess players are often considered mathematically oriented and there are obvious similarities as chess is a game of problem solving, evaluation, critical thinking, intuition and planning -- much like the study of mathematics. Studies have shown that students playing chess have increased problem solving skills over their peers. Researcher suggests that while students playing chess learn concepts through physical and visual stimuli and correlate these concepts to cognitive patterns, mathematics in the classroom usually involves only pure symbolic manipulation. Thus there seems to be some evidence to suggest that chess acts as a sort of link in connecting form (symbolic) with understanding (physical and visual).

In the early 80's Faneuil Adams became president of the American Chess Foundation (ACF). Adams was convinced that chess was an excellent learning tool for the adolescent, especially the disadvantaged. The ACF embarked on the Chess in Schools Program which focused on New York's Harlem School district. Initially the program was focused on improving math skills for adolescents through improved critical thinking and problem solving skills. This was achieved as "test scores improved by 17.3% for students regularly engaged in chess classes, compared with only 4.56% for children participating in other forms of enriched activities."

Also noted was that many students social habits improved when playing chess. The game allows for students of dissimilar backgrounds to integrate with others. Many disadvantaged or special education students are becoming actively involved in chess programs as the value of chess as a social tool is further explored. Advocates of chess are hoping that some of New York's gang related problems will be solved as children and students play chess in their spare time instead of becoming involved with gang related activities. Thus chess steers youth away from trouble by keeping them off the streets as well as being a useful learning tool.

Jerome Fishman, Guidance Counselor, Queens, NY says: "I like the aspect of socialization. You get into a friendly, competitive activity where no one gets hurt. Instead of two bodies slamming into each other like football, you have the meeting of two minds. Aside from developing cognitive skills, chess develops their social skills. It makes them feel they belong. Whenever we get a child transferred from another school who may have maladaptive behavior, we suggest chess as a way of helping him find his niche. The kids become better friends when after the game they analyze possible combinations ... we have kids literally lining up in front of the school at 6:45am to get a little chess in before class."

Principal Jo Bruno , Brooklyn, NY : "In chess tournaments the child gets the opportunity of seeing more variety and diversity. There are kids who have more money than they have, but chess is a common denominator. They are all equal on the chessboard. I believe it is connected academically and to the intellectual development of children. I see the kids able to attend to something for more than

an hour and a half. I am stunned. Some of them could not attend to things for more than 20 minutes." Bruno brings up the important point that chess can focus kids into concentrating on a task for long periods of time. Why is this? The author believes that many adolescents find chess fun and exciting. This corresponds to the youths playing (learning) for long periods of time without distraction.

Dr. Stuart Margulies, a researcher for IBM, stated that he "conclusively proved that students who learned chess enjoyed a significant increase in their reading ability". Dr. Margulies does not explain why he believes there is a correlation between chess and increased reading skills but it is the author's opinion that chess develops cognitive and attention skills. Furthermore, chess forces adolescents to visualize concepts and piece movement. This may allow for better visualization (interpretive) skills when reading.

Where is chess education headed? In the United States a major scholastic effort is underway to incorporate chess into the elementary school setting by the USCF, the US Chess Trust, the AFC and thousands of teachers and volunteers. The USCF scholastic magazine School Mates has over 20,000 copies in circulation each month. Rosalyn Katz of New Jersey spearheaded a movement for scholastic chess volunteers to change the legislation for teaching chess in schools in the state of New York. Katz managed to pass to bills in senate: Bill #S452 and #A1122. The bills read :

"An act concerning instruction in chess and supplementing Chapter 35 of Title 18A of the New Jersey Statutes. Be it enacted by the Senate and General Assembly of the State of New Jersey:

- 1) The Legislature finds and declares that:
    - a) chess increases strategic thinking skills, stimulates intellectual creativity, and improves problem-solving ability, while raising self-esteem;
    - b) when youngsters play chess they must call upon higher-order thinking skills, analyze actions and consequences, and visualize future possibilities;
    - c) in countries where chess is offered widely in schools, students exhibit excellence in the ability to recognize complex patterns and consequently excel in math and science; and
    - d) instruction in chess during the second grade will enable pupils to learn skills which will serve them throughout their lives.
- 2) Each board of education may offer instruction in chess during the second grade for pupils in gifted and talented and special education programs. The department of Education may establish guidelines to be used by boards of education which offer chess instruction in those programs.
- 3) This act shall be made effective immediately.

The Province of Quebec has followed suit and also has programs in place where schools teach chess at the elementary level. Instructors are often professional chess players hired by the school board to teach part-time during the week. British Columbia has no official legislation regarding chess as an active learning tool but the author believes that it is only a matter of time until a comprehensive uniform stance is taken by the province on chess in the classroom. At present chess is taught at few schools in Vancouver, mostly under volunteer supervision. Lynn Stringer currently volunteers many hours starting chess programs in many Vancouver Island schools. As pressure grows from parents interested in better educational programs the author expects chess programs will be introduced province-wide in the near future . This will result in a greater demand for qualified people with the necessary skills to teach chess.

Yasser Seirawan, US Grandmaster, said that, "Chess must no longer remain a civilized luxury of the leisure class in either appearance or fact; rather, chess must assume its fundamental role as a mental integrator and motivational activator. The hard scrabble nature of chess is equal to the task; are we equal to its full scholastic implementation?"

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Chess in the Math Curriculum

One of the most important educational goals is to teach children to think critically, to make judgements. Chess helps them do that during a game a player, must formulate a plan of attack or defense.

A player has to reflect on the problem to be solved which means he/she searches a database, their brain, for previous knowledge. Then they have to systematically check all the combinations of moves and decide on the best course of action. This is a mental exercise we all try to give our kids, teachers and parents it's critical thinking that can be used in other areas of a kid's life, academics and social situations.

Mathematicians have estimated that there are approximately 10 to the power of 50 of possible unique games of chess playable. Repetition is virtually impossible once a player reaches a certain level. Are there links between mathematics and chess? Chess players are often considered mathematically oriented and there are obvious similarities as chess is a game of problem solving, evaluation, critical thinking, intuition and planning much like the study of mathematics. Studies have shown that students playing chess have increased problem solving skills over their peers. Research suggests that while students playing chess learn concepts through physical and visual stimuli and correlate these concepts to cognitive patterns, mathematics in the classroom usually involves only pure symbolic manipulation. Thus there seems to be some evidence to suggest that chess acts as a sort of link in connecting form (symbolic) with understanding (physical and visual).

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In a Texas study, regular (non-honours) elementary students who participated in a school chess club showed twice the improvement of non-chessplayers in Reading and Mathematics between third and fifth grades on the Texas Assessment of Academic Skills.

A New Brunswick study, using 437 fifth graders split into three groups, experimenting with the addition of chess to the math curriculum, found increased gains in math problem-solving and comprehension proportionate to the amount of chess in the curriculum.

In a Zaire study conducted by Dr. Albert Frank, employing 92 students, age 16-18, the chess-playing experimental group showed a significant advancement in spatial, numerical and administrative-directional abilities, along with verbal aptitudes, compared to the control group. The improvements held true regardless of the final chess skill level attained.

In a Belgium study a chess-playing experimental group of fifth graders experienced a statistically significant gain in cognitive development over a control group. Perhaps more noteworthy, they also did significantly better in their regular school testing, as well as in standardized testing administered by an outside agency which did not know the identity of the two groups. Quoting Dr. Adriaan de Groot: "In addition, the Belgium study appears to demonstrate that the treatment of the elementary, clearcut and playful subject matter can have a positive effect on motivation and school achievement generally..."

A four-year USA study, though not deemed statistically stable due to a small (15 students) experimental group, has the chess-playing experimental group consistently outperforming the control groups engaged in other thinking development programs, using measurements from the Watson-Glaser Critical Thinking Appraisal and the Torrance Tests of Creative Thinking.

The Venezuela "Learning to Think Project", which trained 100,000 teachers to teach thinking skills, and which involved a sample of 4,266 second grade students, reached a general conclusion that chess, methodologically taught, is an incentive system suffficient to accelerate the increase of IQ in elementary age children of both sexes at all socio-economic levels.

A study using a sub-set of the New York City Schools Chess Program produced statistically significant results concluding that chess participation enhances reading performance. A related study, conducted in five U.S. cities over two years, selected two classrooms in each of five schools. The group receiving instruction in chess and logic obtained significantly higher reading scores than the control groups, which received additional classroom instruction in basic education (reading, math or social studies).

FACTS

Chess is found as required curricula in nearly 30 countries.

In Vancouver B.C. the Math and Chess Learning Center, recognizing the correlation between chess playing and math skills development, has developed a series of workbooks to assist (Canadian) students in math.

The mathematics curriculum in New Brunswick is using a text series called "Challenging Mathematics" which uses chess to teach logic from grades 2 to 7. Using this curriculum, the average problem-solving score of pupils in the province increased from 62% to 81%. The Province of Quebec, where the program was first introduced, has the best math marks in Canada and Canada scores better than the U.S.A. on international mathematics exams.

Former U.S. Secretary of Education Terrell Bell encourages knowledge of chess as a way to develop a preschooler's intellect and academic readiness.

The State of New Jersey passed a bill legitimizing chess as a unit of instruction within the elementary school curriculum. A quote from the bill states "In countries where chess is offered widely in schools, students exhibit excellence in the ability to recognize complex patterns and consequently excel in math and science..."

And remember, in these days of shrinking budgets and tight-fisted provincial politicians chess is low-tech and relatively low-cost!

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Much of this was taken from http://ourworld.cs.com/kaech5/benefits.html and other websites. I have cross-referenced the studies before -- especially the Canadian ones -- all of this can be backed up. The US Chess Federation actually has a lot of studies you can buy copies of at a low price.

- Jude Isabella, Editor of YesMag, Canada's Science magazine for kids.

Chess, Anyone? -- Chess As an Essential Teaching Tool

Each week, an educator takes a stand or shares an Aha! moment in the classroom in Education World's *Voice of Experience* column. This week, educator Brenda Dyck contemplates whether smart kids play chess or chess makes kids smart. Dyck considers the integration of chess into classroom learning and ponders the thinking byproducts of playing chess. Included: Links to resources and research about the impact of chess on students' skills, thinking abilities, and self-esteem.

One of the things I've noticed while working with gifted and talented students is their love for the game of chess. When I mention this to their teachers, they tell me that gifted students are intrigued by the analysis and strategizing that goes along with the game. They tell me that chess has been an ever-present part of their schooling from the very beginning; most classrooms have a number of chessboards, and the kids start up a game at any opportunity -- even for 15 minutes!

Some students are more serious about chess than others, but most jump at the chance to play. A chess club for students ages 8 to 15 meets once a week in the library. To witness the club -- with its 15 or 20 members engaged in thoughtful focus -- is a sight to see! (Without a doubt, it is one of the quietest lunch hour clubs I've ever witnessed.) Some of the students are serious enough about the game to compete outside of school. In fact, one of my grade 7 students was a regional champion in our province.

CHESS AS PART OF THE CURRICULUM?

After learning that the U.S. Chess Federation pledges that "Chess Makes Kids Smart," I found myself wondering if smart kids play chess or if chess *really* makes kids smart. Could this game be a key in our ongoing search to strengthen the thinking skills of 21st century learners?

Last summer, I did some reading about other schools where educators are asking the same questions. To my surprise, I learned that chess is being taught to more than 130,000 Canadian students -- some as young as second grade -- as part of their regular math program!

At Marina (California) Junior High School, teachers discovered that students' academic performance improved dramatically after only 20 days of chess instruction. George L. Stephenson, chairman of the school's math department, reported that "55 percent of students showed significant improvement in academic performance after this brief smattering of chess instruction."
It seems that scheduling chess as part of a regular math program is about more than entertainment. The initiative is supported by studies that maintain chess's ability to improve the cognitive abilities, rational thinking, and reasoning abilities of even weak learners.

MORE THAN A GAME

In Virginia, math teacher and chess-club sponsor Jan Brandt recently explained to me that chess is "probably the best game there is for developing logical, precise thinking." Ms. Brandt believes that chess encourages "patience, sharp memory, the ability to concentrate, problem solving skills, and the understanding that certain behaviors carry certain consequences." In addition, chess:

- demands both inductive and deductive reasoning.
- requires students to look at a problem, break it down, and then put the whole thing back together.
- involves recall, analysis, judgment, and abstract reasoning.
- improves decision-making skills.
- increases players' self-confidence and improves organizational habits.

All this information got me thinking. If research shows a connection between chess skills and improved reading and math scores, problem-solving ability, concentration, courtesy, responsibility, and self-esteem, then why aren't we all tapping into this multifaceted, cost-efficient critical thinking tool?

As we continue to look for ways to expand our students' critical thinking ability, could it be that some of the secrets to pushing student thinking and improving academic ability reside in a game that dates back to 531 AD?

Further Resources

Hall, Ralph L. “Why Chess in the Schools” RIE (Oregon), April 1984.

> The game of chess is recommended as a school activity. In addition to requiring that individuals become actively involved in a mentally demanding competition, its effects are stimulating, wholesome, and healthy. Several benefits accrue from the teaching and promoting of chess in schools. Chess limits the element of luck (teaching the importance of planning), requires that reason be coordinated with instinct (it is an effective decision-teaching activity), is an endless source of satisfaction (the better one plays, the more rewarding it becomes), and it is a highly organized recreational activity with clubs (leagues, team play) and elaborate systems of local, national, and international governance. In addition, chess is an international language such that players will find a friendly reception in any of the thousands of chess clubs throughout the world. A brief description of the game, comments on its appeal, and techniques to support chess in schools are provided. Techniques suggested include providing opportunities to learn and practice chess in clubs, intramural competition, credit/non-credit classes, and in teams which represent the school in inter-school competition.

Horgan, D., David Morgan. “Experience, Spatial Abilities, and Chess Skills”, Paper presented at the Annual Meeting of the American Psychological Association (Atlanta, GA Aug. 12-16, 1988)

> A study examined chess expertise in 113 children in grades 1-12 who played competitive chess. Specific attention was given to the relationship between experience, as measured by number of games played, and skill, as measured by national chess ratings. For the top 15 players, emphasis was placed on relationships among chess skill, spatial abilities, and logical ability. Spatial abilities were measured by the Ravens Progressive Matrices and the Knight's Tour, while logical ability was measured by a Piagetian task. Findings indicated that improvement in skill was related to experience. Spatial abilities appeared to be more important than logical abilities to skill in chess.

Smith, J., Monty Sullivan, “The Effects of Chess Instruction on Students' Level of Field Dependence/Independence”, Paper presented At the Annual Meeting of the Mid-South Educational Research Association (26th, Memphis, TN, Nov. 12-14, 1997).

> A study was conducted to determine whether chess instruction would change the measure of a student's field-dependence or field-independence as determined by the Group Embedded Figures Test (GEFT) in the direction of stronger field independence. Field dependence/independence is a psychological construct referring to a global versus an analytical way of perceiving that entails the ability to perceive items without being influenced by the background. This was done by comparing the results of pretest and posttest scores on the GEFT for 11 African-American high school students (four males, seven females) in a rural northern Louisiana school. These students had received approximately 50 hours of direct chess instruction and playing experience. Chess

instruction did have a significant effect on GEFT scores for females, but not male, students. Whether this might transfer to improved mathematics achievement is beyond the scope of this study, but it is a problem worth investigating. It is logical to surmise that whatever skill chess instruction enhanced for females may have already been present for males.

Feldhusen, J.F., Philip J. Rifner, "Checkmate: Capturing Gifted Students' Logical Thinking Using Chess" Gifted Child Today Magazine, v20n1p36-39, 48 Jan-Feb 1997.

Describes the use of chess instruction to develop abstract thinking skills and problem solving among gifted students. Offers suggestions for starting school chess programs, teaching and evaluating chess skills, and measuring the success of both student-players and the program in general.

Horgan, D., et al. "Abstract Schemas in Children's Chess Cognition", Paper published at the Conference of Human Development (Nashville, TN April 3-5, 1986)

The nature and development of semantic processing in chess was investigated in a study involving younger players from 6 through 18 years of age. Efforts were directed toward establishing the assertion that skilled players' memory for chess positions depends largely upon the availability of pre-stored schema (PSS) that are both abstract and semantically organized. Subjects were players at the 1985 Tennessee Scholastic Chess Championship who had ratings of 1100 or above. In the first experiment, a total of 46 subjects participated in a midgame task and 48 participated in an endgame task. Subjects were shown target boards for 10 seconds, read accompanying context descriptions when appropriate, and reconstructed from memory as much of the display as possible. Performance was measured by number of correctly placed pieces. In a second experiment, subjects were shown midgame positions they had viewed previously and were asked to reconstruct them, looking at the displayed model as often as necessary. Taken together, data from the memory and reconstruction tasks lend strong support to the general hypothesis that abstract, semantically organized PSSs are an important component of chess cognition, and to several special cases of that hypothesis. Data also disclosed age-related qualitative differences in the cognitive mechanisms for constructing representations of briefly presented chess positions.

Cage, B., James Smith. "The Effects of Chess Instruction on Mathematics Achievement of Southern, Rural, Black, Secondary Students", Research in the Schools vol 7n1p19-26 Spr2000.

Studied the effects of 120 hours of chess instruction on the mathematics achievement of southern, rural, black secondary students. Analysis of covariance results show the treatment group (11 females, 9 males) scored significantly higher than the control group (10 females, 10 males) in mathematics achievement. Discusses results in terms of altering students' perceptual ability.