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DIDACTIC POTENTIAL OF CHESS GAME AND ITS INFLUENCE ON
STUDENT ACHIEVEMENT

¹*Abdulhalim Khamidovich Mahmudov*, ²*Bakhtiyor Khudayberdievich Rakhimov*,
²*Mukarram Djumanovna Toshmatova*, ²*Rano Abdullaevna Khalilova*, ²*Noila Nasim-
qizi Abdurahmanova*, *Rakhima Kurbonovna Turdieva*²

¹Uzbek Scientific Research Institute of Pedagogical Sciences named after Qori Niyazi, 100027.
Tashkent, Uzbekistan street, 98, Uzbekistan.

²Gulistan State University, 120100. Syrdarya region, Gulistan city, IV microdistrict, Uzbekistan.
Email: 1967.baxtiyor@mail.ru.

¹**abdulhalim Khamidovich Mahmudov**, ²**bakhtiyor Khudayberdievich Rakhimov**,
²**mukarram Djumanovna Toshmatova**, ²**rano Abdullaevna Khalilova**, ²**noila Nasim-
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ABSTRACT –

One of the main tasks of modern schools is the development of children's creative potential and the formation of socially significant personal qualities. At school, they should not receive ready-made knowledge, but a model of adaptation to rapidly changing conditions. According to a number of psychological and pedagogical indicators, the chess game is an ideal explanatory model that allows students to form skills for successfully solving practice-oriented problems. Our research is devoted to revealing the didactic possibilities of this explanatory model, where the authors define approaches to the content interpretation and content of the concept of "didactic potential of chess", its essence and structure. The main attention is paid to the correlation of chess training and the dynamics of improving academic performance in other academic subjects. The comparative indicators of improving student's academic performance in the selected subjects with the growth of

chess skills are presented on the example of subjects "Russian language and literature", "Mathematics" and "Foreign (English) language". In terms of didactics, methodology and technology, the thesis is substantiated that chess contributes to the development of logical, creative, critical and independent thinking of the student, which directly affects the success of learning in other academic subjects. The work is interdisciplinary in nature.

I. Introduction

UNESCO declared the 21st century the "Age of Education". Formulating the basic concept of the 21st century education system, Dr. A. Urbanski, Vice President of the American Teachers Association said: "Teaching will be based on learning to think." From our point of view, it is "training in systems thinking". Consequently, in the 21st century, one of the main tasks of a general education school is the development of children's creative abilities (independent and creative thinking) and the formation of socially significant personal qualities (initiative, show willingness to learn, patriotism, motivation for new knowledge, self-education), which must be formed with primary classes. However, the formation of the above qualities in primary school students is impossible in the context of the existing "knowledge" paradigm at school, which is based on the isolation of school knowledge from practical life, where the knowledge gained does not develop the student's creative potential, the ability to think creatively and independently. School education should contribute to the disclosure of the abilities of each student, the upbringing of a decent and patriotic person, a person ready for life in a high-tech, competitive world. The content of education should be structured so that children develop critical systems thinking, creativity, quick analysis and solution of new problems [1].

In our opinion, it is in chess that the didactic potential is laid, contributing to the implementation of the above requirements for a modern school [2, 3, 4]. A student playing chess will constantly: a) critically evaluate a position according to several criteria (critical thinking); b) search for the optimal solution from the created position (heuristic thinking); c) analyze moves a couple of steps ahead (forecasting and foresight); d) take into account all risk factors and possible situations (systems thinking); e) creating a combination leading to success, choosing the best move (creative thinking, responsibility for making a decision); g) the entire learning process is interesting, without fatigue and in a playful way (high motivation).

The famous Soviet teacher V.A. Sukhomlinsky wrote: "Chess is an excellent school of consistent logical thinking ... Playing chess disciplines thinking, fosters concentration and develops memory. It should enter the life of elementary school as one of the elements of mental culture. We are talking about elementary school, where intellectual education takes a special place and requires special forms and methods of work. "

The subject "chess" in elementary school, endowed with rich opportunities through structure and content, is able to give the upbringing and teaching of younger schoolchildren an active purposeful character [5, 6]. Chess, acting on the zone of proximal development, reveals the thresholds of personality development. the system of a general education school, identifying and developing individual abilities, forming a progressive orientation of the personality, contributes to the general development and upbringing of the student [7].

Chess is a model of life, and the advantage of playing learning is that negative actions and wrong decisions do not lead to catastrophic consequences for the participants of such learning, but at the same time give experience of relevant experiences and develop skills for getting out of crisis situations provoked by such behavior ... This is one of the main cognitive mechanisms of chess, that after each game played, the child analyzes the wrong decisions in it and learns from his mistakes so as not to repeat them in the next game.

II. Review

In psychological and pedagogical science, the problem of the “didactic potential of the chess game” and its influence on the academic performance of students has been little studied, and they are not of a systemic nature.

The first scientific research in the field of chess was carried out by A. Binet, a French psychologist, doctor of medicine and law at the University of Paris. He studied the problems of memory and memorization of complex material. In his work, published in 1894, he characterized chess activity as an activity with a high creative content [8].

The first world chess champion V. Steinitz also wrote about the positive influence of the game of chess on human intelligence: "... the infinite variety of combinations possible in the game of chess opens up the widest scope for exercise, and, therefore, for the development of the logical and imaginative abilities of the mind" [9].

Psychological and pedagogical scientific research in the field of chess was carried out by the Soviet psychologist L.S. Vygotsky in 1933. He was engaged in the development of semantic perception. He notes in his research that:

an essential feature of a chess player's perception is structure, that is, perception does not consist of separate atoms, but is an image within which there are various parts [10].

Doctor of Pedagogy, Professor V.V. Knyazeva characterizes the uniqueness of chess as follows: “Chess develops imagination, analyticity, special forms of thinking and attention, highlighting the essential, choosing a solution, creative communication and isolation, and also forms the independence of creativity and its active “nature, a sense of time, responsibility for their actions, dedication, perseverance, patience, etc.” As Professor S.D. Neverkovich, “Playing chess is a process that forms the character, properties and qualities of a student's personality, they help him in learning, achieving harmony between innate and acquired qualities. In other words, the academic subject "chess" serves to develop the following qualities: motivation for learning, interest in learning, development of memory, attention, logical thinking” [11].

In more recent studies, for example, scientists A.P. Burgoyne, G. Sala, F. Gobet, B.N. Macnamara, G. Campitelli (2016) consider the relationship between cognitive ability and chess skill [12]. Studies have shown that chess skill positively and significantly correlated with fluid thinking ($r = 0.24$), understanding-knowledge ($r = 0.22$), short-term memory ($r = 0.25$) and processing speed ($r = 0.24$). It was noted that the ability to play chess correlated more strongly with numerical abilities ($r = 0.35$) than with verbal ($r = 0.19$) or visual - spatial ($r = 0.13$).

In their studies, G. Sala, F. Gobet, JP Foley, M. Joseph et al. Note that the skills acquired in the process of teaching chess in schools are positively transferred to mathematics, reading and general cognitive skills, and the chess group showed better effectiveness planning than non-chess players, which is most strongly expressed in complex problems. " At the same time, researchers note "... despite the fact that "the hypothesis of the "chess effect" has received some scientific support, this hypothesis has yet to be convincingly proved" [13, 14].

Research by R. Ortiz-Pulido et al. (2019) reported "... the cognitive benefits of playing chess for school-aged children. The most favorable areas appear to be mathematics and reading. To confirm these results, various scientific studies are described in which brain activation is demonstrated using magnetic resonance imaging when novice, intermediate and advanced chess players play a game. Given these data, it is proposed to use chess as a tool to improve the performance of boys and girls" [15].

The work of F. Gliga, P.I. was directed to research the influence of role-playing chess teaching on the performance of schoolchildren, in particular on memory, sustained attention and creativity. Flesner "The Cognitive Benefits of Chess Learning for Beginner Children" (2014). The authors note that "... in a group of 20 beginning primary school students (chess group), an increase in cognitive skills was found compared to the control group" [16].

The work of the authors P. Y. Fleshner, S. Apostol, B. Baubek, F. Gliga is devoted to the analysis of the main cognitive abilities that are positively influenced by the game of chess [17].

In his dissertation work, M.Yu. Gutenev notes that "... chess as a reflexive game contains the possibilities of developing the creative components of a person's thinking (logic, accurate calculation of variants, technique and knowledge of chess theory, intuition, fantasy), which contribute to the rise of creative potential individual and society. Playing chess develops the skills of strategic thinking, foresight of possible results and consequences of actions, the skills of combining both objective and subjective factors of activity ..." [18].

Joseph, Ebenezer et al. In "Mentoring Children Through Chess Learning Improves Cognitive Function" analyzes the effect of chess training frequency on children's IQ improvement. Chess training frequency refers to the time a chess coach spends with a child [19].

Aciego, Ramón, et al. Investigate the benefits of playing chess regularly for the intellectual and socio-emotional enrichment of a group of 170 schoolchildren aged 6-16. The experimental results show the growth of intellectual and socio-emotional qualities in the experimental group [20].

A number of works are devoted to the influence of chess on the increase of cognitive skills in the subject of mathematics [21, 22, 23]. These studies examined the influence of teaching to play chess on the development of metacognitive abilities and ability to solve mathematical problems in students of different levels of school education, as well as the influence of chess average level in the success of the mathematics lesson by comparing the results of the exam in mathematics among high school students who play and do not play chess.

Our brief review of works on chess didactics shows that the process of studying

the didactics of the academic subject of chess is at the initial stage. The problems of correlating the success of teaching chess with the success of mastering other school subjects remain poorly studied. The psychological, pedagogical and didactic mechanisms of the influence of chess mastery on improving academic performance in other academic subjects have not been sufficiently investigated. The psychological, pedagogical and methodological aspects of the transfer of logical techniques used in chess problems to educational tasks of other disciplines have not been fully investigated. It follows from these considerations that the study of the didactic mechanisms of the influence of chess mastery on the improvement of academic performance in other academic subjects is an actual and demanded problem.

III. Results

In our research, we put forward the following scientific hypothesis:

game skills of chess mastery contribute to the rapid and rational finding of effective ways to solve various educational tasks in other school subjects. As a result, one can observe an increase in student achievement in general.

When implementing chess curricula in general education schools, one should consider the complex of psychological and pedagogical conditions aimed at increasing the effectiveness of the formation of logical thinking of chess players [1]:

- ensuring the formation of all components that make up the logical thinking of chess players (motivational, substantive, operational-functional, reflexive);
- compliance with general didactic indicators, i.e. considering the sequence of presentation of the material, the pace of increasing complexity, etc.;
- highlighting the aspect problems inherent in each of the stages of a chess game in the process of their genesis and successive transformation of one into another;
- the allocation and assimilation of generalized concepts that form the general orientation of the strategy in the party, using computer programs;
- identification of theoretical relationships between different stages of the party and their specification;
- considering the individual characteristics of students when drawing up variable formulations of tasks.

A long-term study of the problem, the study of the creative experience of teachers indicates that the following factors affect the quality of teaching in primary grades:

- motivation and interest in knowledge (X1);
- the degree of students' understanding of the new topic (X2);
- activity and involvement in the classroom (X3);
- stability and intensity of attention (X4);

- character traits (dedication, perseverance, patience, accuracy, efficiency (X5);
- independent creative thinking (X6);
- the ability to plan, predict, imagination, systematization and generalization (X7);
- the ability to highlight the essential, inference, good memory (X8);
- readiness for learning activities (X9);
- responsibility for their actions (X10);
- ingenuity, logical and abstract thinking (X11);
- discipline, will, resistance to failure, the ability to self-esteem (X12), etc.

The identified factors were structured into groups according to the following features:

- motivational, this includes X1, X2, X3, X9;
- personal qualities - X5, X10, X12;
- intellectual abilities -X4, X6, X7, X8, X11.

In accordance with the structured groups, questionnaires, tests and situational tasks were developed and used in pedagogical practice.

It should be noted that the academic subject of chess in many ways contributes to the formation of the above qualities in students. The experiment was aimed at the fact that the subject of chess forms the above-mentioned qualities in students and this ultimately affects the success of the study.

For the experiment, students of 2nd grade were selected. In the control classes, classes were conducted without the subject of chess, in the experimental classes, 1 hour per week was allocated for teaching chess (34 hours per academic year). Below is the main content of chess lessons for 2nd grade students and the motivational, intellectual and personal qualities formed in them in accordance with the identified factors.

Table 1. Development of motivational, intellectual and personal qualities in primary school students in the lessons of the subject of chess

The main content of the chess training program	Groups factors affecting the quality of schooling	Developed motivational, intellectual and personal qualities
1. Acquaintance with the chessboard. Alternating white and black fields. Territories of the white and black kingdom. Center of the board. Verticals, horizontals and diagonals. Field address	X4, X7, X11	stability and intensity of attention; the ability to plan, predict, imagination, systematization and generalization; quick wit, logical and abstract thinking
2. The name and designation of figures. The	X1, X9, X11	motivation and interest in learning;

name of the white and black pieces. The initial placement of white and black pieces on the chessboard.		readiness for learning activities; quick wit, logical and abstract thinking
	X1, X3, X6, X8	motivation and interest in learning; activity and involvement in the classroom; independent creative thinking; the ability to highlight the essential, inference, good memory
3. Moves and capturing pieces. The move of a pawn, king, rook, bishop, knight. Capture by pawn, king, rook, bishop, knight. Pawn transformation. A pawn move two moves.	X2, X6, X8, X10	the degree to which students understand the new topic; independent creative thinking; the ability to highlight the essential, inference, good memory; responsibility for their actions
4. The relative value of the pieces. The value of the figures. Comparative strength of figures.	X3, X4, X5, X7	activity and involvement in the classroom; stability and intensity of attention; character traits: purposefulness, perseverance, accuracy; ability to plan, predict, imagination, systematization and generalization
5. Special rules. Castling. Capturing a pawn on the pass.	X5, X6, X7, X8, X10, X12	character traits: purposefulness, perseverance, accuracy; independent creative thinking; planning, forecasting and systematization; the ability to highlight the essential, inference, good memory; responsibility for their actions; discipline, will, resistance to failure, the ability to self-esteem
6. The essence and goals of the game. How to defeat an opponent, take the king prisoner? The concept of the shah. Checkmate of the king. Draw and draw options. Castling. The concept of "stalemate". Stages of the game. Opening, middlegame, endgame.	X1, X2, X3, X7, X9, X10, X12	character traits: purposefulness, accuracy; the degree to which students understand the new topic; activity and involvement in the classroom; planning, forecasting and systematization; readiness for learning activities; responsibility for their actions; discipline, will, resistance to failure, the ability to self-esteem
7. Start of the game. Debut. Basic principles of the debut. The role of the center. The concept of light and heavy figures. Control by pawns and minor pieces from the center. Development of light figures.	X1, X2, X3, X4, X6, X7, X10, X11, X12	character traits: purposefulness, accuracy; the degree to which students understand the new topic; activity and involvement in the classroom; stability and intensity of attention; independent creative thinking; planning, forecasting and systematization; responsibility for their actions; quick wit, logical and abstract thinking; discipline, will, resistance to failure, the ability to self-esteem

Mathematics (as the most researched in terms of the influence of chess mastery), Russian language and literature (the influence of chess mastery on verbal skills) and a foreign language (reading) were chosen as academic subjects.

Pupils of the control and experimental groups were tested for: activity and involvement in the classroom; the degree to which students understand the new topic; stability and intensity of attention; independent creative thinking; quick

wits, logical and abstract thinking. In total, 125 schoolchildren were involved in the experiment. Significance of difference in results - $P < 0.01$ and 0.05 .

The result of the analysis of empirical data was the conclusion that high-quality, systematic educational lessons in chess had a positive effect on the development of certain aspects of the motivational, intellectual and personal activities of primary school students. The acquired opportunities can be indirectly manifested in the success of educational activities due to their use.

In the course of mathematical analysis, the following were calculated: the correlation coefficient r ; arithmetic mean - x ; mean square deviation - b ; mean error of the arithmetic mean - m ; assessment of the reliability of the correlation coefficient - $m(r)$; the regression coefficient is R [13].

For calculations, quarter marks were taken (chess grades in the experimental groups are put in the journal along with the rest of the subjects).

Table 2. Quarter marks of chess players (chess grades in the experimental groups are put in the journal along with the rest of the subjects)

Mathematical indicators	Number of students	Academic subjects		
		Russian language and literature	Maths	Foreign (English) language
r	80	0,495	0,748	0,47
x	80	3,2625	3,75	3,75
b	80	$\pm 0,4123$	$\pm 0,4123$	$\pm 0,4123 \pm 0,6185$
m	80	$\pm 0,046$	$\pm 0,046$	$\pm 0,046$
$m(r)$	80	$\pm 0,084$	$\pm 0,0493$	$\pm 0,087$
R	80	0,495	0,748	0,313
	$P < 0,01$			

The experiment shows that there is a direct positive correlation of average strength between chess and the Russian language, chess and a foreign language, and a strong positive relationship between chess and mathematics. Correlation coefficients are reliable, they exceed their error by 7-8 times.

On the basis of experimental data, a diagram of the influence of chess mastery on the success of teaching in the selected academic subjects is presented (Fig. 1).

As can be seen from the diagram, in the first period of study (6 months) the growth of chess mastery and academic performance in other subjects (both those who are engaged and those who are not engaged) are approximately equal. The influence of chess mastery is stronger after 6 months of learning chess. This primarily affects students who are engaged in chess. This influence is explained by the fact that many skills of chess mastery, such as: concentration of attention, analysis and assessment of the position, search and selection of the correct solution, planning and organization of a combination, forecasting the opponent's moves, striving for victory, motivation for new things, help in the assimilation of other subjects.

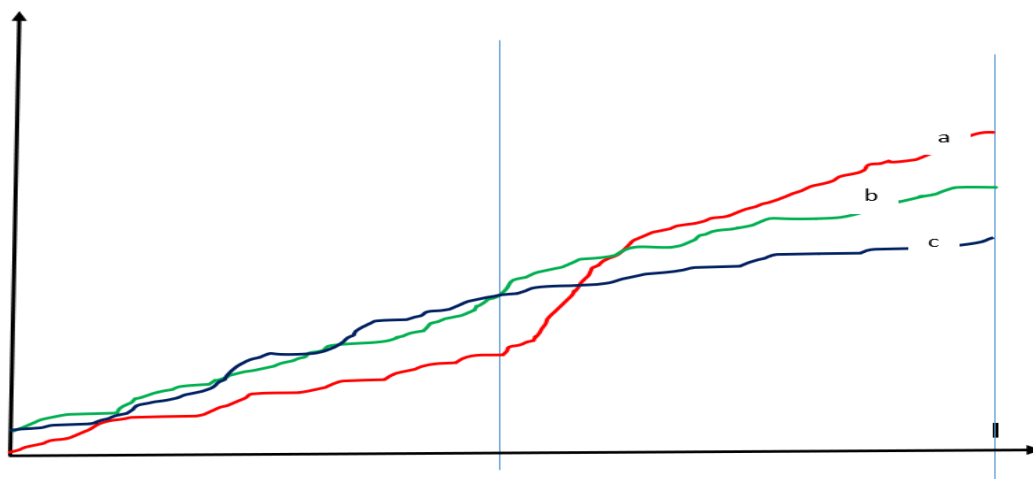


Fig. 1. Average value of the indicator of the influence of the growth of chess skill on the success of teaching in other subjects

Here:

- a) The growth of the chess mastery of a chess student.
- b) Student performance in other subjects, studying chess.
- c) The student's performance in other subjects not studying chess.

Thus, it can be argued with good reason that the growth of chess mastery has a positive effect on the success of teaching in Russian and foreign languages, mathematics, and with the growth of the causal factor, the consequence will also increase. The calculation of the regression coefficient R showed us how much, on average, the academic result will improve with increasing chess mastery. Academic success on average increased by 0.75 points in mathematics, 0.5 points in Russian and 0.3 points in a foreign (English) language.

Thus, it can be said with sufficient confidence that with high-quality and systematic teaching of primary school students in chess, there will be an increase in academic performance in other academic subjects.

IV. Conclusion and Implications

1. In psychological and pedagogical science, the didactic possibilities of the chess game and their influence on the progress of students are poorly studied, and they are not of a systemic nature.
2. Numerous studies of the didactic possibilities of the chess game show the influence of chess mastery on the development of cognitive skills in mathematics, to a lesser extent in other subjects.
3. There are numerous works of foreign scientists who have convincingly proved the fruitfulness of the use of chess for modeling the most complex process of creative, heuristic thinking of a person.
4. Analysis and synthesis of scientific material and practical experience made it possible to reveal the relationship of the main content of the chess training

program with the developed motivational, intellectual and personal qualities of the student.

5. The results of experimental research allowed to reveal the success of the students of the chess group. The results increased on average by 0.75 points in mathematics, 0.5 points in Russian and 0.3 points in a foreign (English) language. Success in other subjects is observed mainly after 6 months of systematic chess training.

6. It can be said with sufficient confidence that with high-quality and systematic teaching of primary school students in chess, there will be an increase in academic performance in other academic subjects. This increase is observed mainly after 6 months of constant, high-quality chess training.

7. Do not expect a quick pedagogical effect from the introduction of the subject of chess. First of all, it is necessary to develop the very subject of "Chess". Consequently, we need scientific research that reveals the psychological, pedagogical, methodological, philosophical, didactic, methodological and technological aspects of this subject.

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