The Impact of Students' Attitudes and Learning Activities on the Chess Academic Achievements in Primary Schools

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The purpose of the current research is to reveal the mechanisms of the influence of teaching and learning strategies and students' motivation on the chess knowledge in elementary schools. The sample of the study consists of 476 pupils from 42 schools, 476 parents, 42 teachers. The survey was conducted by random sampling with the participation of all regions of the Republic of Armenia, including the capital Yerevan. During the research, the following methods and tools of quantitative and qualitative research have been applied: questionnaire, test, action research. The results of the study demonstrate that developing new strategies by combining game playing and solving chess problems will stimulate students' learning interests and increase chess knowledge and skills. The positive attitudes towards the subject prevails, as well as the indicators of the students' self-determination manifestation. The solution of complex tasks by the students is more related to internal effort and abilities, allocating less attention to the success factor, as in the instance of a game of chess. On the other hand, considering the subject as complex has a negative effect on the results of the chess knowledge test.

Keywords: chess education; teaching and learning strategies; self-determination theory; intrinsic motivation; extrinsic motivation; attitudes; problem solving; game playing.

Влияние учебной деятельности и установок учащихся начальной школы на учебные достижения по шахматам

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Целью настоящего исследования является выявление механизмов влияния стратегий преподавания и обучения, а также мотивации учащихся на шахматные знания в начальной школе. Выборка исследования состоит из 476 учеников из 42 школ, 476 родителей, 42 учителей. Опрос проводился методом случайной выборки с участием всех регионов Республики Армения, включая столицу Ереван. В ходе исследования были применены следующие методы и инструменты количественного и качественного исследования: анкетирование, тест, «исследование в действии» (action research). Результаты исследования демонстрируют, что разработка новых стратегий, сочетающих игру в шахматы и решение шахматных задач, будет стимулировать интерес учащихся к учебе и расширять шахматные знания и навыки. Было выявлено, что среди учащихся преобладают позитивное отношение к предмету, а также показатели проявления самоопределения. Решение учащимися сложных задач в большей степени связано с внутренними усилиями и способностями, при этом фактору успеха уделяется меньше внимания, как в случае с игрой в шахматы. С другой стороны, рассмотрение предмета как сложного негативно сказывается на результатах теста на знание шахмат.

Ключевые слова: шахматное образование; стратегии преподавания и обучения; теория самоопределения; внутренняя мотивация; внешняя мотивация; установки; решение проблем; игра.

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Introduction

The problem of chess in education and the effectiveness of its application as a tool for students' development have been studied from many perspectives. "**Chess and Cognitive Development**" study has been conducted by Johan Christiaen [1]. Expanding this research Ferguson's study focused mainly on "**Developing Critical and Creative Thinking Through Chess**" [2]. All these and many other research projects have found many evidences about the effectiveness of chess in education.

Armenian scientists have conducted several studies devoted to chess in education since chess has been implemented as a compulsory subject in elementary schools curricula in the Republic of Armenia. Research papers are devoted to the **impact of chess on cognitive and intellectual development [**9, 12**], quantitative analysis of the efficacy of chess in education** [5], **socio-psychological analysis of factors influencing Chess Education [3, 10],** the **connection of chess knowledge with the indicators of progress in mathematics and native language [**11**], typical Expression of Cognitive Dissonance and Consonance among Primary-School Children playing chess [**6**], problem of chess and critical thinking [4, 8], the social value of chess [**13**],** etc.

Summarizing the results and assumptions of these studies, we can state that chess as an educational subject has a huge impact and potential for students' cognitive, social and emotional development. Nowadays, we should not only focus on testing these results but we must also take into account that there are many cultural, environmental, social-psychological factors including teaching and learning strategies, students' motivation etc., which can influence the chess knowledge acquiring process among students. None of the above-mentioned studies are focused on a deeper analysis of teaching and learning chess, such as defining how teaching and learning strategies and students' motivation can influence student's chess achievements. We tend to explain this by the absence or lack of necessity to study these kinds of problems so far. Actually, these problems are key issues for chess teachers and chess teaching methodologist. Within this context, one of the operational problems was regarding allowing students play chess during the lessons, which has been raised by many Armenian chess teachers during interviews and impersonal conversations. The problem of interactions between game and learning components is among the most important issues of contemporary school education. This problem can mostly be referred to chess education, where the game appears as an educational subject.

The authors point out that "conceptual confusion is particularly acute at the boundaries of these two activities in the establishment of so-called developmental game learning" when analyzing the problems of the transition from play to learning activities [16, p23].

There is another study, conducted by Philip Rifner [7], devoted to **Problem-Solving Skills in Students with Average and Above Average Intelligence**, which found that the inter-domain transfer of chess skills 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. What can we learn from this study? From the point of view of our research purpose, we mostly focus on the study results to show that teaching goals and other factors (or independent variables) should also be taken into account. Moreover, we supposed, that the independent variables have different kinds of impacts on chess achievements,

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depending on personal characteristics, (including teaching and learning strategies implemented by teachers and students correspondingly, i.e. playing chess during the lessons; students' motivational factors, such as attitudes towards the lessons, causal attributions, self-efficacy, etc.).

By teaching and learning strategies we mean techniques and methods that teachers and students use for better learning. Especially within current research we mostly focused on students' game playing and solving chess problems (tasks) on the chessboard during chess lessons.

Among motivational factors which can have an impact on the students' chess knowledge, we are going to analyze attribution and students' attitudes to their lessons.

Weiner [14] identified ability, effort, task difficulty, and luck as the most important factors affecting attributions for achievement. Attributions are classified along three causal dimensions: locus of control, stability, and controllability. The locus of control dimension has two poles: internal versus external locus of control. The stability dimension captures whether causes change over time or not. Controllability contrasts causes one can control, such as skill/efficacy, from causes one cannot control, such as aptitude, mood, others' actions, and luck.

Weiner states: "Causal attributions determine affective reactions to success and failure. For example, one is not likely to experience pride in success, or feelings of competence, when receiving an 'A' from a teacher who gives only that grade, or when defeating a tennis player who always loses…On the other hand, an 'A' from a teacher who gives few high grades or a victory over a highly rated tennis player following a great deal of practice generates great positive affect." [15, p. 362].

Students with higher school achievement attribute success to internal, stable, uncontrollable factors such as ability, while they contribute failure to either internal, un-stable, controllable factors such as effort, or external, uncontrollable factors like task difficulty.

Concerning the subject of chess learners' attributes, it is important to demonstrate their distinctive significance in educational achievement. It is especially interesting for chess learners to obtain credible information about their own abilities, achievements, failures, and comments on the task's complexity, as they have repeatedly become the subject of discussion after introducing chess as a compulsory subject in elementary schools. Thus, during discussions with teachers and annual trainings, issues concerning how tough or accessible chess activities are for various students, if chess might have a detrimental influence on students' self-confidence, self-efficacy, and so on were frequently raised.

The purpose of the current research is to reveal the mechanisms of the influence of teaching and learning strategies and students' motivation on the chess knowledge in elementary schools.

Research methods: In order to find the impact of many factors on chess education in Armenia, empirical research has been conducted. During the research, the following methods and tools of quantitative and qualitative research have been applied: questionnaire, test, action research.

Questionnaires were prepared for the beneficiaries — pupils, teachers, parents — which included questions about the child's chess experience, parents' attitude towards the chess subject, the teacher's effectiveness in teaching chess. Psychologists, chess players and teachers took part in compiling the questionnaires, which clarified and discussed each task to get a definite version.

The test on the chess knowledge was compiled, the purpose of which was to determine the level of knowledge acquired by pupils during the three years of learning chess.

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The sample

The survey was conducted by random sampling with the participation of all regions of the Republic of Armenia, including the capital Yerevan. The total number of selected schools were 42.

Therefore, as a result 476 pupils from 42 schools, 476 parents, 42 teachers participated in the republican research.

The results

To the question "How often do you play chess during lessons?", the students' answers are distributed as follows (*Diagram 2****).***

There is a linear trend: the decrease in the frequency of playing chess in classes raises the average score of the chart solution. Except for the "never" category, which drastically reduces the rating.

The Bold data in the column "Sig." of Table 1 are less than 0.05, indicating that the observed linear trend is statistically significant.

The analysis of the data showed that the average score of chess test solutions is the lowest and is 3.33 points in the case when students "never" play chess during chess lessons, (Diagram 3)
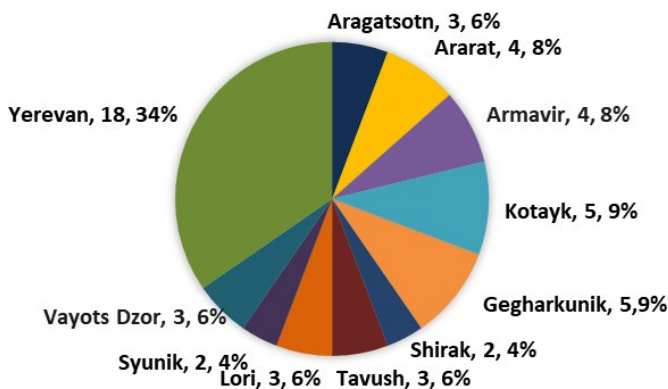
Diagram 1. The number of regional schools involved in the research
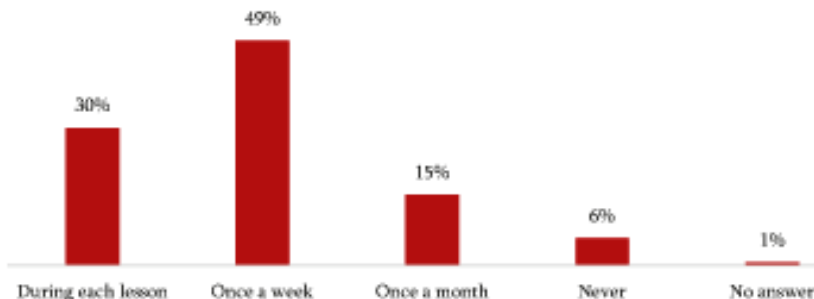
Diagram 2. Frequency of playing chess during chess lessons

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Means of the number of correctly solved problems with weighted assesments
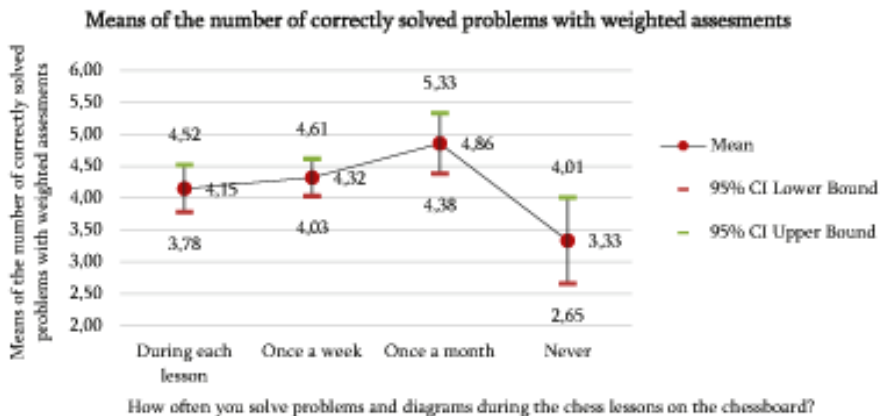

Diagram 3. The number of correctly solved problems with weighted assessments

Diagram 3 shows that if the level "Never (they never play chess in class)" is excluded from the analysis, then when the intensity of the chess game is reduced, the average score of the chess test increases from 4.15 to 4.86. Dispersion analysis of three levels of chess playing intensity — "During every lesson", "Once a week" and "Once a month" shows that there is a statistically significant linear trend. decreasing the frequency of playing chess in classes increases the average score of the chess test $F(1, 444) = 4.329$, $p = 0.038$.

To the question "How often do you solve problems and diagrams during the chess lessons on the chessboard ?", the stu-dents' answers are distributed as followнs (Diagram 4)

Visual comparison of the average scores of the chess test at different levels of intensity of solving problems in chess lessons, that increasing the intensity of solving chess problems in lessons increases the average score of the chess test (Diagram 5)

The dispersion analysis showed that the linear trend of increasing the average score of the chess test observed in Diagram 5 is statistically significant — $F(1,470) = 8,028$, $p = 0.005$.

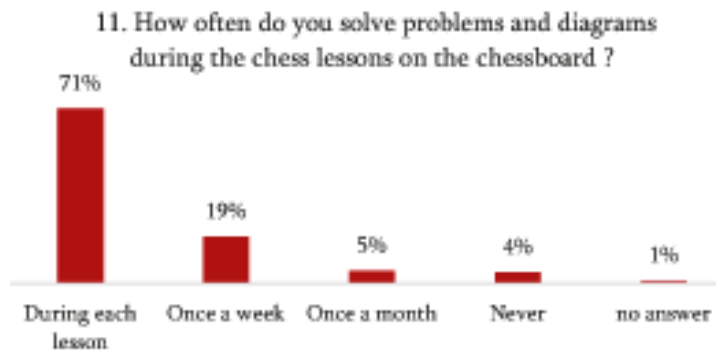**Influence of chess lessons on chess skills**. To evaluate the influence of chess

Diagram 4

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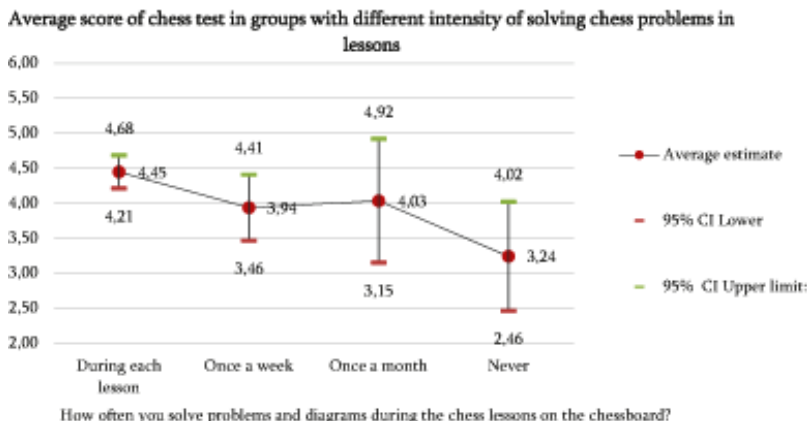Психологическая наука и образование. 2023. Т. 28. № 5

Diagram 5. Influence of the intensity of solving chess problems in lessons on the average
score of the chess test

lesson settings on chess skills, students were given eight statements, from which they had to mark no more than three that they agree with the most. The order of answer selection was not taken into account. Approvals and the percentage of the choice of each of them are shown in Diagram 6.

To evaluate the influence of each of the tested attitudes, the t-criterion was used. For each attitude, the difference between the average scores of the chess test was estimated for two groups — those who marked and those who did not mark this attitude.

All differences in the Table 1 are statistically significant, except the differences conditioned by the factor "d. I learn a lot of useful things during chess lessons".

To the question of "What do you usually do during chess lessons?", there were 3 options. No priority was set between the options. There is a count of how many students cited this choice in any of the three notes.

Diagram 7 Behavioral models of students during chess lessons. It was allowed to mark no more than three answer variants.
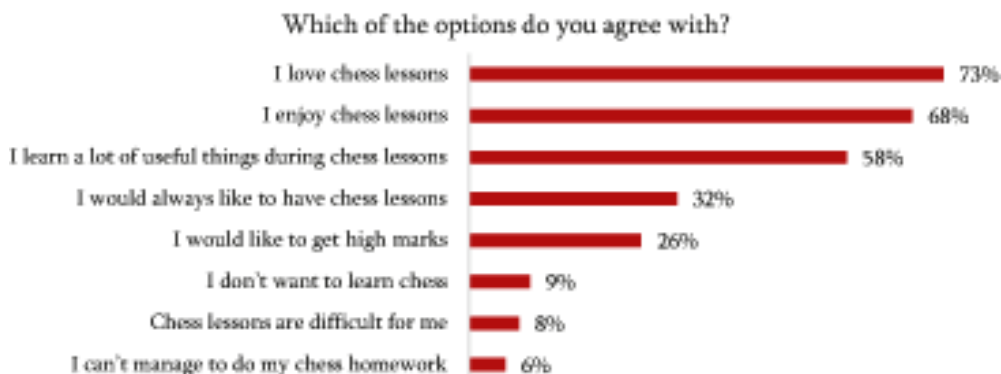

Diagram 6. Settings for chess lessons. Percentage of those who marked this statement.
No more than three statements were allowed to be noted

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Table 1

Average values of the chess test for those who marked and did not mark this setting and the results of t-tests

The number of correctly solved problems with weighted assessments	a. I enjoy chess lessons	Not mentioned	Mean	**3.59**
		Mentioned	Mean	**4.61**
	b. I don't want to learn chess	Not mentioned	Mean	**4.37**
		Mentioned	Mean	**3.38**
	c. I love chess lessons	Not mentioned	Mean	**3.84**
		Mentioned	Mean	**4.45**
	d. I learn a lot of useful things during chess lessons	Not mentioned	Mean	4.33
		Mentioned	Mean	4.24
	e. I would like to get high marks	Not mentioned	Mean	**4.50**
		Mentioned	Mean	**3.64**
	f. Chess lessons are difficult for me	Not mentioned	Mean	**4.41**
		Mentioned	Mean	**2.61**
	g. I can't manage to do my chess homework	Not mentioned	Mean	**4.38**
		Mentioned	Mean	**2.54**
	h. I would always like to have chess lessons	Not mentioned	Mean	**3.92**
		Mentioned	Mean	5.05

What do you usually do during chess lessons?

I pay attention to the teacher's... — 88%
I am delighted of the idea of... — 70%
I'm thinking of how I'll do my... — 28%
I am talking to my friends — 19%
I am waiting for the bell time — 12%
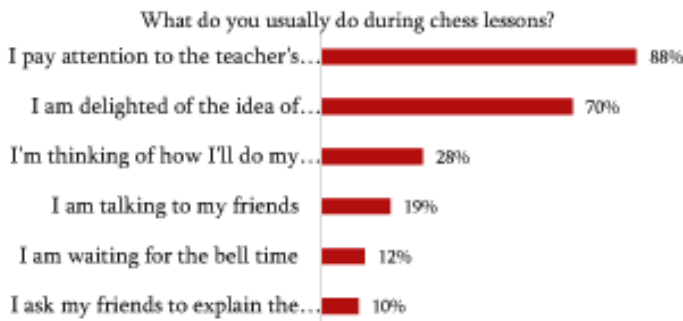I ask my friends to explain the... — 10%

Diagram 7. Behavioral models of students during chess lessons. It was allowed to mark
no more than three answer variants

Three behavioral models have a statistically significant effect on chess skills: those students who checked "I'm waiting for the call" have statistically significantly worse chess skills than those who did not check this option. The same is true for those who checked "I talk to my friends." And those who checked "I pay attention to the teacher's explanations of the lesson" statistically significantly have better chess skills than those who did not check this option.

Two possible answers: "b. I'm thinking about how I'm going to do my homework." and "I'm excited about the idea of playing chess" are on the edge of the commonly accepted level of statistical significance of 0.05. The first of them reduces the level of chess skills, and the second increases it.

The only behavioral model for which no statistically significant effect on chess skills was found is "f. I ask my friends to explain this lesson to me."

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Table 2

**Average values of the chess test for those who noted and did not note
this behavioral model and the results of t-tests**

Settings for chess lessons	Not checked	Noted	Values and stats t-test significance
a. I am waiting for a call.	4.45	2.97	t(476) = −4.949 p = .000
b. I think about how I will do my homework.	4.40	3.96	t(476) = −1.947 p = .051
c. I'm talking to my friends	4.41	3.72	t(476) = −2.679 p = .009
d. I pay attention to the teacher's explanation of the lesson	3.06	4.47	t(476) = 5.046 p = .000
e. I'm excited about the idea of playing chess	3.99	4.41	t(476) = 1.920 p = .056
f. I ask my friends to explain this lesson to me	4.30	4.10	t(476) = −0.573 p = .569

**The influence of students'
self-esteem on chess skills.**

To assess the impact of students' self-esteem on their chess skills, students were asked to choose one of three self-esteem options related to chess and chess lessons. In this case, the choice of no more than three options were also allowed. The proposed options for self-assessment and the percentage of students who marked these options are shown in Diagram 8 .

An assessment of the impact of the self-assessment options shown in Diagram 7 on chess skills is given in Table 3.

The data in Table 2 shows that five of the six self-esteem options have a statistically significant effect on chess skills, except for one — "e. My teacher says that I play chess well."
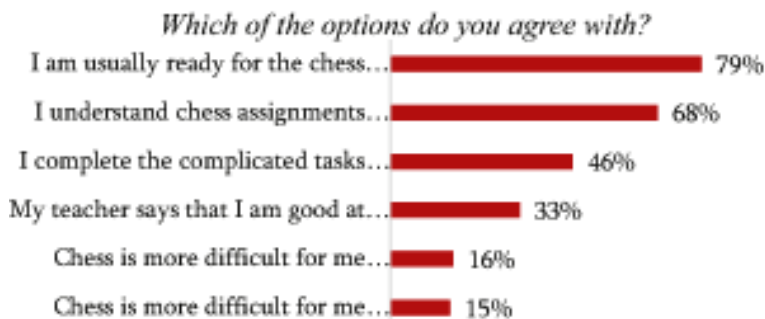

Diagram 8. Student self-assessments. No more than three options were allowed.

Table 3

Self-assessment options	Not checked	Noted	Values and stats t-test significance
a. I'm usually ready for chess lessons	3.83	4.40	t(476) = 2.208 p = .029
b. Chess is more difficult for me than for my classmates	4.52	2.97	t(476) = -5.474 p = .000
c. I quickly understand chess problems	3.63	4.59	t(476) = 4.362 p = .000
d. I successfully complete complex tasks	4.15	4.42	t(476) = 5.046 p = .000
e. My teacher says I'm good at chess	4.09	4.67	t(476) = 1.349 p = .178
f. Chess is more difficult for me than other subjects	4.49	3.06	t(476) =-5.208 p = .000

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Statistically significantly increases self-esteem chess skills: "a. I'm usually ready for chess lessons," "c. I quickly understand chess problems" and "d. I successfully complete complex tasks."

Statistically significantly reduce self-esteem chess skills: "b. Chess is more difficult for me than for my classmates" and "f. Chess is more difficult for me than other subjects."

Discussion of the results. The analysis of Diagram 2 shows that almost half of the students play chess once a week. Considering that the students take the chess subject twice a week, this is a quite high index. Discussions with teachers and chess methodologists revealed that such a frequency is not always expedient, as it can lead to a lack of curriculum.

Simultaneously, Diagram 2 shows that, despite the fact that 15% of respondents play chess once a month in class, this relatively low rate has the greatest influence on chess knowledge and skills. According to the experts**, allowing students to play once or twice a month as a way to summarize themes is the best option.** And considering the revealed linear trend, according to which the decrease in the frequency of playing chess in the classes increases the average grade of the chart solutions except for the "never" category, which drastically reduces the grade. It must be stated that this fully corresponds to the logic of a reasonable construction of a chess program. It must be stated that this fully corresponds to the logic of a reasonable construction of a chess program.

Referring to the sequence of solving problems and diagrams in chess lessons, it should be noted that the absolute majority of respondents solve diagrams and problems during every lesson (71%; Diagram 3). In contrast to the game's frequency indicators, increasing the frequency of solving tasks in lessons improves the average score on the chess test's chart solving. It's worth noting that, despite the frequency of solving tasks once a week (19%) is significantly higher than the frequency of solving tasks once a month (5%) within the surveyed team, however, solving tasks once a month has a slightly greater impact on the results of a chess test (Figure 5) Although the "*once a week*" and "*once a month*" frequencies are statistically different from the chart solution scores only in the "every class " and "never" categories. We assume that this learning technique is being replaced in the classroom by other types of learning activity, which requires additional investigation. However, it becomes clear that solving tasks on the chessboard should be considered a prerequisite for class effectiveness and a learning strategy.

The questions presented in Diagram 5 were mainly aimed at assessing students' motivation to study chess. The first two questions seek to uncover the emotional component of students' attitudes about chess class, as well as the manifestation of students' self-determination, the choice of which was made by an absolute majority. The question "*I learn a lot of interesting things during chess lessons*" is more related to the cognitive sphere of interest, but the questions "I don't want to learn chess" and "*I would always like to have chess lessons*" suggest a specific action. As a result, it may be inferred that they express the qualities of motivation's voluntary components. The desire to get a high grade is expressed by the external motivating factor of the students, in particular ideas about the teacher's assessment. "*Chess lessons are difficult for me*" and "*I can't manage to do my chess homework*" describe the manifestations of students' self-efficacy, where the question "*Chess lessons are difficult for me*" expresses the attribution of the complexity of the task, and the question "*I can't manage to do my chess homework*" expresses the attribution of abilities.

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In the results obtained, it is noteworthy that all the motivational components as a result of the binary analysis provided statistical certainty in terms of the impact on the solution of the chess test. (Tables 3). The only exceptions were responses to the question "*I learn a lot of interesting things during chess lessons*" for which the lack of statistical certainty is apparently connected to the subject's original content, although this issue needs further clarification. As a result, it's reasonable to state that motivating variables have a big influence on chess knowledge and skills.

Diagram 6 shows the answers to the questions related to the actions of the learners during the lesson (teaching and learning strategy) and their expectations.

In fact, the answers to the question "*I pay attention to the teacher's explanation of the lesson*" express the directive teaching strategy, in that case " *I ask my friends to explain the lesson to me*" can be attributed to the interactive strategy in some sense. The question "*I am talking to my friends*" is mostly related to discipline, but it can also express some aspects of interactivity. Given that the issue of homework has been repeatedly discussed within chess teachers, parents, and educators, the expectation related to " *I'm thinking of how I'll do my homework*" may characterize students' attitudes toward the issue.

The *students* ' attitudes on the possibility to play chess can be expressed in their responses to the question "*I am delighted of the idea of playing chess*." Finally, the question "*I am waiting for the bell time*" is intended to imply that *students* are bored. In fact, as can be seen in Diagram 6, incomparably high scores were recorded among the respondents in the answers to the questions "*I pay attention to the teacher's explanation of the lesson*" and "I am delighted of the idea of playing chess".

This may be the reason for concern in certain ways because when we evaluate these two questions separately, it turns out that students normally listen to the lesson delivered by the teacher in earnestly, but wait for the playing time. On the other hand, this assumption requires further investigation, and the evidence supplied does not let us conclude that it is correct.

Referring to the influence of these factors on the results of the chess test, it should be noted that the latter are statistically influenced by the negative answers to the questions "*I pay attention to the teacher's explanation of the lesson*", as well as "*I am waiting for the bell time*" and "*I am talking to my friends*", or rather the lack of positive answers (Table 5, 6).

The next set of questions, like the previous one, was mainly aimed at revealing motivational factors.

The answers received were "*I am usually ready for the chess lessons*", which can be considered as a series of **attributes related to the personal efforts** (unstable internal attribution), and "*I understand chess assignments quickly*", which is already an **assessment of personal abilities** (Stable internal attribution).

Questions such as "*I complete the complicated tasks successfully* ", "*Chess is more difficult for me than for my classmates*", "*Chess is more difficult for me than other subjects* " include ideas about complexity. Another question, "*My teacher says that I am good at chess*" was to expose the attribution of a teacher's external, shaping grade. (Diagram 9).

The effect of each position on the average scores of the chess tasks as a result of the t-test using are statistically significantly different in all pairs, except for the answers to the question "I complete the complicated tasks successfully". (Table 7, 8)

Of particular interest here is the fact that the lack of understanding of complexity, both in comparison with classmates and other subjects, has a significant impact on the results of the chess knowledge test.

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Another interesting aspect is that only positive responses to the questions "*I am usually ready for the chess lessons*" and "*I understand chess assignments quickly*" have a statistically significant impact on the test's outcomes. In other words, we may say that the ideas about complexity have a negative effect on chess knowledge, which we consider obvious, as those ideas have a negative effect on self-efficacy. To explain why the responses to the question "*I complete the complicated tasks successfully*" are an exception to the statistically significant difference, on one hand we must study the nature of the chess game, where success is almost non-existent and on the other hand, we assume that at this age the adequate metacognitive abilities that will allow us to reliably assess the fact of solving complex tasks have not yet been formed. That is, by resolving the problem, students no longer regard it as tough.

Thus, summarizing the research, we have come up with the following conclusions:

1. **Almost half of elementary school students play chess once a week, with the majority expecting to play more frequently. Simultaneously, given the teaching methodology and conditions, it may be desirable to enable students to play once or twice a month as a summary of a certain group of themes**. This result provides a foundation for proposing or lowering such frequency, as well as altering the teaching style to some extent, while taking into consideration the learners' expectations and establishing a reasonable programming sequence.

2. Most students solve tasks and chess-problems while learning the subject. **Increasing the frequency of solving tasks in each lesson increases the knowledge and skills of chess.** Therefore, it is obvious that solving tasks on the chess board should be considered a mandatory condition for the effectiveness of the lesson and an teaching strategy.

3. Chess students often pay close attention to the lesson explained by the teacher, which has a direct good influence on their chess knowledge, but experience with effective application of interactive teaching methods is limited. At the same time, it can be assumed that boredom and disorder during the lesson have a negative impact on the educational outcome. Considering these questions in the context of the lack of statistical indicators of impact on the interest of the chess class, it can be assumed that **it is desirable to develop new strategies to stimulate students' learning interests and link them to chess knowledge**.

4. In the structure of the educational motivation of the chess subject**, the positive attitude towards the subject prevails, as well as the indicators of the students' self-determination manifestation**. The latter can be considered as another indirect advantage of the chess subject, that is, making the right choice and managing one's own activities. As a result of the research, all the motivational components have provided statistical certainty in terms of the impact on chess knowledge. As a result, it should be stated that **motivating factors have a major influence on chess knowledge and skills**. This conclusion may be due to the fact that although the role and significance of motivational factors are obvious, the discovery of this pattern can be an indirect indicator of the reliability of the research.

5. Discussing the issue of chess education in the context of attributions, **it was found that among students the predominant were internal attributes, and considering the subject as complex has a negative effect on the results of the chess knowledge test and the solution of complex tasks is more related to internal effort and abilities, allocating less attention to the success factor, as in the instance of a game of chess**.

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