Խ.ԱԲՈՎՅԱՆԻ ԱՆՎԱՆ ՀԱՅԿԱԿԱՆ ՊԵՏԱԿԱՆ ՄԱՆԿԱՎԱՐԺԱԿԱՆ ՀԱՄԱԼՍԱՐԱՆԻ ԳԻՏԱԿԱՆ ՏԵՂԵԿԱԳԻՐ
УЧЕНЫЕ ЗАПИСКИ АРМЯНСКОГО ГОСУДАРСТВЕННОГО ПЕДАГОГИЧЕСКОГО УНИВЕРСИТЕТА ИМ. Х. АБОВЯНА

Հումանիտար գիտություններ №-3 (41) 2021 Гуманитарные науки

COMPARATIVE ANALYSIS OF THE STAGES OF SOLVING MATHEMATICAL AND CHESS PROBLEMS AIMED AT DIVERGENT THINKING OF PRIMARY SCHOOL LEARNERS

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Annotation. The article presents the chess-mathematical problems of primary interest to primary school learners, the stages of its solutions, as a result of which comparative analyzes are conducted.

Keywords. Mathematics, chess, condition, unknown, chess, finger, chessboard, version, diagram, stage, requirement, division, chess pieces.

Submitted to the editor 24.11.2021

SUMMARY

Since 2011, in the Republic of Armeniathe subject "Chess" has officially been taught in the 2nd-4th grades.In parallel with the analysis of the process of teaching chess in the primary school, such issues were singled out, which are mostly connected with the solution of the problems of mathematics envisaged in the same classes. More precisely, the clarifications of the issues ate raised below:

1) to get acquainted with the conditions of chess and mathematical problems;
2) to evaluate the given position in the chess problem, to separate the condition from the demand in mathematical problems in a similar way, to perform an analysis aimed at divergent thinking;
3) to make a plan for solving chess-mathematical problems;
4) to choose a method or methods for solving chess-mathematical problems;
5) to organize the solution of chess-mathematical problems in groups or individually;

6) to apply guiding questions during the solution of chess-mathematical problems;
7) to use even the wrong solutions to chess-mathematical problems for finding the right ones;
8) to summarize, analyze and conclude the solutions of chess-mathematical problems according to the categories of divergent thinking.

The aim of the article is to find out the results that the 4th graders achieved in solving the problems set by the subjects of "Mathematics" and "Chess" in the conditions of choosing similar methods aimed at divergent thinking.

The set of experiments and the venue. The process of solving the following mathematical and chess problems was tested at Yerevan AYB School using new teaching technologies. 40 participants from the 4th grades took part in the experimental workfrom February 2020 to October 2021. Mathematical-chess problems with their complexity correspond to the educational programs of the 4th grade of the Republic of Armenia.

Methods and materials. During the research the materials used include - methodological instructions provided by the given subjects of the primary school, the creative thinking tests (William's divergent thinking test), the interview method in individual lessons and statistical methods. For the study of divergent thinking, 3 tasks were set each, with 40 minutes of "Mathematics" and "Chess" subjects, taking into account the results of the initial experiments and the abilities of the children. The interview was conducted by the teachers teaching mathematics and chess in the given class in order to study the components of divergent thinking.

Introduction

In elementary school, students solve many problems in the process of teaching mathematics and chess. The article attempts to analyze and compare the stages and process of solving first mathematical and then chess problems in terms of divergent thinking.

> **Problem 1.** The girl found 36 mushrooms and the boy 28. It turned out that 6 of those mushrooms cannot be eaten. How many mushrooms did the children find to eat? [1, page 5]

Usually the analysis of the problem starts with the clarification of the following questions: What are the conditions mentioned in the request? Since the number of mushrooms collected by the children is alreadygiven separately in the request.The number of mushrooms that are not edible is also known. The demand of the problem is to find out the number of mushrooms children picked to eat. Surely, the problem can be solved in different ways, which serve as a basis for making judgments about the components of divergent thinking. We ask guiding questions in advance. 1) Do we know how many mushrooms the children picked together?, 2) Can we find out how many mushrooms they found together, 3) Do we have data on the number of mushrooms not to eat? 4) If we find the whole number of

mushrooms and we have the number of mushrooms not to eat, can we find the number of mushrooms to eat?

Now let's move on to the process of solving a similar chess problem in terms of content.

Problem 1. Consider the one-step chess problem (see Figure 1) where whites start at a given position [2, p. 46].

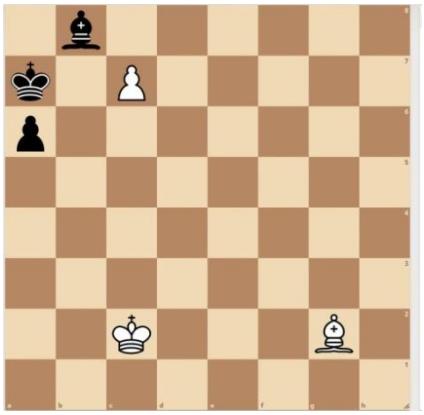


Diagram 1

In the following position, the whites must checkmate the blacks' king. Before solving the problem, one should carefully understand the position .To solve the problem, one must evaluate the position and first of all, the position of the kings. Since the whites are to checkmate in one step, it is enough to assess the position of the black king. It is necessary to notice the possible steps of the black king. Assessing the position, one must take into account the fact that the whites have a white Bishop that cannot check the black King. Therefore, it is necessary to find possible checks by whites. Here the method of excluding the solution of the problem can be used [3, p. 5], if we exclude the possibility of checking with the white bishop and the king, then it remains only to check with a pawn, who can check the black king only in case of being converted to a knight, as a result, the black king appear in the position of a checkmate.

During the solution of the mathematical problem the given condition and the requirement are separated, during the solution of the chess problem the given position is evaluated.When solving a mathematical problem, we try to find the solution to the problem through reasoning. In solving the chess problem, we used a method that helps to find the "checkmate" step. The chess problem is simple, but to solve it, the learner should imagine the possibility of converting a pawn, excluding other checkmates by whites' chess pieces beforehand. In both cases the learner should imagine the solution to the problem. In order to solve it, the vital necessary skills that should be include- creativity, ability to imagine the further steps beforehand, perception of a new position and assessment. Now back to the process of solving the mathematical problem observed in the same class.

Problem 2. The perimeter of a triangle is equal to 27 cm. The length of one of the sides is 8 cm, the other - 10cm: Find the length of the third party [1, Page 7].

Of course, in order to solve the problem, it is necessary for the learner to have some knowledge about the perimeter of a triangle as well as the unit of measurement of length. If the learner knows that the perimeter of a triangle is the sum of the lengths of the three sides of the triangle, then finding the solution to the problem leads to subtracting the lengths of the two sides from the given perimeter. The result is the length of the third side of the triangle.

Let's move on to the chess problem.

Problem 2. Consider a two-step chess problem (see Figure 2). In the given position, the launch is given by whites, following checkmate in 2 steps [3, p. 30].

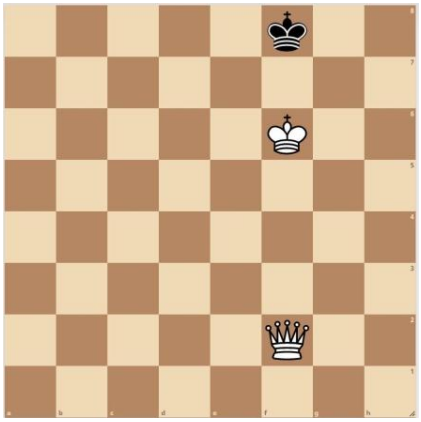


Diagram 2

To solve the problem, children first use the step-by-step transfer method. E.g. the step belongs to the blacks'. In the position, the children see two possible steps of the blacks' king. 1….Kf8-e8 and 1….Kf8-g8. After observing the mentioned steps of the blacks' King, children are to try to find out from which field the Queen of whites' is to checkmate the blacks' King. It is not difficult for fourth graders as they is familiar with checkmate positions. Finding the whites 2.Q e7#, 2.Qg7# steps the child infers in which field the white queen should be in order to simultaneously control e7 and g7 fields. Learners find the - 1.Qf2-a7 - step. It turns out that in order to solve the problem, it was necessary for the learner to know the checkmate positions with the queen. The difficulty in solving a chess problem relies on the idea of taking mental steps and imagining a position. However, when using problem-solving methods, it is easier to find a solution. Chess problems are solved on a "simple to complex" basis. The learner imagines the final position, then, according to knowledge perceived, creates that position from one or several steps in his/her mind, without moving the pieces. Solving such problems develops the child's creative mind, expands visual perceptions, refines the counting technique, strengthens the sense of time, therefore, knowing the final position, he/she takes a step to reach the final position he/she imagined or knew in a short time.

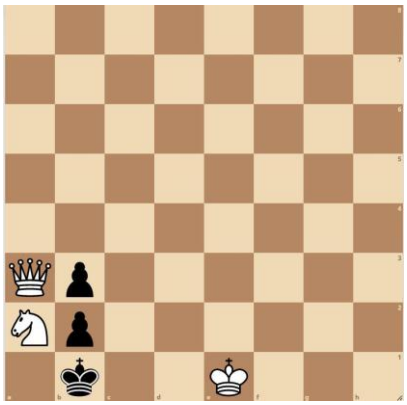
Learners are reminded in advance how to calculate the perimeter of a triangle and create a checkmate position with a queen. To solve the math problems children read the requirement of the problem, although there were children who needed additional explanation so that the teacher could "present the problem once more" and then many children could find the answer to the problem, and some could do so through guiding questions. As a result of applying the "Exclusion" method in the chess problem, the students found the Qa7 step leading to checkmate.

The students completed the task without moving the pieces, imagining the checkmate position. Then, without placing the pieces, they imaginedthe whites Ke6, Qe3 blacks' Ke8 position on the field, the requirement of which is the same: Is it possible to declare a two-step checkmate? In this case, having the answer to the problem, the children moved the pieces to the vertical E.

The pre-analyzed position helped them to imagine the next position, what the teacher had said before. The answer was correct, again with the help of step Qa7, the whites declare a checkmate in two steps. Let us now consider a mathematical problem that requires active imagination and logical operations.

Problem 3.A clock in Ashtarak strikes three times in four minutes. In how many minutes will it strike nine times? [4, p. 26]. To solve the problem, it is necessary for the learners to find the time (period) from one beat to the next. But before that, they must find the number of intervals between the three beats. Learners find that there are two ranges for three beats. Then they find the interval between the striking beats by dividing the 4 minutes into two equal parts. That is, it took 2 minutes from one beat to the next. Now let's move on to the problem requirement. How many minutes will the nine beats take? Again, the number of ranges must be determined first. Since there are nine beats, the children find the number of beats, which is one less than the number of beats. Then the number of ranges will be 8. The children found that it takes 2 minutes from one beat to another, so in the case of 8 intervals it will be 8x2 = 16 minutes.

In parallel, let's move on to the chess problem.



Problem 3. Now consider a two-step finger problem. In the given position (see Figure 3), the turn is for whites' to move, checkmate in two steps [3, p. 9].

Diagram 3

To solve this problem, let's try to use the methods of creating a checkmate position and step transferring. The point of the checkmate positioning method is to visualize the emerging checkmate position before finding a solution. It is necessary to apply the step first transfer method: Suppose the step belongs to the blacks'. They have 1….Kb1-a1, 1….Kb1-c2 and 1….b3xa2 three-step capability. If 1….Kb1-a1, then (if the queen of whites is left << a2. Na2-c3 #. And if 1… . Kb1-c2, then the whites will have the opportunity checkmate with the queen from the fields of e4, f5, g6, h7. If 1… .b3xa2, then in the resulting position the whites can checkmate only from the field d1, that is t say 2. Qd1#. If we combine the above judgments, it will become clear that the queen of whites must stay on the "a" vertical and at the same time be able to control any of the d1, e4, f5, g6, h7 fields. And this can be done by moving the queen to the a4 field. Then the solution to the problem is 1. Qa3-a4 step, after which the characters appear in the Zugzwang situation. If 1….Kb1-c2, then 2. Qa4-e4#, 1….b3xa2 will be followed by 2. Qa4-d1#, and 1….Qb1-a1 with 2. Na2-c3#:

As a result of this type of study, it turned out that additional skills are required by the learner when solving a chess problem. To recite: 1) imagining the given position in mind, calculating the approximate values of the pieces, 2) moving them in mind without touching the pieces, 3) imagining each new position in mind, discussing and calculating possible steps in the new positions, 4) seeing intersections of the steps of the pieces, 5) to checkmate the opponents King in the current position 6) to create mental checkmate positions, 7) to find all possible steps of the opponent.

With the above-mentioned logical operations, children are able to solve mathematical-chess problems by following the same logical operations. It turned out that children solve the chess task clearer and faster than the math one. The reason is poorly connected with the peculiarities of mathematics and chess. The solution of a math task or problem presupposes a precise calculation, which leads to at most one answer in elementary school, and in the case of chess we can say that the directions of calculation are very different.

In any position, the opponent has many opportunities to take steps, so the child must be taught the ability to take all the steps mentally. Of course, the children see the pieces on the chessboard, but they cannot move them, using the step transfer method, throwing the opponent into the Zugzwang situation and winning in two steps. This is why the development of a child's two-way thinking is vital, when he/she not only observes his step, but also all the possible steps of the opponent and mentally imagines the position, evaluates it and creates checkmate positions that he/she initially imagines. The listed skills are developed in the process of solving chess problems, which are useful in solving mathematical problems, too. In addition, during the game of chess, the learner constantly calculates how many points he/she has. For example, one can count how many points each side has in the starting position. The learner adds the approximate values of the pieces in his/her mind, of course, for

convenience, he/she starts with the pawn-8 points, after which increases the value of rooks - 10 points, total number is 18 points. Then he/she adds the values of four light figures, 4 pieces of 3 points, that is, 12 points, total number is 30 points. In the end he adds the value of the queen equal to 9 points, final number is 39 points.

During this calculation, the learner acquires a preliminary knowledge of the approximate values of the pieces, the rest, while imagining, he/she performs in his mind the addition, possibly multiplication operation, without writing or seeing numbers. A child playing chess visually calculates which piece controls the most fields, which makes him/her active, and he/she compares which piece controls the most fields with his opponent. Unlike chess math exercises and problem solving, the learner's eye sees the numbers or writes them on his/her own. It can be said that due to the solution of chess problems, the learner develops the ability to turn images into numbers and to act on them [8]. Solving chess problems develops a series of static pieces - imagining and seeing the trajectories of their movement, which is also a very important skill, especially when solving problems related to movement; it is also possible when solving geometric problems.

The process of solving chess-mathematical problems was studied with an individual approach through an interview. After recording the personal data of 40 students, the arithmetic mean of the data was calculated to give a general idea of divergent thinking. [5]

Since divergent thinking involves the **fluency of thinking** [6], we mean that it is a characteristic of speed, which indicates the performance of actions in accordance with the requirements of the problem in a given time, the next transition for finding a large number of solutions. As an indicator we have chosen the number of steps taken sequentially per unit time when solving both mathematical and chess problems. The duration of one lesson (40 minutes) is defined as a unit of time for fluency of thinking and other components.

As for the **flexibility of thinking** [6], we can say that it shows the number of out-of-standard but on-demand actions at the specified time. Observe the movements of the pieces with a different approach. For example, to checkmate other ways. Non-standard thinking. See what else can be done so that the opponent does not understand (backup step).

Let us now turn to the **originality of thinking**. Thinking creativity shows how much the child sees the whole playing field, the possible movement of the pieces from the opponent.

The **elaboration of thinking** [6] describes one of the primary characteristics of a child as the process of discovering cause-and-effect relationships involved in chess moves or actions involved in solving a mathematical problem.

Name: [6]. What is the name of each chess or math problem given by the learner (one or two words or phrases)?

Characteristics of divergent thinking (According to F. Williams)	Average data of the step-by-step solution of mathematical problems of forty 4th grade students according to the characteristics of divergent thinking	Average data of step-by-step solution of chess problems of forty 4th grade students according to the characteristics of divergent thinking	Characteristics of divergent thinking (According to F. Williams test)
1) Fluency of thinking or fluent thinking	4	5	6
2) Flexible thinking (flexibility of thinking)	6	8	7
3) Originality of thinking (thinking creativity/originality)	3	4	5
4) Elaboration of thinking	6	8	5
5) Naming	4	3	5

The study of correlation relationships shows:

1) The connection between mathematics and chess is 0.9065.

2) The connection between the components of chess and Williams' divergent thinking - 0.5353.

3) The relationship between the components of mathematics and Williams' divergent thinking is 0.5783.

Thus, a comparative analysis of the stages of solving mathematical-chess problems shows that the actions included in the mathematical-chess problems are based on almost the same logic [9]. It can be assumed that in terms of correlations, their data are quite close to each other (correlation coefficient - 0.9065). The comparison of the components of divergent thinking in mathematics showed that their relative correlation was 0.5783, and the correlation of divergent thinking in chess showed 0.5353. These differences are less pronounced in specific features, as the game of chess is more the product of imagination and Williams' divergent thinking test is more based on imagination. [7].

In both cases it is necessary to evaluate the position, and in the case of mathematics it is necessary to clarify the given condition and requirement as much as possible. As for the solution of math and chess problems, it can be stated that although the same methods have been used, they still have their specific applications.

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ԱՄՓՈՓՈՒՄ

ԿՐՏՍԵՐ ԴՊՐՈՑԱԿԱՆԻ ԴԻՎԵՐԳԵՆՏ ՄՏԱԾՈՂՈՒԹՅԱՆԸ ՄԻՏՎԱԾ ՄԱԹԵՄԱՏԻԿԱԿԱՆ ԵՎ ՇԱԽՄԱՏԱՅԻՆ ԽՆԴԻՐՆԵՐԻ ԼՈՒԾՄԱՆ ՓՈՒԼԵՐԻ ՀԱՄԵՄԱՏԱԿԱՆ ՎԵՐԼՈՒԾՈՒԹՅՈՒՆ

ԿԱՐԱՊԵՏՅԱՆ Վ.Ս., ՄԻՍԱԿՅԱՆ Ս.Զ., ՍԱՐԳՍՅԱՆ Շ. Գ.

Հայաստանի Հանրապետությունում 2011 թվականից 2-4-րդ դասարաններում պաշտոնապես դասավանդվում է «Շախմատ» ուսումնական առարկան: Կրտսեր դպրոցում շախմատի դասավանդման գործընթացի վերլուծություններին զուգահեռ առանձնացվել են այնպիսի հարցեր, որոնք առավելապես կապված են նույն դասարաններում նախատեսված մաթեմատիկայի խնդիրների լուծման հետ: Ավելի կոնկրետ նկատի ունենք ստորև առաջադրված հարցերի պարզաբանումները. 1) ուշադիր ծանոթանալ շախմատի և մաթեմատիկական խնդիրների պայմաններին, 2) գնահատել տրված դիրքը շախմատային խնդրում, նմանատիպ ձևով մաթեմատիկական խնդիրներում առանձնացնել պայմանը՝ պահանջից, կատարել

դիվերգենտ մտածողությանը միտված վերլուծություն, 3) կազմել պլան շախմատային և մաթեմատիկական խնդիրների լուծման համար, 4) ընտրել մեթոդ կամ մեթոդներ շախմատային և մաթեմատիկական խնդիրներների լուծման համար, 5) խմբային կամ անհատական տարբերակով կազմակերպել շախմատային և մաթեմատիկական խնդիրների լուծումը, 6) կիրառել ուղղորդող հարցեր շախմատային և մաթեմատիկական խնդիրների լուծմանը ընթացքում, 7) օգտագործել շախմատային և մաթեմատիկական խնդիրների նույնիսկ սխալ լուծումները ճիշտ լուծումներ գտնելու համար, 8) ամփոփել, վերլուծել, եզրակացնել շախմատային և մաթեմատիկական խնդիրների լուծումները՝ ըստ դիվերգենտ մտածողության կատեգորիաների։

РЕЗЮМЕ

СРАВНИТЕЛЬНЫЙ АНАЛИЗ ЭТАПОВ РЕШЕНИЯ МАТЕМАТИЧЕСКИХ И ШАХМАТНЫХ ЗАДАЧ, НАПРАВЛЕННЫХ НА ДИВЕРГЕНТНОЕ МЫШЛЕНИЕ МЛАДШЕГО ШКОЛЬНИКА

КАРАПЕТЯН В. С, МИСАКЯН С. З., САРГСЯН Ш.Г.

В Республике Армения с 2011 года предмет «Шахматы» официально преподается во 2-4-х классах общеобразовательных школ. Параллельно с анализом процесса обучения шахматам, в начальной школе были выявлены некоторые вопросы, которые в большей степени связаны с решением математических задач в тех же классах. Более конкретно мы имеем в виду разъяснения приведенных ниже вопросов. 1) Внимательно ознакомиться с условиями шахматных и математических задач. 2) Оценить данную позицию в шахматной игре, аналогично отделить условие от требования в математических задачах, провести анализ, направленный на дивергентное мышление. 3) Составить план решения шахматно-математических задач. 4) Выбрать метод или методы решения шахматно-математических задач. 5) Организовать решение шахматно-математических задач групповым или индивидуальным методом. 6) Задавать наводящие вопросы при решении шахматно-математических задач. 7) Использовать даже неправильные решения шахматных и математических задач, чтобы найти правильные решения. 8) Обобщать, анализировать, решать шахматно-математические задачи по категориям дивергентного мышления.

Approved for publishing by PhD, lecturer Marianna Amiraghyan,
08.12.2021թ.