v. 2, n. 12, 2022

International Journal of Human Sciences Research

SUDOTIX GAME: A SIGNIFICANT PROPOSAL FOR EXERCISES WITH INTEGER OPERATIONS

Thiago Nanetes Ferreira
Graduating from the Mathematics Course at the institution: Universidade Estadual Paulista-UNESP

Rita de Cássia Pavan Lamas
Advising Professor: PhD, Universidade Estadual Paulista -UNESP
Funded by the Dean of Graduation/ UNESP (prograd)

Abstract: In the Mathematics project of the Institute of Biosciences, Letters and Exact Sciences of São José do Rio Preto, together with the Unesp Teaching Nucleus Program, one of the objectives is the full participation of undergraduates in the daily life of a state school in the interior of the State of São Paulo, providing them with opportunities to experience teaching practices that overcome the problems of teaching and learning mathematics. In this work, a research was carried out on mathematical games to work with the object of knowledge, integers, and an experience was presented that exemplifies the teaching practice with an original mathematical game, named Sudotix in the seventh years. The board game was inspired by three other games: Sudoku, Matix and Magic Square. The theme of the game allowed us to work with objects of knowledge: ordering integers, notion of a Cartesian plane, addition and subtraction operations on the set of integers. The game was applied in the problem solving approach and adapted for remote teaching, due to the Covid-19 pandemic. The teacher (scholarship holder) acted as a mediator in the teaching and learning process, differently from the role of the teacher in traditional mathematics teaching. Students were encouraged to develop arithmetic thinking. They effectively participated in the classes, were motivated to do the operations and proposed different strategies in order to achieve the objective of the game.
Keywords: Mathematical games, Elementary School, Integer numbers, Problem solving, remote teaching.

INTRODUCTION

The UNESP Teaching Nucleus project, entitled: Support for meaningful learning in seventh grade mathematics teaching, developed in 2021, aimed to serve Elementary School students at a State School in the interior of the State of São Paulo, in which the scholarship students worked in the seventh years (A, B and C), with 38 students in each class.

Due to the Covid-19 pandemic, the scholarship holders experienced a didactic proposal with the students of the partner school in remote teaching, being mediators of the teaching and learning process.

One of the biggest challenges in teaching mathematics is to encourage students to develop logical reasoning, critical thinking and autonomy. In remote teaching, this worsened, requiring the teacher to seek alternatives. Mathematical games can promote meaningful learning in a playful way both in the school environment and outside it.

> To teach through games is a way for the educator to develop more interesting, relaxed and dynamic classes, being able to compete on equal terms with the countless resources that the student has access to outside of school, awakening or stimulating their desire to attend regularly the classroom and encouraging their involvement in activities, being an agent in the teaching and learning process, as they learn and have fun, simultaneously. (SILVA, 2005, p. 26).

Also the proper use of the game in the classroom "[...] is the possibility of reducing the blocks presented by many of our students who fear Mathematics and feel unable to learn it" (BORIN, 2007, p. 9).

In view of this, a research was carried out on mathematical games to work with the object of knowledge, integers. In this work will be presented, in particular, the experiences related to the basic operations of addition and subtraction in the set of integers, with the proposed mathematical game named Sudotix, together with the partner school in the aforementioned project. This practice made possible an alternative capable of streamlining teaching, even if remotely.

METHODOLOGY

The Sudotix game was proposed to strengthen the learning of content involving addition and subtraction operations in the set of whole numbers, according to the math skills EF07MA03 and EF07MA04 (BRASIL, 2018). It was based on three others: Matix (UNESP IBILCE, 2018), Sudoku (QUINELATO, 2015) and Quadrado Mágico (DEDOPULOS, 2013).

The material consists of: 1 board (Figure 1), where the lines are represented by numbers from 1 to 9 and the columns are represented by letters from A to I; 16 pieces already fixed on the board with negative and positive numbers; 48 pieces with negative and positive numbers. Column I contains the values that must be the sum of the elements of each row (or approximately) and row 9 contains the values that must be the sum of the elements of each column (or approximately). Your objective is to accumulate the fewest points, which means that the team that least deviates from the value of the sum corresponding to that row/column will win the game.

The rules of the game are: 1. each team will have 24 pieces (Figure 2), so that they have the same pieces; 2. Separated into two teams, before starting, it must be decided which one will have the rows and which one will have the columns. Next, a representative of each team must choose an odd or even number to decide which one will start; 3. the values that appear in column I and line 9 represent the sum of the respective line/column; 4. the pieces can only be placed in empty positions; 5. the team that starts the game may choose to place any piece respecting the restriction of the position established in rule 2. For example, if the Coluna team starts, the Linha team will be the next to play, however, it must pay attention to placing the part only in the row corresponding to the column in which the last part was added; 6. with the board duly filled in, the students themselves must calculate the points obtained in each row/column. For this, the sum of the row/column must be calculated and analyzed as follows: the sum of that row/column will be considered only if the error between the sum obtained and the sum fixed on the board is less than 10 units. In this case, the team will accumulate the pre-defined sum score always with a positive sign. Otherwise, it will have 100 points in the respective row/column; 7. the wild pieces reverse the sum sign of that row/column that are fixed; 8. when it is not possible to apply rule 5, the team whose turn it is to play may again allocate any piece respecting the position restriction established in rule 2.

Two classes (one hundred and fifty minutes) were used for the application of the game. The first class was used to learn the rules and discover the game's strategies. With the help of the scholarship holders, the students read the rules and discussed until their doubts were resolved. At the end of the game, students were asked to fill in a table (Figure 3) with the sum obtained in each row/column and, according to rule 6, the score achieved in each row/column. In the second class these data were analyzed.

THEORETICAL REFERENCE

The Paulista Curriculum emphasizes the use of mathematical games methodology.

> Games help students socialize, encourage teamwork, seek mutual cooperation, that is, encourage interaction between peers. In the same way, as games establish rules that represent limits, this helps them learn to respect the numerous solutions for the same situation, in addition to questioning their mistakes and successes. (SÃO PAULO, 2019, p. 314).

The proper use of games favors the acquisition of knowledge, meeting one of the objectives of the project mentioned above.

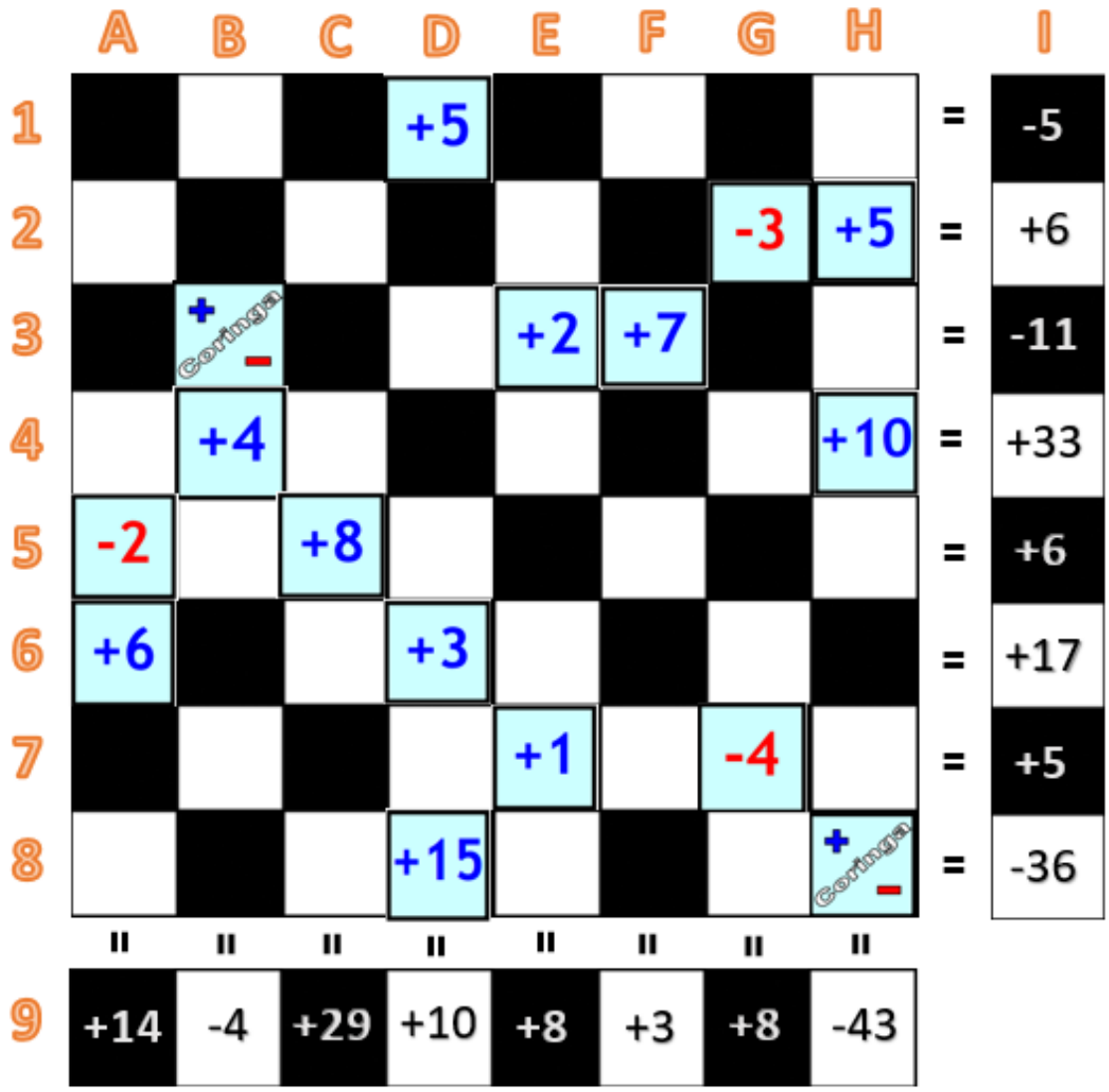

Figure 1 - Game board.

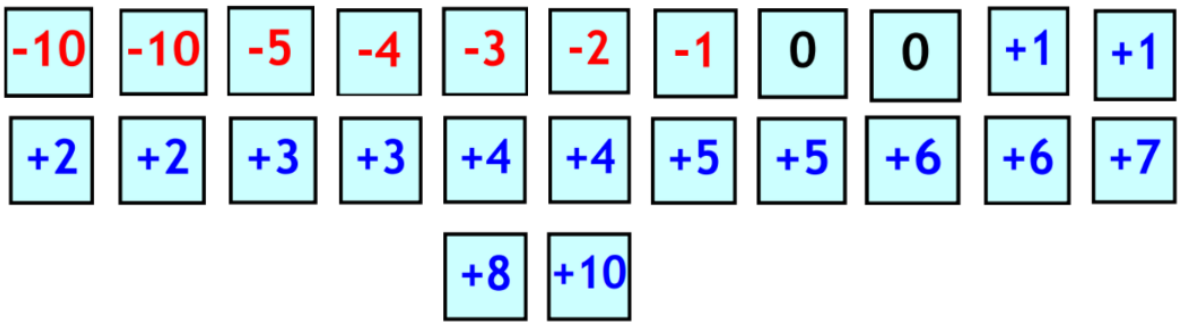

Figure 2 - List of parts that make up the game.

Line Team

	Pre-fixed values	Results	Punctuation
I1	-5		
I2	+6		
I3	-11		
I4	+33		
I5	+6		
I6	+17		
I7	+5		
I8	-36		

Column Team

	Pre-fixed values	Results	Punctuation
A9	+14		
B9	-4		
C9	+29		
D9	+10		
E9	+8		
F9	+3		
G9	+8		
H9	-43		

Figure 3 - Table with sum of both teams.

> (...) any game can be used when the objective is to propose activities that favor the acquisition of knowledge. The issue is not in the material, but in the way it is explored. It can be said, therefore, that any game works, but not just any way. For us, playing isn't just fun, and winning isn't just about luck. This means affirming that, regardless of the game, the action of playing that we value must be committed and coordinated with both actions already carried out and future ones, corresponding to a set of intentional actions integrated into the system as a whole. (MACEDO, 2000, p. 24).

The Problem Solving approach was used in the application of the games, as it is adequate to develop a critical posture in the face of any situation that requires an answer.

> The student's posture in front of a game is the same as that of a scientist in search of a solution to a problem, both leave for experimentation or attempt, after this phase, they begin to collect data that can influence or change situations and formulate hypotheses, so they set out to experiment and observe what happens, reach their conclusions and verify their hypotheses. Logical reasoning is one of the priority goals of mathematics teaching and the game aims to develop it. (BORIN, 2007, p. 8).

In the intervention with games, even via Google Meet, the scholarship holders induced the students to use the four steps, based on Borin (2007) and Macedo et al. (2000): careful reading of the game rules to understand what is allowed and possible, what you want with the game, and what the game materials are; game practice and strategy building; game practice with problem-situations resolution; verification of the efficiency or otherwise of the strategies.

In this way, the execution of these steps in the use of the game sought to favor the good performance of the player, because in this case, the game was considered as a problem whose solution is the discovery of strategies to win. Each move triggers a series of questions, such as: Is this the best strategy? Is it the only possible move? Made mistakes? Which ones?, through which the scholarship holders evaluated whether the students knew and understood the mathematical contents they wanted to approach with the game.

RESULTS AND DISCUSSION

One of the difficulties considered relevant was the application of the game in the remote format, since the students would not have direct contact with the material. Once the columns were identified with letters and the lines with numbers, the students were able to point out the position in which they wanted to place the piece, and then it was cut from the slide by the scholarship holders and placed on the board.

The students were divided into two teams. The game was started by the Line team. A player chose the +7 piece at position A1. Then, in the turn of the team, the piece +10 in position A2 was chosen. As time went on, the students completed the board, respecting the turn of each team and the position of each piece. They had a little difficulty with the locomotion condition that was stated in rule 5, in which players must place their piece based on the last move. With the help, it was possible to observe that the students understood this rule better, because in the next plays there were moments when they corrected themselves, without the interference of the scholarship holders, making a collaborative work between the members that made up each team.

This way, the students were capturing the idea that the game brings that the choice of a piece influences the move of the other team. Thus, it was possible to notice some manifestations of competitiveness between the teams. The players expressed that they were doing mental calculations in order to reach the goal, making the match more fierce and interesting. For example, when the Coluna team placed the piece +6 in the C8 position, a student from the Linha team commented "Don't do that to me! How do you put that there?", since there are only three more positions available in this line, which would influence the sum. "We're tangled up", comments another member of the Linha team. The Coluna team celebrated with laughter. Next, it is the Line team's turn to play, so it accommodates the -10 piece in another position on this line in order to decrease the units added by the opposing team. The Linha team realized the difficulty in using the available parts.

At another point in the game, on the Line team's turn, a member said "I want the -4 piece". Another indicated +2 in the chat. He reinforced again the first "No. Please give me a chance". With that, they agreed to use -4. The most interesting thing is that in this move, the student sees the chance to complete this line and then does it, managing to get as close as he wanted to the sum of that line.

In the following class, the data indicated in the table were checked with the registration of the results of the game brought by the students. We noticed that they were able to perform the calculations correctly, although they had difficulties regarding rule 7. The Linha team approached the sums as much as desired in three lines, totaling 470 points, and the Coluna team in four columns, with 445 points. This way, the team won the game with a difference of 25 points.

The change from traditional teaching to the game methodology motivated the participation in these classes. This can be seen in the students' statements: "Next week, I will have to go to school in person, but I will try not to miss school, even if I arrive late" and "Class is good today".

FINAL CONSIDERATIONS

The shift from traditional teaching to the use of mathematical games encouraged students to work with whole numbers, even remotely. Understanding of basic operations has been improved. However, some students still prefer face-to-face teaching "You have to play this game in face-to-face classes, because here it is much slower".

We corroborate with Grando (2000, p.35) that some advantages of the use of mathematical games are in the fixation of concepts already learned, introduction and development of contents, creativity, among other factors.

REFERENCES

BORIN, J. **Jogos e resolução de problemas**: uma estratégia para as salas de aulas de matemática. 6 ed. São Paulo: IME – USP**,** 2007.

BRASIL. Ministério da Educação. **Base Nacional Comum Curricular**: educação é a base. Brasília, 2018.

DEDOPULOS, T. **Jogos Medievais** - Volume 1 - mais de 60 enigmas, ambientados na Idade Média, para desenvolver o raciocínio lógico. Rio de Janeiro: Ediouro Ltda, 2013.

GRANDO, R. C. **O conhecimento matemático e o uso de jogos na sala de aula**. 2000. 239 p. Tese (Doutorado em Educação) - Faculdade de Educação, Universidade Estadual de Campinas, Campinas, 2000.

MACEDO, L.; PETTY, A. L. S.; PASSOS, N. C. **Aprender com jogos e situações-problema**. Porto Alegre: Artes Médicas Sul, 2000.

QUINELATO, P. T. **Fazer e compreender no jogo Sudoku e em suas situações-problema: um estudo com alunos do 9º ano do ensino fundamental**. 2015. 221 p. Tese (Doutorado em Psicologia) - Instituto de Psicologia, Universidade de São Paulo, São Paulo. 2015.

POLYA, G. **A arte de resolver problemas**: um novo aspecto do método matemático. 2 ed. Rio de Janeiro: Interciência, 1975.

SÃO PAULO. Secretaria de Educação. **Currículo Paulista**: uma construção colaborativa, 2019. Disponível em <https://efape.educacao.sp.gov.br/curriculopaulista> . Acesso em 2 Ago 2021.

SILVA, M. S. **Clube de matemática**: jogos educativos. 2.ed. Campinas: Papirus, 2005.

UNESP IBILCE. **Jogos no Ensino Fundamental II**: 6º ao 9º Ano - Departamento de Matemática. Disponível em: <https://www.ibilce.unesp.br/#!/departamentos/matematica/extensao/lab-mat/jogos-no-ensino-de-matematica/6-ao-9-ano/>. Acesso em 18 Ago 2021.