

Game Theory in the Secondary Education — Ideas Relevant to Young People's Lives in the Social and Scientific Approach

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Abstract: Teaching middle school students with coordinating central and individual plans will be achievable. This is a good opportunity for Game Theory, because of the science-developed items are widely to used. Those students leaving the school, during their university studies, or their adult lives, they encounter life situations, the analysis of which this area of mathematics also deals. That is why high school students applied game theory to teach beyond the classroom environment pointer. After the historical review of the concepts the students are classified a wide range of examples to the situations discussed. My report presents the process from design to implementation.

Key words: game theory, educational goal, double game, matrix

1. Introduction

The social relevance: The time, knowing the social processes and the laws of nature, in the education is equally few. The teachers who teach in various disciplines, they receive a little opportunity for consultation, and professional discussions rarely happen in the indicated topic. The results of the social sciences and the natural sciences, the learners reach in isolated portions are difficult to connect for them. In the secondary education a significant part the young hold the survival of the science and math lessons as a primary aspect. These facts cause internal stress for those who seek to raise awareness of science. Another source of increasing tension is the dynamic development of technology and science. This involves the intrinsic transformation of society, consolidation or blurring of certain social values. Today, it increased its topicality, that it's difficult to find disciples in the "Pure science laboratories" while the science-made devices in the household, transport, and in medicine are classified among the basic needs of members of the society. The game theory gives the opportunity, which connected to several scientific areas, may build a bridge between the sciences while it uses the tools of mathematics.

2. The Pedagogical Program

2.1 Educational Goal

- contacts, empathy, cooperation
- the need of compliance, change, rules, agreements

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- discipline, orderliness, determination, commitment of responsibility
- failure tolerance, patience, perseverance, intrepidity, goal orientation
- success orientation, daring, risk-taking and prudence
- highlighting the essence, systematically thinking, logical thinking, analytical thinking
- concentration, sustained attention, memory, contemplation, creativity, imagination,
- bottom line highlighting, text analysis, reading comprehension, alternative survey
- grouping, organization

2.2 Instructional Goal

- multiple games grouping skill, finding common features within each game type
- analysis of differences in game types: consequences, justification and evaluation rule
- the formulation of the main considerations for individual games, analysis of strategies
- find winning strategies, analysis of algorithms and interpretation
- edification of games, search games making recognition a particular type of game
- Game Theory Story

2.3 Contact Individual Subjects

Among the subjects displayed in addition to physics the mathematics, history, social studies, literature, grammar, information technology, religion, ethics, biology, sociology, psychology and pedagogy.

2.4 Competencies to be Developed

The implemented program made it possible to establish and develop: the communication in the native language, arithmetic, mathematics; natural sciences; information technology, learning to learn, interpersonal and civic competences, entrepreneurial skills as well as cultural awareness.

2.5 Used Teaching Tools

During the planning session I was considering the availability of the motivating force to use technical devices for solving the manual, individual or group tasks. With this combination it is achievable to help students experience in addition the excitement of the learning process, the joy that our work gives, as well as recognize the possibilities given by the classroom environments.

2.6 Material Applications

Coin, writing instruments, paper, dice, wheels, fondant, chair, ICT devices: smartphone, computer, interactive whiteboard.

2.7 Methodological Toolbox

Individual work; students work in pairs, group work; frontal work; an independent research.

3. Presentation of the Program

The goal is to understand the social structures using the methodology of game theory. The target audience was a group of junior high school students. The work took place in consecutive physics lessons, the life situations, the students tried between real and organized conditions using ICT tools, simulations or thought experiment. The students have worked the analysis of variations within a given game type, they have been completed the examination of the consequences with explanation, evaluation of the rule. I assumed that it is important that the

creation and interpretation of the concept of mixed strategy is based on a random basis. The lessons learned from the deduction of the games, of a creation the game, investigation and identification in case of different interactions was carried out by the students. The planned implementation of nine lessons, it was a great help that students were proficient in the use of ICT tools, were active and helpful including the remaining parts of the home processing. In the first year the program was developed over 26 students. Although the students were motivated, at the beginning of lessons, or before a new type of game has been introduced we played a common game.

3.1 The Chocolate Game

Two chosen pupils have a box of chocolates. They have to decide what to do with the resulting sweets: Leave them in or out of the box. After the decision and action, they both drop their box. When deciding, they cannot see what their partner did with their own dessert. Examining both boxes, doubling the amount of chocolate found there. So students get each other’s boxes.

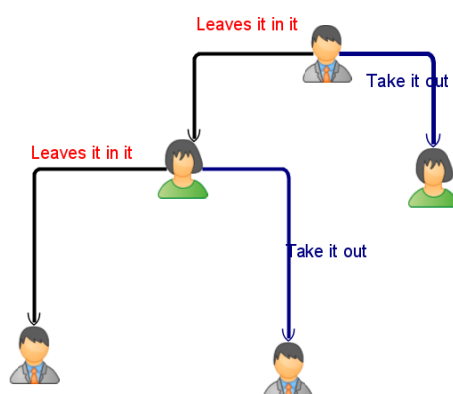


Figure 1 The Illustration of the Chocolate Game

Preferences matrix if A and B likes chocolate		 A	
 B	2;2 (C;C)	0;3 (C;D)	
	3;0 (D;C)	1;1 (D;D)	

Figure 2 The Illustration of the Chocolate Game

In those cases when the processing took place in groups the research happened by using online content, the students were searching for each concept by using a smartphone. For the benefit of the broadening the research and of game time, I have minimized the mathematical applications. I tried to realize my ideas, which I created during my planning on the occasion of implementation. However, any changes were made by reasons of interest of the group, or because of the actual real-life situations.

3.2 Thematic Description of the Implementation of the Program

3.2.1 The Basic Concepts of Game Theory and Decision Making Theory, Historical Summary

Ahead of the learning process, there was a short research on history of game theory. The research included on

theoretical scientists in the area of science, and in disciplines learning on theory. It took place in the first section to explore the game theory as a relationship between science, and mathematics, sports, gambling, politics....

3.2.2 To Define Games

The repetition of basic concepts of game theory (player, decisions, strategy) was followed by the creating of the decision table and its supplement. The students deepened the basic concepts by the analysis of everyday life situations. On this lesson the students got acquainted with determining a profit and a loss, with the interpretation of the payment course of concrete application examples. In this topic, we most often dealt with the two-player games, in the first time, faithfully to the history of progress, we began, with a sum of the constant, that is with the games based on the total conflict of interest between. Then we dealt with the trap situations which are important in the detection of social and an individual perspective. Such suitable trap situation interactions were interpreted by the students, and the list was expanded by examples from their own living space.

3.3 Students in the Decision-Making Dilemmas

I eat fast food or meals

Fast foods are fatigued, but delicious. Meal is healthy but not delicious.

I sell my beloved clothes or keep them in the closet

If I sell, I have to get away from them, but I can make others happy. If I do not sell it then it may be a nice memory but it will stand and dust in the closet.

I drink some liquor or coke in the party

If I drink alcoholic drink I'll be drunk but I feel good with my friends. If I'm sober about the coke, but it may not be a good mood.

3.4 Normal and Extensive Form of the Game

Understanding the dilemmas, during of analysis and comparison of the situations occurring in everyday-life, some of the students had a good, clear view on a trap-nature situation. This work was followed by interpretation of the games in extensive form: The sequence of the steps; processing and interpretation of the game tree. The students have learned the depiction of the games for each life situation in normal, that is to say a matrix, and in extensive, or graph is forms. Meanwhile, they have observed the significant consequences of the changes of terms and conditions. We have been carried strategic analysis by known examples of simple and overall experiences. Along with this we studied the limits and the opportunities of the number of possible moves.

3.5 Traveling in a Tram

You are on the tram where the ticket vending machine reads the following:

The ticket price is 300 HUF. We do not have a check. Thanks to honest customers that they have contributed to the travel costs. Do you buy this ticket?

Table 1 Traveling in a Tram

No inspector	Outlay
purchase	300
cadge	0

The ticket price is 300 HUF. Every tenth flight is checked. Who is not in possession of a ticket, is punished by an amount equal to twice the price of the ticket. Do you buy this ticket?

Table 2 Traveling in a Tram

Outlay			
	No inspector	There is an inspector	
purchase	300	0	300
cadge	0	600	600

3.6 Two-Person Zero-Sum Game with A Saddle Point

In the following step for the games classification consisting a total conflict of interest between parties we dealt by examining of the decisions in case of the parties have clear strategies. In such interaction the interests of the partners disagreed the most possible sharply. The parties involved in the interaction calculated the prize as a positive profit, and the losses a negative as profits. The amount of gain of the players is zero or a fixed value. The concept of the rational player for the students was a new knowledge, who aspires to dodge the possibility of the worst consequences based on the principle of the "least bad". That concept has proved "human" according to some of the students.

3.7 Two-Person Finite Games, and Games with Variable Amount, without A Saddle Point

The parties consisting of a total conflict of interest was followed by the analysis of games, where among the players there is not complete conflict of interest. The students have learned that in the games without saddle point, it hurts a player, if his opponent is informed that what kind of strategy he had chosen. Therefore, the goal for both players is to try to conceal the strategies from the other player. The students have recognized within a short time, that the parallel which is between of such games and divorce processes. Understanding the games without saddle point gave a new approach: It was discernible that during such series of decisions, the strategy of choice is worth to leave to chance, and mix with strategies by means of the randomness. It was new information, that a game, even though there is an optimal solution, may not be fair. From the practical examples, the military and sporting events and analogies observed in the movies have not been left out.

3.8 Games with Several Participants, the Evolutionary of Game Theory

Studying the evolutionary game theory the students learned about its origin. It shows a nice example of relations between sciences, that although the evolutionary game theory has biological origins, it was later also extended to social, economic and physical processes. The students have applied the evolutionary strategy on simple examples. They studied the stability of the game in multistep situations. Here the students met with TFT strategy, connecting the game theory and the teachings of Christ, also called as a Golden Rule. The main feature of the TFT is the forgiveness predisposition: as soon as partner in the interaction gives the sign of cooperation the other party is also open for cooperation. Playing the game many times the students have recognized that in a multi-step, multi-player game, one does not need always win to finally reach a good result. In the simple life situations the learners who have been playing according to the indicated strategy, may not have won, but it was a serene and enjoyable experience of events.

3.9 In the Elevator Door

You are at the same time with a partner in front of the elevator that is just starting. You can be polite, but you can get angry. The companion recompense may be accepting and rejection. How this interaction can be represented?

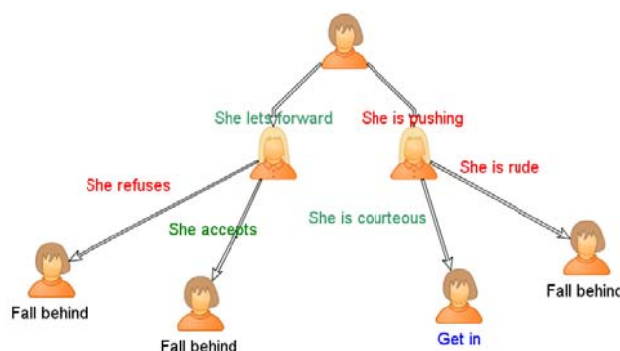


Figure 3 An Illustration of the Life Situation

4. Assessment

At the end of the work the students described the analysis of a chosen a type of game theory. They performed analysis of a chosen literary work. For the analysis, they selected the normal or extensive form, which they found more suitable in the given situation. They presented the analysis to each other. The program also helped students learn about their relationship with each other, science and themselves. I won this information when completed at the end of the test subject analysis.

5. Conclusion

The students live their lives in constant interaction. Among these interactions, in which the actors act as equal partners, and there are cases, where the participants spend lower or higher positions of power. We have searched for the project, how mathematics describes the strategic outcomes of interactions between peer-to-peer partners. By using examples from their own lives and reading, the students have come closer to the mathematics and game theory. Thus, the greater the probability, that strategic thinking is evolving, and to become a responsible person for decision making.

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