Develop reductive argumentation with the help of didactic games

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Abstract

Computer sometimes helps pupils with their homework. But usually at home is being used as "game machine". Pupils usually use computer for entertainment. There are many kinds of computer games such as: strategies, RPG, simulations, arcades or adventures e.t.c.. Most of such games have nice music and awesome graphic so kids like them very much. But most of them also don't teach mathematic. Maybe can we give kids such games which can teach them "solving math problem" with fun, not only at school, but also at home? In this paper I'll try to show the example.

I would like to present our project – pack of educational games for PC. Each of the games is such prepared to be attractive for children, but is based on educational math's games. It uses computer properties to make mathematic more fun. Pupils playing such game even don't notice that they are teaching mathematic. Every kid naturally want to win the game. He want to bit second player, and to do this he must solve math problem – he must discover winning strategies.

Key words: didactic of mathematics, reduction method, computer games, educational, games, math problem solving.

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Computer already settled in our houses. It serves to edition of texts, finding information in Internet, however the most often it is used to entertainment. Pupils often after lessons sit before computer to relax and play computer games. If it can be connect pleasure with useful? Maybe can we give kids such games which can teach them solving math problem with fun, not only at school, but also at home?

Math is associated from tasks solving. There is a lot of true in this sentence, because tasks played, play and will play in teaching of mathematics fundamental part**.**

There are many different classifications of mathematical tasks in literature [1], [2], [6], [8]. In all of them "*didactic games*" are displayed as separate type of tasks, which however can realize the functions of others types of math's tasks. This is one of basic property of didactic

games which can be used as training tasks, math's problem or educational "*provocation*" … .

What is it ***the game***? We can use notion of game as the action (the moves) executed by playing persons or teams (at least two), peaceably with settled forward the rules, which is the aim victory of one of playing persons (one of teams) [4].

Didactic game is specific game, which bases on basic function of the child's psyche, on need of play and this game influence on his intellectual actions consciously [3].

Rules of didactic game characterizes, that:

- realization of move peaceable with rules of game requires the realization the operation, which capture is the aim of teaching,
- every evaluation of strategy of game is connected to discovery of property or dependence, which perception is the aim of teaching [7].

Fact, that games imitating true fight influence on development of intellect remarkably, was well-known and recognized for many years. However it is hardly used in school teaching. It really recently, seeking the new methods of teaching, adapted to modern aims of education, some of didactics discovered the huge of didactic values of such games in process of math's teaching. [4] The utilization of the games is one of methods to make pupils more interested in mathematics, which inflicts, that their approach to this "*difficult*" subject becomes positive. This positive putting is the essential element of didactic success.

Currently didactic games, as a method of education, became more popular at schools. Usage such games has three main functions:

- motivating to undertake intellectual effort,
- didactic, they teach contents and the methods of mathematics,
- educational, they teach rules of team's work [4].

Mathematical didactic games have well-chosen mathematical contents and constructed principles of them lead to mathematical activities. Additionally they introduce element of rivalry.

At present "*traditional*" games more often are pushed out by modern computer games. This kind of software delivers entertainment mainly. The newest games have awesome, colourful graphic, trying faithfully simulate reality. They have well-chosen "*nice for ear*" sounds and music. And at final the most important fact - computer games are fully interactive. The player is the one who decides what and when must be done in virtual world. The technical possibilities of computer are able to cause that, every time this virtual world are different, unique, however peaceable with definite by author of game conditions.

The computer didactic game is able to connect values of both: either didactic game

and computer game. I would like to show one of such games, which teach reductive method.

Reductive method called also ***reduction*** is a method "*moving from end to beginning*". It is very useful in process of solving mathematical problems. In this method we start from the point we want to prove, from the question which was put in the task. Answering on question: "*what would it sufficed to know ...* ?", we formulate next questions, easier and more easier, answers of which would lead us to the solution of the task. Proceed until we got question, which is obvious to us [6].

This method ought to be teach not by standard demonstration, but across creation such situations in which this way of thinking can appear spontaneously or it can be discreetly provoked by teacher's question. One of such situation may be the intention of winning the game.

'Matchtaking' is the computer didactic game for two players. If there is no real opponent computer plays as the second player. The game consists in taking matches from the table, however principles are closely definite. Players establish before beginning of the game how many matches there are on table and how many of them can be maximally taken by each player in one turn (fig. 1). For example there will be 20 matches on table and each player can take up to 4 of them at once. Winner is this player who will take the LAST match.

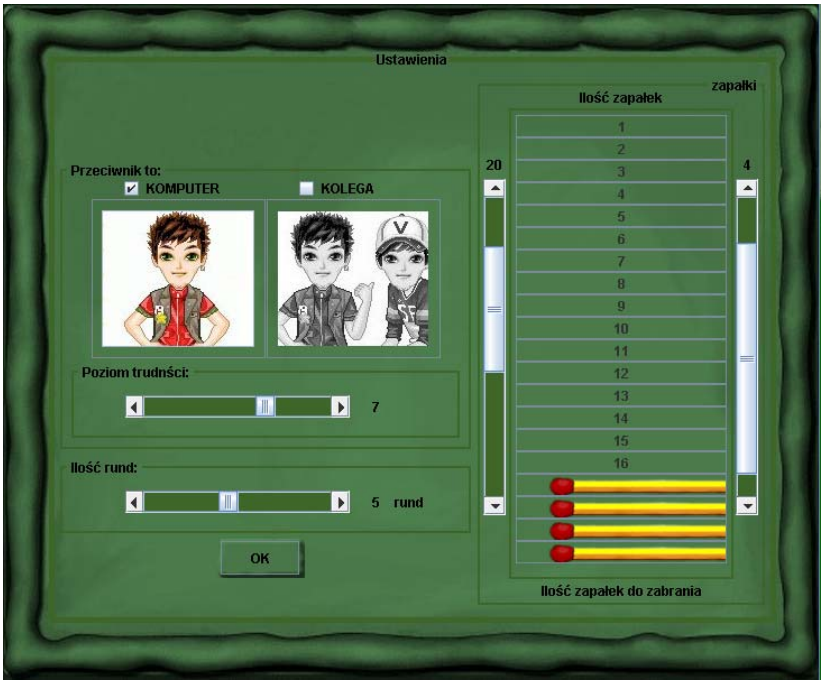

Figure 1

Player can establish the quantity of rounds in the game, and if the opponent is computer - additionally establish the level of the difficulty from 1 to 10. After confirmation this properties players cross to proper board (fig. 2)

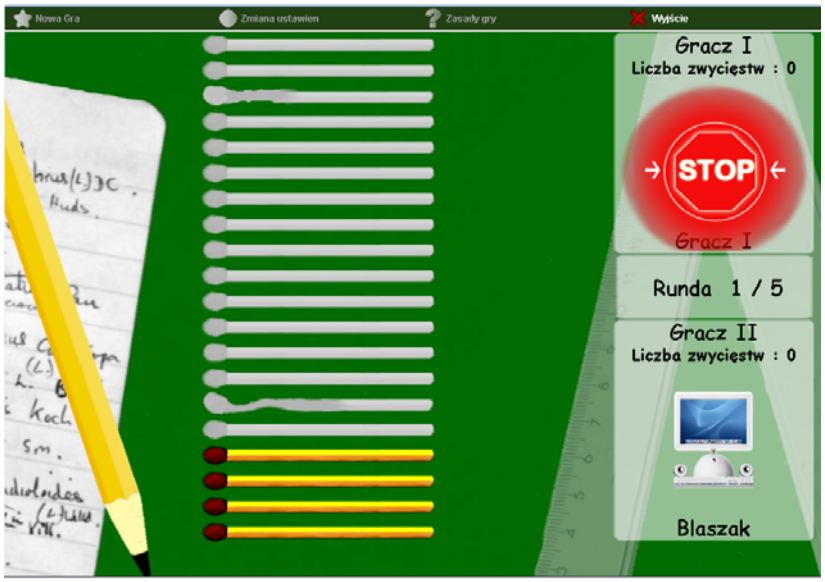

Figure 2

'Matchtaking' is the game connected with the reductive argumentation. The reductive method is also called the analytic method. It consists in this, that if we want to find the solution, we start from the "end point". In the case of the search of the solution the reductive method, we begin the reasoning from the question put in the task. Answering the typical question for the reduction „What would suffice to know", we formulate new questions, the most often easier, to answer which should give the solution of the starting task. If we are known answers on new questions, exchange them to next questions, on which are answers well-known or obvious to us. We resolve the task on numbers of the different tasks which lead to the solution of the task from which we went out on the beginning.

„*The scheme of the reductive reasoning is following in the case of the argumentation of statements. If by* ***F*** *we will mark foundations, and by* ***T*** *- the thesis, then we for such conditions:*

$$T_1, T_2, \ldots, T_n,\ T_1 \Rightarrow T,\ T_2 \Rightarrow T_1,\ T_3 \Rightarrow T_2,\ \ldots,\ T_n \Rightarrow T_{n-1} \text{ and } F \Rightarrow T_n.$$

At last, so every step of such reasoning is the formula of sufficient condition for the thesis, or different the already received condition with regard of the foundation of the statement, received postulates, definition and statements" [5].

The reduction is the very attractive and effective method which one uses not only near the argumentation because of this that:

- the thesis usually is one, and foundations several,
- one need the often only definition to the application of the sufficient condition for the thesis,

- there are generally far less statements with the set thesis than statements with given foundations.

We can equally well begin from the foundation near the argumentation as from the thesis, however the chance of the success is a lot of smaller. Taking under the attention all advantages of the reduction in mathematics itself, and also her beyond mathematical use in the situations of the everyday life, the fact becomes obvious, that you should teach the reduction at the school. And it should be teach early, in such situations where it results in the natural way from the constructed suitably didactic situation so it would be comprehensible and accessible for pupils. The game ***'Matchtaking'*** attends this postulate. The discovery its winning strategy is more effective of reductive reasoning. By the *winning strategy* in the game we understand the way of the conduct which guarantees the victory independently from the partner movements" [5].

Let's try to find out the winning strategy of ***'Matchtaking'***. Because there are many variants of properties of the game, we concentrate on one of them – there are 10 matches on table and each player can take up to 2 matches in one turn. At the picture 3 we number matches from 1 to 10, and we see we can take 1st or 2nd one (fig. 3). The winning is 10th match.

Figure 3

We want to take the match of number 10. The question is: *which match we should to take earlier, to be sure to take 10th match in my next turn, independently my opponent movement* ? It's suffice to take the 7th match, because if the partner takes one match (8th) this I will take the matches of number 9 and 10 and I will win. And if the partner takes two matches (8th and 9th), then I will take the last match – 10th, because only one will stay on table (fig. 4).

Figure 4

So, the next question is: *which match we should to take earlier, to be sure to take 7th match in my next turn, independently my opponent movement* ?

It's suffice to take the 4th match, with analogous reason as in the previous step. Leading this reasoning farther we uncover the next matches which taking guarantees us winning round (fig. 5).

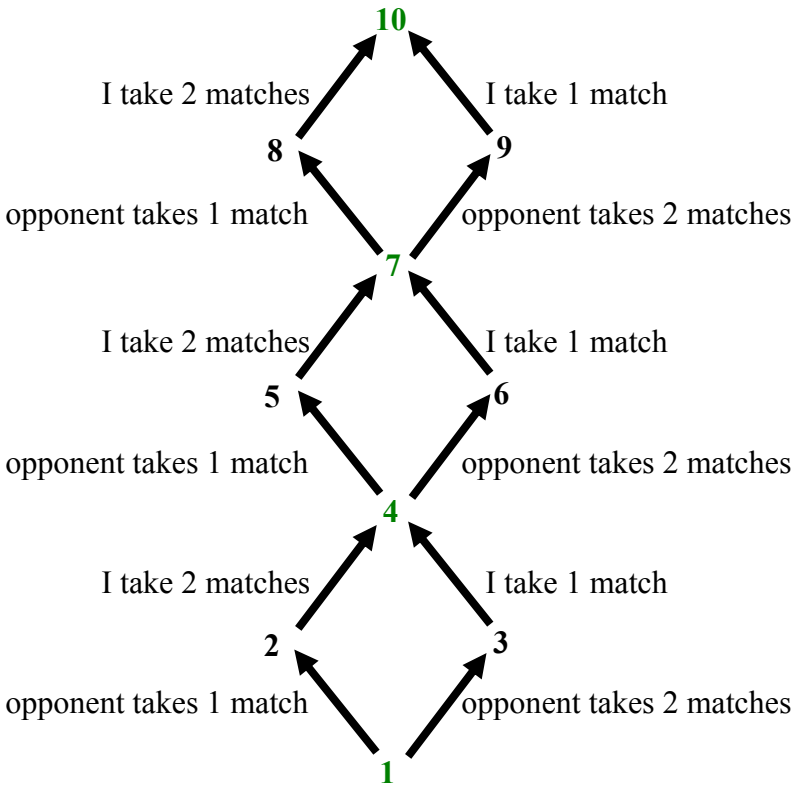

Figure 5

In the consequence of that we get full winning strategy: *Who begins the game and takes matches numbers 1, 4, 7 and 10 always wins*. The player who knows this strategy but did not begin the game, has such chances as the player beginning the game, because using partner chaotic movements with the large probability he can *jump into* strategic matches.

To emphasize the relationship of this strategy with reductive reasoning, it can be noticed, that we began reasoning from the match, which we take as the last one. We can obviously try to find out this strategy in the other way. Let's take the described situation once again, however let's begin searches from the beginning. In few steps we find out that such reasoning requires investigation of the large number of cases (in our situation more then 80), in which we can *get muddled up* very easily.

It is not possible to find out one strategy which will assure us the victory for all configuration of the game, but it is possible to find out such winning strategy for every accessible configuration separately.

Let's see what happened in similarly situation, in the case when there are ***n*** matches on the table, and can be taken up to ***k*** of them (**k < n**).

To take n^{th} match I have to take the match number ***n*-(*k* + 1)**. The next question is: *Which match I have to take to be sure that I will take the match of number* ***n*-(*k* + 1)**? The answer is: the match of number ***n*-2(*k* + 1)**. Leading this reasoning farther, we notice that certain regularity steps out. We notice that taking matches about numbers: ***n*-0(*k* + 1), *n*-1(*k* + 1), *n*-2(*k* + 1), *n*-3(*k* + 1), …, *n*-s(*k* + 1)** (when $s < \frac{n}{k+1}$) gives us the guarantee of the victory.

As you can see reductive reasoning is the most effective way to discovery winning strategy of this game even in global case.

Described game ***'Matchtaking'*** is part of collection of math's didactics games. Working over such project we realize that this product is dedicated for children. It is necessary to take care about graphic, music and sounds. Children are very demanding. If we want children to like this game, we should to make it look eye-catching and attractive for them.

Well-made educational game can became an object of interest even of the most demanding player. Under colourful, breath taking graphic, interesting music and the sound effects, in easy way we can "*smuggle*" mechanisms responsible for formatting logical and creative thinking as well as the skill of uncovering the strategy.

The desire of victory is natural helping factor for uncovering winning strategy. It

seems, that such didactic games are proper for pupil independently for age. They help to develop way of thinking which should be the basic aim of education at school, but it is not possible without general introducing computers. The computers allows teaching in a way that was unavailable up to now.

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