



QUALITATIVE RESEARCH OF PROBABILITY TEACHING WITH DIDACTIC GAMES

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ABSTRACT. *The following paper gives several conclusions from a qualitative research focused on observation of performance and behavior of pupils during lessons in which were used didactic games. The observation was conducted on fourteen year old pupils (13 girls, 6 boys) from the Sports Gymnasium of J. Herda in Trnava, from September 2013 to March 2014. The observation was conducted on 28 lessons where were tested 30 didactic games focused on teaching of the thematic area Combinatorics, probability, statistics. We used the method of direct observation, i.e. the studied reality was observed in the field. The paper especially focuses on what pupils understand under the concept of the game, how they perceive teaching through play, what types of games pupils enjoy and what kind of knowledge of the thematic area Combinatorics, probability, statistics did pupils acquire through play. The paper also mentions opinions of pupils on teaching with games, which they expressed in a questionnaire filled in at the end of the qualitative research.*

KEY WORDS: *observation, didactic games, combinatorics, probability, statistics.*

CLASSIFICATION: *A20, D40, K10*

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Introduction

The latest school reform puts more emphasis on teaching of the thematic area of combinatorics, probability and statistics. This thematic area does not belong to teachers' favorites and thus it is also not very popular for pupils. Lately, the recommended number of lessons in elementary schools dealing with these topics has been doubled when compared with the curriculum from the year 1997, and the knowledge should be acquired spirally in each grade throughout the whole school year. The state education program recommends addressing a number of topics using games [2]. We have created didactic games from the thematic area Combinatorics, probability, statistics and verified their use in the classroom.

The following paper presents conclusions of a qualitative research aimed at monitoring of pupils' performance and behavior during the lessons in which were used didactic games.

Implementation of the Qualitative Research

In accordance with Gavora, we understand monitoring as observation of human activity, record (registration or description) of this activity, its analysis and evaluation[1].

The monitoring was carried out in the grade 8 classroom (13 girls, 6 boys) of the Sports Gymnasium of J. Herda in Trnava in Slovakia, from September 2013 to March 2014. We observed 28 lessons and tested 30 didactic games. We used the method of direct observation, i.e. the studied reality was observed in the field. According to the method of recording we carried out a structured observation.

This type of observation is best used for activities that are in some way organized, not spontaneous, such as activity of pupils during lesson. When using the structured observation we are looking for answers to pre-defined and designed phenomena[3].

We have set the following goals of the qualitative research and research questions:

- To find out how the pupils perceive teaching through games.
 - o What the pupils understand under the concept game?
 - o Do pupils with lower grades like the game?
 - o What types of games do pupils enjoy/don't enjoy?
 - o What requirements does a game have to meet to be enjoyable for pupils?
- To find out the knowledge of pupils of the thematic area Combinatorics, probability, statistics.
 - o Do the pupils have the necessary knowledge of the thematic area Combinatorics, probability, statistics according to the State Education Program?
 - o Is it possible to teach the thematic area Combinatorics, probability, statistics through games?
 - o Did the pupils acquire some knowledge of the thematic area Combinatorics, probability, statistics when using games?

There was only one teacher (the author of the article) present on the lesson. The observed reality was recorded in the observation sheet through short notes and more detailed notes after the lesson. During lessons we recorded the occurrence of phenomena (frequency) by natural coding of the observed phenomena in the observation sheet with specified basic observed categories of phenomena, thus the code was noted if the phenomenon occurred, and at the same time were noted some pupils' comments and short notes. After the end of the lesson, detailed notes about what was happening in the classroom were written down. To facilitate the observation entries in some categories we used observation scales. Pupils expressed their opinion on teaching with games also through a questionnaire which was given to them at the end of March 2014.

Some Conclusions from the Observations

How pupils understand the concept of game

Pupils' answers on the item in the questionnaire: Explain what do you understand under the concept of game:

- o "Game is a work that we like to do"
- o "A group of people playing together"
- o "Game is fun." – this response occurred several times.

We were surprised by one pupil's answer and we present it in the fig. 1: "Activity where we can unleash our potential and show what we know. We have the opportunity to express ourselves and to have fun at the same time."

3) Vysvetli, čo rozumieš pod pojmom hra:
Game is an activity where we can unleash our potential and show what we know. We have the opportunity to express ourselves and to have fun at the same time.

Figure 1: Pupils on games

Based on the responses of pupils in the questionnaire, but mainly on experience from observing pupils during lessons where were used didactic games, but also during common lessons, we come to the conclusion that pupils consider a game to be **any activity** during lesson where they work in an unusual way, e.g. filling in crosswords or solving of

problems given in an unusual way. For example, if pairs compete against each other in solving crossword.

How pupils perceive teaching with games

Pupils see the inclusion of games into the learning process as fun and relax, not learning. They feel that they have a free period, they can move freely around the classroom, they can talk, have fun.

Pupils had initially felt that a game is a voluntary activity and if they don't want to, they don't have to get involved in the game, respectively, they can end and discontinue the game at any time.

After the game, the teacher led a discussion about the game, phenomena, knowledge which pupils could learn through the game. In several cases the teacher tried to use the game as a motivation to explain some information. However, it was difficult to teach pupils to discuss the game. From the pupils' perspective, the game was over and they did not want to discuss it any further. They did not engage in discussions and they rarely remembered any conclusions. Some pupils were not able to memorize the relationship to calculate the probability even after the third game. At first, pupils did not use findings from one game in another. They saw each game as a new activity and did not see the connection. However, over time, some of them did learn to see it.

Pupils do not see the opportunity to learn something new, to explore or to find something out as a motivation; a game has to contain an interesting activity, aids, or the possibility to compete with others.

63% of pupils consider teaching mathematics through games to be very interesting (Fig. 2).

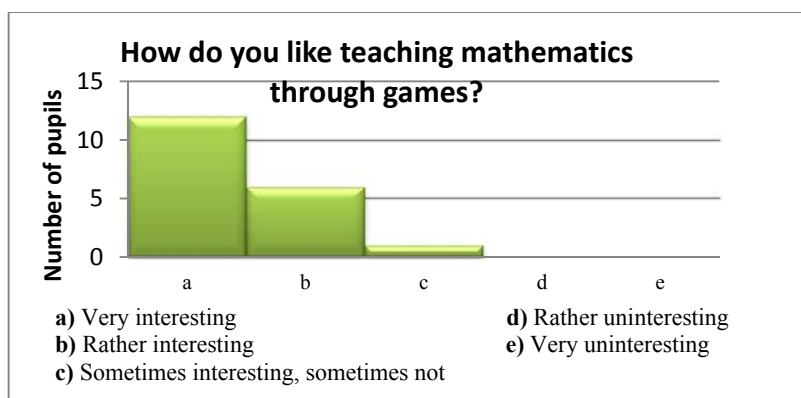


Figure 2: Pupils' responses on an item in the questionnaire

Although the pupils gradually learned to discuss the games and found out that we played games concentrated on the thematic area Combinatorics, probability, statistics and that they are supposed to gain some knowledge from this area through playing, they did not take the inclusion of games as learning but a free period.

In the questionnaire they were supposed to express their attitude towards the statement: "When we play a game we have a free period." Up to 68% of pupils expressed agreement or strong agreement with this statement (Figure 3).



Figure 3: Pupils' responses on an item in the questionnaire

What types of games pupils enjoy

Pupils especially enjoyed group games. Creating of groups was affected by social relationships between pupils. Some girls refused to be in a group with boys and vice versa. If it was the teacher who divided the class into groups, some pupils got angry and refused to cooperate and participate in the game.

Majority of pupils (52,63%) prefers working in a group of 4 (Figure 4).

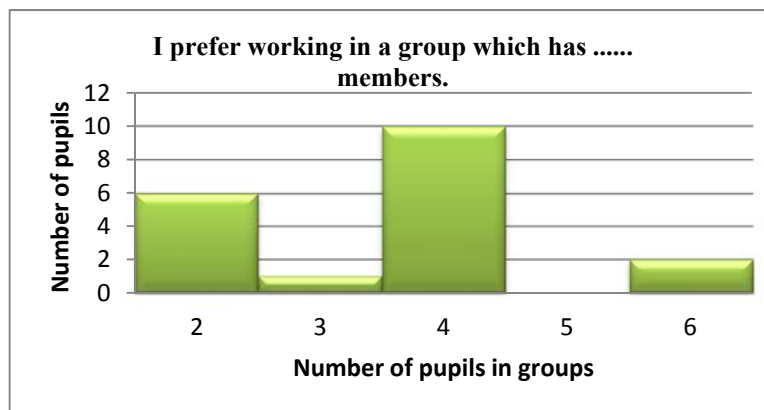


Figure 4: Pupils' responses on an item in the questionnaire

Pupils justified their choice of four-member groups in the questionnaire as follows:

- If a group is smaller, everyone has a chance to get involved
- As we help each other, we complete one another
- More "fun"
- More brainiacs
- We can choose the best from several opinions
- We have more opinions
- I hardly have to do anything

Six pupils preferred working in pairs and their reasons are:

- It is easier to reach an agreement

- One is enough
 - There are few of us, we don't have to shout at each other
- Pupils liked the most games of chances, where the outcome depended on chance, i.e. they did not have to think during the game.

Teaching of the thematic area Combinatorics, probability, statistics through games

We worked on this thematic area in spiral, twice a month the teaching of mathematics included games designed for this thematic area. Each game was followed by a discussion.

Games were aimed at **understanding of the concepts of random experiment, random event, odds, probability, certain, impossible, probable event.**

Pupils had problems using these concepts in games. They argued that they are familiar with these concepts, but were not able to use them; they did not understand them well. In several cases they marked a low-probability event as impossible respectively interpreted low probability as zero. The teacher was constantly using these terms during the games. After about the tenth game, pupils gradually began to use them as well, thus, they commented that an event with zero probability was impossible and were able to distinguish a game of chance.

Pupils perceived the concepts of **odds and probability** as semantically identical. They felt that probability is just a professional term for odds. They were able to calculate the probability of a random experiment with only two different results. For example, they were able to say that the odds of the outcome heads when tossing a coin is 1:1 and that the probability is 50%. They were not able to calculate the probability of an event with several outcomes of a random experiment, like when throwing a dice. However, they were gradually able to evaluate and compare chances of winning of two players.

Pupils dislike using decimal numbers and thus did not like probability in the form of decimals. They understood the outcome in the form of percentage better.

Although the pupils gradually learned to calculate the probability in majority of cases they still made their decisions based on luck, hunch. In games they were choosing an option according to their hunch bit according to the likeliness of an event.

We found out that pupils have only poor understanding of **the concept of randomness**. Some pupils (regardless of their grades) think that the desired outcome of a random experiment depends on luck. During the game Draw a person they commented on their failure to draw a white ball from the pouch with four black and one white that they were not lucky that day.

The games were also aimed at understanding of estimation of probability using relative frequency. Pupils were not familiar with the **frequency view of probability**; they didn't encounter calculating a relative frequency of an event. Thanks to the games, pupils themselves realized that they were not able to tell anything about the probability of an event after conducting one random experiment, but that if they conduct enough experiments, they are able to fairly accurately estimate the probability of the event.

The games also focused on **finding a number of all and favorable outcomes of a random experiment**. Pupils had no problems with writing of all options and were also able to construct and use a tree diagram. Proper manipulation with cards during the game Numerical mania enabled the majority of pupils to discover the relationship to calculate the number of variations with and without repetition (of course without using factorials). Pupils who did not manipulate the cards in a proper way but were able to list all the possibilities of the game and to draw a tree diagram did not discover this relationship.

Pupils had problems **analyzing the solutions of games**. They are used to tasks where they take all given data and make several algebraic operations. They made too rapid conclusions when analyzing the games. They made their decisions according to one event and did not check the other. If a pupil found out that there was a ball number six in the pouch, he selected the pouch as a drawing tool, because he was immediately able to come up with several outcomes of a random experiment where he win with the number six. However, there were also balls with other numbers in the pouch, but the pupil did not care. Only pupils with higher grades were able to learn to properly analyze the game and find all possible outcomes of the random experiment.

Conclusion

This paper presents several conclusions from the observation of lessons taught using didactic games. It mentions pupils' understanding of the concept of a game, their perception of teaching and learning through games, which types of games do they prefer and what knowledge of the thematic area Combinatorics, probability, statistics did they gain through the games. Other conclusions with more detailed information on the conducted research will be found in the dissertation thesis of the author. Pupils had little knowledge of the thematic area Combinatorics, probability, statistics.

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