Acta Didactica Universitatis Comenianae
Mathematics, Issue 5, 2005

# HISTORY AND PRESENT OF DIDACTICAL GAMES AS A METHOD OF MATHEMATICS' TEACHING

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**Abstract.** This article analyses data coming from history, present and researches on didactical game as method of mathematics' education. In these analyses we inquire if mentioned data support our hypothesis about didactical game as effective way of mathematics' teaching.

**Résumé.** Cet article analyse les notices de l´histoire, de la présence et de la recherche du jeu didactique comme une méthode de l´éducation mathématique. Dans cette analyse on étudie si les notices présentées confirment nos hypothèses du jeu didactique comme une voie effective de l´enseignement mathématiques.

**Zusammenfassung.** Dieser Artikel analysiert didaktische Spiele als eine Methode der mathematischen Bildung vom Sichtpunkt der Historie, der Gegenwart und der Forschung. Ziel ist herauszufinden ob die gegebene Analyse unsere Hypothese von Effektivität der didaktischen Spiele als Methode der mathematischen Bildung unterstützt.

**Riassunto.** Questo articolo analizza dati provenienti dalla storia, dal presente e dalle ricerche su giochi didattici come mezzi di educazione matematica. In queste analisi, noi indaghiamo se i dati citati supportino o meno le nostre ipotesi circa i giochi didattici come efficaci metodi per l'insegnamento della matematica.

**Abstrakt.** Tento článok analyzuje didaktické hry ako metódu matematického vzdelávania z pohľadu histórie, súčasnosti a výskumov. Cieľom je zistiť, či uvedená analýza podporí našu hypotézu o efektívnosti didaktickej hry ako metódy matematickej edukácie.

**Key words:** didactical games, historical analysis, analysis of present situation, results of researches, didactical obstacles, effective education

## 1 INTRODUCTION

Content of this article is presentation of history and present of didactical games as a method of mathematics' teaching. Author has for longer time conducted research on efficacy of mathematics' education that used didactical games in. The main hypothesis of this research was that usage of didactical games would improve pupils' mathematical knowledge and their attitudes and feeling towards mathematics' education and thus increase efficacy of such mathematics' teaching (Result of this research see in Vankúš, 2005). This article is dealing with the same hypothesis, but used methodology is analysis of historical background of didactical games and analysis of researches on discussed matter. So aim of this article is to give the reader answers to these essential questions: Gives analysis of historical development of using of didactical games in mathematics' education some reasons that approved our main hypothesis? What information came from various researches that were dealing with didactical games? Can we make conclusion that history, present situation and researches on applications of didactical games as a method of mathematics' teaching supports our main hypothesis? Can we assumed that didactical games as method could help overcome some obstacles in mathematics' learning process?

Before we give answers to these question we have to discuss the matter. First of all we will precise the notion **didactical game**. *Didactical game* denotes in pedagogical literature pupils' activity that brings fun and pleasure for pupils and also realises stated educational goals. The main differences between normal meaning of word *game* (Brousseau, 1997, p. 48–49) and between meaning of *didactical game* are:

- normal game is totally free, in didactical game all pupils have to participate,
- didactical game is used to realise educational goals, the main aim of normal game is, just fun and pleasure,
- didactical game has its external management (teacher, rules of game).

Otherwise structure of didactical game is the same as the structure of other didactical situations (see Trenčanský, 2001; Regecová, 2003**).** More about didactical games, with concrete example, can reader find in this work (Vankúš, 2005**)**. For needs of this article we will take in account definition stated above.

Now we are going to introduce to reader some facts from history, present situation and researches dealing with didactical games. Stated data show development of the using of games in education.

## 2 GAMES IN HISTORY AND PRESENT OF EDUCATION

History of games and their using in education goes long time ago. Game as educational tool was already advised by Hellenic philosophers.

**Plato** (427 BC – 347 BC) gave reasons for using of games in education in his works *Republic* and *Laws*. The main educational method for children at the age from 3 to 7 years is according to Plato the game. It has to prepare children for their future job. For example working with puzzles is in compliance with Plato suitable part of future architects' education. In such playful activities can one sees natural abilities and capabilities of children:

> *"...no with violence but playfully put boys in these studies, therefore you can simultaneously better inquire their natural inclinations."*

Importance of game for education was also considered by Plato's disciple **Aristotle** (384 BC – 322 BC). In his works *Politics* and *Ethica Nicomachea* he supported need of games in childhood. Proper game is in accordance with Aristotle for children the most suitable activity.

The Hellenic tradition in education continued in Ancient Rome Empire. The first schools here appeared at the beginning of republican constitution and were called "*ludi*", that means *games.* In fact, games used in these institutions were mostly related to physical development of pupils.

After the end of West Rome Empire feudally constitution was established during the $5^{th}$ – $10^{th}$ centuries in the West European countries. Blossoming of this constitution came in the age of the $11^{th}$ – $15^{th}$ century. There was high influence of the medieval church on education. The whole education headed to development of pupils' submission and obedience. Therefore hard discipline took place in the schools and also corporal punishments were used. The main method of teaching was learning by heart. By this ways of education there was little place for using the games in.

But this doesn't mean that game hadn't in the Middle Age very important place in children's life. In the archaeological exhibitions from the period between the $14^{th}$ and the $15^{th}$ century we can find dolls, dogs figures, figures of knights and their horses, various ceramic toys… Considering the founds the cock-horse has been the most popular toys till the end of the $16^{th}$ century in the area of Slovakia. So play also in this epoch was preparation for jobs in the adult life: tournament cock-horse for the "knightly life", dolls for maternal role of the girls, various tools from wood and clay for development of labour skills and habits. But systematic using of the games in the frame of schools' education was in this epoch taboo.

Better time for the using of games in education came in the age of Renaissance. Instead of submission and obedience the fostering of physically and men-

tally developed man was preferred. For the orientation on the man is this movement called Humanism. Humanists criticised rough middle age education. They refused oppressing verbalism and formalism in education, rejected cruel discipline in the medieval schools. They wanted the old Greek and Roman authors had been studied in the schools. The teaching of the nature sciences: biology, geography, physics and also the teaching of history were demanded. In compliance with these opinions and claims of humanists the change of education was needed. The teaching had to be more vivid and practically oriented, the work of pupils more active. As a method fulfilling these criteria also game was used.

Support for some teachers in the 15$^{th}$ – 18$^{th}$ century were opinions about role of game in education took from the antiquity. One of them was great European didactic, **J. A. Comenius** (1592–1670). According to him the game is very important part of bringing up the child, the whole education should be playful and joyful. Therefore raising of pupils' interest in learning and explaining of teaching stuff in the game-like ways is always needed.

Comenius stated basics of "schola ludus" (school by play) in his works *School of Infancy, Schola Ludus* and *Didactica Magna.* He perceived game as a natural means of children's development, as spontaneous demonstration of child's activity bringing pleasure and joy. He also highlighted importance of team games for development of children's social skills. The game is, in accordance with Comenius, good for children's health and whole physical development (some body games), it cultivates their senses, memory, intellect, speech and working diligence. Comenius also regarded game as preparation for future job. In this matter he put stress on leading child from spontaneous playful activity towards intentional working activity – to reach this he recommended to guide children during the games and used games with rules (These games teach children accept need of externally managed activities.).

Humanistic opinions about education appeared also in the pedagogical work of English philosopher, scholar and pedagogue **J. Lock** (1632–1704). He studied tasks of education from the theoretical and also practical point of view. He criticised middle age education and its methods. The teaching has to be, according to him, natural and without compulsion. He recommended using games with letters and picture books for the teaching of reading and writing.

From the era of Renaissance came also work *Emile* of French representative of Enlightenment **J. J. Rousseau** (1712–1778). Author there argued for humanistic opinions on childhood. The limit of the childhood had been considered age of 6–7 years till the Renaissance. After this age child had begun to labour. So humanists defended right of the longer "playful" childhood.

Rousseau in his work stated that education should be realised by natural means, considering children's age and personality. He refused memorising and unreasonable discipline. The basis of education has to be, according to Rousseau, children's own observations, thinking and experience. Therefore he put game into education, con-

sidering it as activity proper and attractive to children. In concrete he put attention towards motoric games and games developing writing, computing and musical skills. In accordance with Rousseau game is for children natural activity that in the best way fulfil children's need of doing.

The Rousseau's idea about game continued in the work of German didactic **J. H. Pestalozzi** (1746–1827). He put focus on teaching by active doing of children. The spontaneous and internal motives of children have to be released in this doing. Pestalozzi considered as such proper activity the game. He stated need of systematic using of didactical games in order to realised educational goals.

Already from the 18th century came the first researches on the educational functions of game. Well known is pedagogical system of games coming from German clergyman and pedagogue **F. W. Fröbel** (1782–1852). Fröbel was disciple of Pestalozzi. Also he believed in big educational importance of game and he recommended using it in education. Game is, in accordance to him, means of the development of youth:

> *"Playing and games are the highest degrees of the children's development, development of the man at this age, because they are natural expression of children's interior needs."*
>
> *(Quotation of Fröbel by Lange, 1863, p. 33)*

Fröbel worked out method of pre-school education for Kindergartens and the set of toys for these children. This set is known as "Fröbel's gifts".

Fröbel's gifts are set of six collections of simple toys. The first are seven cotton balls of different colours, attached to the thread. The child can by them improve recognition of colours and space orientation (notions "forward", "backward", "left", "right" linked with the motions of balls). The second gift is collection of wooden sphere, cube and cylinder. This has to familiarise children with basic geometrical objects. The third gift is big cube consisting of eight smaller cubes, the forth gift is cube parted into eight boards. The fifth and the sixth gift are cubes, consisting of twenty-seven smaller cubes. All this "puzzle-cubes" have to teach children to construct space object and thus developed children's space imagination and logic. Fröbel made precise method of using his gifts, including auxiliary material for teachers. The gifts were some time quite popular.

Fröbel's view on educational usage of game is released in this quotation:

> *„Games of childhood are origins for future life of children; in them is released and developed the whole man, his dispositions and inner tendencies. Whole future life of man has its origins in the age of childhood."*
>
> (*Fröbel, 1826)*

These positive attitudes toward the role of game in childhood came into all European countries and were introduced also in Slovak's school education. More about it see in (Žbirková, 1994).

Some precise analysis of game and its meaning in man's life were done in the 19th century by prestige psychologists, philosophers and pedagogues. Let us mention F. Schiller, H. Spencer and K. Groos.

**F. Schiller** (1759–1832), German philosopher and poet, found his ideals of freedom and happiness in the game. He consider game as an activity that makes possible free releasing of man's personality and so improves one's life. Schiller also thought about reasons of playful behavior. In according to his ideas the game is demonstration of superfluous life-energy of people and animals.

**H. Spencer** (1820–1903), English philosopher, sociologist and pedagogue, demanded education that prepares children for life. In his works he stated didactical principles that became basis of Anglo-Saxon pedagogic. In this principles is included need of active and joyful education based on pupil's experience. So he called for adequate amount of pupil's games.

Also Spencer thought about reasons of human's and animal's game. In compliance with Schiller he considered game as alternative use of energy spared from its natural spending in struggle for survive.

**K. Groos** (1861–1946), German psychologist and pedagogue, worked out first scientific conception of reasons and meaning of play behavior. In his works *Play of animals* (1896) and *Play of people* (1898) he highlighted play's role of preparation for adult's tasks and behavior. In the first of mentioned works he wrote:

> *"We shouldn't think that animals' play is luxury of youth, but instead of this the period of youth is given them in order to play."*

Groos believed that behaviour of mammals and especially of man is so complicated, that they need special period of youth. In this period they by means of play prepare themselves for adulthood. The play is, according to Groos, some kind of instinctive behaviour that makes up basis for development of intellect. Groos' opinions on game as means of complete development of youth were broadly accepted and the most of them are reconsider as true also in the present, because they are in compliance with evolution's theories.

**M. Montessori** (1870–1952), great Italian pedagogue, used in building of her education's theory works of F. W. Fröbel, J. H. Pestalozzi and J. J. Rousseau. She worked out auxiliary program for children with reading and writing troubles; she made up system of education for children at the age from 3 to 6 years. She put special focus on creation of children supporting environment that should gives

motivations and possibilities for children's development. In the frame of her educational system she dealt with improvement of whole children's personality: their sensorial and motoric apparatus, vocabulary, preparation for reading and writing, calculus and various abilities and skills. As a means of this education she used games in the big extent as activity proper for children. She believed in Groos' ideas about importance of game for youth's development.

**J. Piaget** (1896–1980), eminent French psychologist, studied precisely functions of play in children's life. He classified four types of play.

The first and the simplest is "exercise game". In this form of game person uses some of his/hers skills just only for the reason of joy. This joy comes from ability something to do or to use new skills and/or knowledge. (The same do also adults for example with a new car or PC.)

The next form is "symbolic game". It is on the top in the age from 2-3 to 5-6 years. Basis of this form is assimilation of reality considering the needs of child. This assimilation is going through symbolic speech, constructed and changed by child. By the means of symbolic game child obtains possibility of doing without limitations and pressures of its environment and real conditions. So symbolic game is important for feelings and intellectual state of child and development of these two areas. Example of symbolic game is playing to be at school, to be pirates…

The third form of game that appears in child's development is "game with rules" (blind man, hide-and-seek…). The children learn games of this type one from the other and by the assistance of adults. Importance of them is in socialization and development of ability to cooperate and to act considering some external rules.

The fourth type is "constructive game". They are transition from symbolic game to activities with characters of "serious" job. There are some games as various puzzles, rebuses and intellectual constructive activities.

If we consider Piaget's research game develops motoric, feelings, intellect and imagination. It is also important for children's socialisation, development of cooperation and as a preparation for creative activities and solving of problems. So in accordance with results of Piaget game is necessary and important part of education.

**L. S. Vygotsky** (1896–1934), Russian psychologist, put in his work attention towards cognitive development of child. Especially he studied links between thinking and language. In his opinion cognitive skills and thinking patterns are not primary determined by born factors but are the products of activities in the frame of social institutions of culture in which is individuality bringing up. Game is one of these activities suitable for development of cognitive skills and thinking (Goldfarb – Rozycki, 2000). Vygotsky highlighted role of game for child's socialisation.

**J. S. Bruner** (1915), important American psychologist, made significant contribution towards development of cognitive psychology. In his work he continued in the theory of children's development by J. Piaget. He took concern in effective ways of education and proper creation of curriculum on the basis of constructivism theory. The main idea of Bruner's theory is that education is active process in which pupil alone constructs new notions and conceptions in compliance with his existing knowledge and/or experience. The task of teacher is to motivate pupils to such construction. Teacher has to transform the knowledge pupils should know so that they are proper for children's abilities of learning. In this direction Bruner focuses attention on games. He highlighted children's ability to concentrate them during the game. This concentration is aimed on games' process, its elements and necessary information. So game is, in accordance with Bruner, suitable method of education. He proposed development of children's logical thinking by the means of game during the first years of school education.

Using of games in education significantly expanded by the development of Reformatory pedagogic at the end of the 19$^{th}$ and in the 20$^{th}$ century. Active, creative and motivational form of education came to the top. Some of new theories of education considered game as one of the main teaching methods.

**J. Dewey** (1859–1952), founder of pragmatism, highlighted natural educational and cognitive functions of game. Thus he considered game as very important method of education. The game fulfils Dewey's demand to link school with life and make it place where children's learn by life not by artificial tasks. In his work *Democracy and Education: An Introduction to the Philosophy of Education* he referred that all nations in all ages let the game to act very big role in children's fostering, because the play teaches children about world where they live and about activities and skills needed in their life.

**R. Steiner** (1861–1925), Austrian scientist and philosopher, made up method of education used in Walfdorf's schools. He put focus on development of whole pupil's personality, its knowledge, thinking, social abilities and also its will and spiritual area. In his opinion education has to reflect on actual needs of child as they are changing by its physical, mental and emotional development. Till the age of 7 years he demanded games, drawing and cognition of nature and objects of everyday life as a main activities of children. Game is in his theory considered as necessary need of complex development of man's personality. Also recent Steiner's followers emphasized role of game in education (Jenkinson, 2001).

Importance of game for education is assigned also by French educational group GFEN (*Groupe Français d'éducation nouvelle*). This group of French pedagogues and didacticians deals with theoretical and practical improvement of schools' education. They put stress on teaching methods that lead pupils to active work during lessons. Therefore game has important place in their conception of education as said prominent sympathiser of this group **H. Bassis**:

> *"Our didactical method is based on game, that means on our findings that game beside that it brings activity and pleasure has many specific abilities. It has socialisation influence, it forced to accept its limitation given by rules (sanction is exclusion from game's process), it causes extreme effort – that means it has qualities about them all sermonising speeches on working dream as not reachable goal."*
>
> (GFEN, 1991)

Role of game in education is in the time of the 20th and the 21st century very popular theme. There are hundreds of works from psychology, sociology, pedagogy and didactics dealing with this matter. So in our analysis of present situation of didactical game as method of education we focus only on its using in mathematics as a teaching subject.

**Onslow** in his work (1990) inquired positive influences of social interaction between children in the frame of didactical game. In this research he continued in the work of **Bright**, **Harvey** and **Wheeler** (1985). He stated following requirements in order to make education with using of didactical game more effective:

- Didactical game has to be integrated into mathematics' curriculum; it has to use proper language, symbols and materials.
- Participation of children during whole game should be active.
- Important are interventions of teacher to manage game to its aims and in order to help pupils to build up new notions and learn new mathematical processes and ways of thinking.

**Randel**, **Morris**, **Wetzel** and **Whitehill** (1992) referred that using of didactical games during mathematics' teaching can support pupils' motivation and performance during lessons. The active participation of children in games is the need of better understanding and memorizing of teaching stuff.

**Pulos** and **Sneider** (1994) found out that proper chosen didactical game helps children to learn new mathematical notions and skills. These researchers recommended putting game into mathematics' curriculum as an auxiliary activity. They inquired that experience gained trough proper didactical game used after lessons dealing with some mathematical notions and skills leaded to better understanding and more durable memorizing of them.

**G. Booker**, Australian pedagogue, has used games in education at primary schools. In his work *The Maths Games* (2000) he described the experience and observation from using of didactical games. Let us mention some of them:

> *"Game is for children funny activity, that brings motivation and full interest of pupils, what is essential for constructive teaching. Children*

*that are not willing learn to pleasure their parents or teacher or because the reason that mathematics will be necessary for their future life, often learn by their own will in the frame of the social interaction with other pupils. Game gives context real for children…*
*From these reasons game have important place in mathematics' education. It offers conditions in which is possible construct and develop mathematical concepts. Game improves pupils' ability to solve problems by the need to explore and to use new strategies and refines other skills by the means of using these skills in the frame of game. It supports social interactions those lead to learning."*

More researches dealing with didactical games realised people from **The Mathematics Assistance Centre** from the University Griffith in Australian, city Brisbane. These researches faced using of games as an integral part of education. Part that leads to new pupils' knowledge and cognition of new mathematical notions (Brooker, 2000). They tried to find method of implementation of constructive way of mathematics' teaching. In this way of teaching is needed to create links between concrete representation of situations in which were mathematics' ideas developed and between interpretation of these situations and symbols proper to teach children these ideas (*didactic transposition* see Bereková et al, 2003). Children have to learn by their own experience within proper chosen activities. One of these activities is didactical game. It also enables development of language needed for working with mathematical concepts. Let us to make brief summary of these researches' results.

Didactical games:

- give for pupils a real context in that they can realise themselves fully. This supports constructive teaching.
- enlarge children's subjective valuation of mathematical knowledge, because this knowledge is needed for participation in the game that is wanted activity.
- help pupils to construct mathematical concepts by manipulation with objects in the frame of game and by verbalisation of pupils' activities, thoughts and attitudes.
- demanded respect to rules of game. That is support for on rules based mathematical disciplines.
- are more effective if were built on mathematical ideas and for the sake of game is needed to understand certain mathematical notions and to posses certain mathematical skills.
- support pupils in building of new ideas. These ideas have to be defended against other players.

- prompt to control and check doings of other players. In this checking pupils rely more on themselves as on external authority (teacher, textbook etc.).
- they enhance pupils' self-reliance and self-regard because fortuitous elements of games make every player's victory possible.
- let teacher to see abilities of children in normal conditions not in the artificial conditions of some school's activities.

Also many of Slovak and Czech pedagogues have much experience from using of didactical games during mathematics' education. Let us mention some of them.

**V. Kárová** in her works (1991,1996) stated need of using didactical game as a valuable teaching method. In accordance with author game forms following pupils' features that are necessary for effective education:

- overall good attitude to school and educational process,
- inner motivation magnifying pupils' knowledge, abilities and skills,
- self-control and self-evaluation of own work.

**E. Krejčová** and **M. Volfová** in their work (1994) highlighted big value of game as a vital part of education. Putting didactical game into education enlarge, in accordance with authors, pupils interest in active work during mathematics' lessons and overall interest in mathematics. It improves whole process of mathematics' lessons. As a positive feature of didactical game they referred about necessary integration of knowledge from different parts of mathematics' curriculum and also from different teaching's subjects. On the basis of their own practical experience authors formulated these points needed for proper integration of game into education:

- Game has to be attractive for children.
- Game has to be adequate for age and individual children's skills and features. Younger pupils love game with some enigma elements, not so gifted students like team game, gifted and older students love individual game.
- Every game has to have clearly formulated rules. If the rules are broken the punishment has to come (some bad points etc.). Rules shouldn't be changed without good reasons.
- Game has to have good organisational and material management.
- Too often introducing of new games is not effective.
- Game shouldn't be put to education coincidentally. Every game has to head towards some educational goals.
- Game has to make active the most of children, ideally the whole classroom. Every pupil should have chance to be during the game successful as the individuality or as the part of team. In order to consider children's individual abilities is good to prepare different levels of game's difficulty.

– We prefer game touching the most of pupils senses and develops the most of their knowledge, abilities and skills.

Positive influences of games on development of primary school children described in her work **J. Cejpeková** (1996). She has seen potential of didactical game in these areas:

Didactical game:

– makes pupils active,
– develops their memory, imagination, concentration, thinking and speech,
– refines pupils' feelings area, supports learning by experience,
– improves self-confidence and self-cognition,
– makes possible social learning, prepares for various social situations,
– motivates, develops interests, satisfies needs, leads to creativity and self-reliance,
– has important influence as relax.

In accordance with **Š. Kováčik** main areas of possible didactical games' usage are (1999):

– discovering of new knowledge,
– exercising and fastening of teaching stuff,
– development of thinking and applying of knowledge.

M. Zelinová made precise analysis of functions of game in children's development. According to author game has important role in development of these areas of personality (1999):

*Noncognitive areas*:

– feelings and the positive experience, improvement of self-confidence,
– bigger activity and motivation,
– social behavior, better social skills,
– boost of creativity, pleasure of creative activities.

*Cognitive areas*:

– sensors and motoric abilities,
– memory,
– abilities of evaluation,
– creative thinking.

## 3 ANALYSIS OF STATED DATA

Now we are going to make analysis of aforementioned data. So reader will find answers to questions given in the introduction of this article.

If we consider history of didactical game we could say that role of game in education has increased trough centuries. There is visible tendency of using game in education more and more. Some of new pedagogic theories consider game as a main teaching method. Psychologists referred that game is natural means of education. Also many researches dealing with didactical game in education and also specially focused on mathematics' teaching said that game has many positive features and could be really proper children's work during the mathematics' lessons.

So summary of aforementioned data is that game appears to be suitable method of mathematics' education. But we have to add; no method is generally good or bad. If we choose proper game, considering children's interests, age, abilities, knowledge and skills we would have chance to have success. What is proper game and how to use it? Some requirements were stated in aforementioned data coming from various researches. In bibliography to this article can reader find some books that comprise collection of didactical games suitable to be used during mathematics' lessons. Some of these books also contain methodology of using of these games.

One of the biggest positive features of game is that it is natural means of children's education. So children consider game as wanted activity and they love it. Game has for children close context and so it helps overcome some learning's obstacles.

The main learning obstacles are (Brousseau, 1986):

- ontogenetic obstacles,
- didactical obstacles,
- epistemological obstacles.

Let us describe these obstacles more in details.

*Ontogenetic obstacles* are linked with pupils' maturity. Possibility to develop some skills, knowledge and abilities depends on pupils' mental age, that means on the state of development of pupils' cognitive abilities. (It is linked with development of pupils' brain, thinking patterns, ego, intellect etc.) So pupils can have for example neuro-physiological limitations, which may depend only on their chronological age (Spagnolo, 1998).

*Didactical obstacles* are linked with methods of education and content of teaching stuff. So these obstacles could be overcome by proper chosen methods and content of education.

*Epistemological obstacles* come from the nature of the concept that has to be taught. For instance, if there are some non-continuities or radical changes in the evolution of mathematical concept, epistemological obstacles during the

teaching of this concept could appear (Spagnolo – Margolinas, 1993; Spagnolo, 1998; D'Amore, 1999; Sbaragli, 2004).

Considering facts stated in this article the proper game could help overcome first two learning obstacles. As was said in this article proper game should be suitable for children's age and individual abilities. Moreover game is natural way of education. So we get over the ontogenetic obstacles. If we consider game as appropriate method of education and we choose game with suitable content also didactical obstacles are overcome.

## 4 CONCLUSION

These article made analysis of data coming from history, present and researches dealing with didactical game as method of mathematics' education. We looked for answer to question if analysis of above-mentioned data will give support for our hypothesis. This hypothesis says that usage of didactical games would improve pupils' mathematical knowledge and their attitudes and feeling towards mathematics' education and thus increase efficacy of such mathematics' teaching.

We can say that all data stated in this article show that our hypothesis appears to be true. We can see that using of games in education increased trough centuries and nowadays is game considering as proper and important teaching method by many educational theories. Also many researches found that game has numbers of positive features. These features make game natural and adequate method of education.

But as we have already said no educational method is suitable everywhere, for everyone and all time over. Therefore if we would like use didactical game we have to choose the game proper for age of our pupils, their interests and abilities. This game has to have suitable content in order to lead to realisation of stated educational goals. We have to manage the game in material and organisational way. The game has to be integrated into curriculum. If we fulfil all these needs our game can really lead to more effective teaching and overcoming of some learning's obstacles.

There are many open problems in area of this article. Will using of game really leads to increase of children's mathematical knowledge? Is education by game suitable for normal everyday classroom with certain number and type of children? Is it possible to integrate game into education without need of longer teaching time and much more teachers' work? Answers to this question are theme of the next researches. They will verify more correctly aforementioned hypothesis and possibly open using of didactical games for mathematics' teachers.

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