

## Teaching Mathematics Through Games at the First Stage of Elementary Education

Soylu, Yasin

Science Department, Ağrı Education Faculty, Atatürk University, Ağrı, 25240-Erzurum, Turkey

Işık, Ahmet

Department of Secondary Science and Mathematics Education, Kazım Karabekir Education Faculty,  
Atatürk University, 25240-Erzurum, Turkey; Email: ahmetisik25@yahoo.com

(Received April 14, 2003 and, in revised form, September 3, 2003)

Children interest themselves in all different toys they see, before beginning to speak. The psychological reasons for children's interest in toys have been investigated for a long time. Thus many scientists have studied on the question "what is game?", but they have not reached a consensus yet. Such contradiction may be dependent upon different points of view of the researchers about game. Besides, the view of game of a child and an adult is different too. According to an adult game is a rebirth and escape from monotony. For child it is a work. The aim of this study is to make mathematics regarding a mass of abstract concepts for the students of grade 1–3 of primary school in the concrete operations period, more attractive with the help of educational and instructional games, and to contribute to student's developing. The capability of thinking and producing by changing abstract concepts into concrete ones.

*Keywords:* Primary Education, Mathematics Teaching, Games and Toys.

*ZDM classification:* UA91, U31, U61

*MSC2000 classification:* 97A90, 97U30

### I. INTRODUCTION

Mathematics and game take place in the whole period of individual's life at different levels. Game is not a wasting activity that child spends and just provides entertainment as many adults think. Game is the most serious occupation of child, it is his own work. By means of game child develops this sensitivity about himself and his environment to improve his knowledge and ability. Thanks to the interaction with his friend, game materials, type of game etc.

Child improves individual and interpersonal communication performance and gets important steps within the other domains (memory, motor, mental, etc.) of developments (Tuğrul 2000). Game is a field of experience that provides child for perceiving oneself and other environment (Johnson 1998). While the child is playing game the touches the thinks, moves and relates them and he forms some constructions and he observes (Attifield & Wood 1996; Wood 1995).

Mathematics and mathematical thought are not limited to school curriculum which is isolated from his life. Child lives with mathematics spontaneously and grows up with mathematics. Generally mathematics is considered to be formed on a system of four operations whereas there are numerous operations and knowledge within game that is the most popular work of child. But the confusing assessments and perceptions which society focuses on game and mathematical concept abstract relating these concepts.

When one of them is regarded as a recreation and the other is regarded as a serious and formal field of study, it seems impossible to integrate each other to reach the same goals (Tuğrul 2000, pp. 556–561). Whereas game is not just an activity that amuses child, and has not certain disciplines, rules and seriousness. Game has also same disciplines, rules and serious features. Mathematical is a course that meets, at the same point and category, game in terms of being entertaining in addition to be bound to some disciplined and serious rules.

The fear and preconceptions toward mathematics are not unique to our country. Pedagogues and mathematicians also in other countries look for the ways to make mathematics liked and make it more attractive. In our country, the problems of mathematics teaching are due to nature and characteristic of mathematics in our school. Especially such an education for from life and which is theoretical obstructs the expected success (Umay 1996). Besides from the first day of school, since the links with daily life cannot be provided well and since the reason for why we use mathematics is not told, it is considered as a very different phenomenon.

Furthermore, it causes student to be unsuccessful and prejudiced towards mathematics (Işık 1998). The factors that affect the mathematical success of student are the socio-economic situation of the family, level of education, school environment, knowledge of language and attitudes towards. Mathematics seems to be the most important effective factor. The student whose mathematical intelligence is high has positive attitude to mathematics and he is quite successful in math lesson (Papanostosiou 2000).

In a study one of the important reasons for that majority of people do not like mathematics is the absence to take of invention and the matter that mind is not constantly be active (Kart 1996). So as to develop positive attitudes and define the mathematical terms by the students situations in games should be given and students should be provided with reaching some results and generalisations. One of the important

dimensions of these educational systems is to carry out such an education by means of games.

According to some researches, game is the most original occupation (Dönmez-Baykoç 1992, p. 13, pp. 20–21, pp. 26–27).

- Game is child's own occupation (Özhan 1997, pp. 13–14).
- Game is the way of internalisation of stimulus and reaching adaptation system (Özhan 1997).
- Game is a volunteer activity or movement that is practised through freely accepted and binding rules in certain location and time, involving feelings of tension and amusement with the awareness of being different from real life (Poyraz 1999 pp. 6–136).
- Game is a work for adults and to children it is an activity that is performed by the present force when it is stimulated by the environment.

Frobel's view of education is based on game (*cf.* Soylu 2001). Frobel has developed instructive games such as geometrical objects and building toys in order to make the game variable and enrich it. He focuses on the necessity of child's playing with educational-instructive games and toys. In the kindergartens opened by Frobel for 3–6 years old children the source of activities has been the natural games of German children of village. He attached importance to language and game in his educational way. Frobel's educational methods and materials have still their validity (Soylu 2001, pp. 5–6).

When Maria Montessori, in 1906, opened a school for children that he would implement his own principles of education in Italy, he first attempted to create an environment appropriate to children. He defended that child should live in conditions that he can move freely and educate himself on his own and appropriate to learning and he called the school "House of Children". Here the things should be proportional to the length of child and shelves should be in appropriate height so that child can reach easily. There are not any classrooms isolating groups from each other. Montessori regards game as the occupation of child and attaches great importance. Here the duty of teacher is not to interfere with the child, make him know the environment help him choose the necessary materials and to teach him repeat what he has taken, make them respect to others work and help children their education on their own.

Montessori indicates that education starts by birth and the first years of life are so important in terms of physical, mental and personal development and calling the first six years "sensitivity period" and emphasises that it should be evaluated well. According to Montessori, the value of game, which is his own work during this sensitive period, is of great importance in terms of education.

The place of game is so important in child's life. Child tends to express himself by

means of game. He/She learns to a being the rules and to connect with others. The students in the five years of primary education are still under the influence of game process. In these ages, it is known that the games with groups and competitions are widely liked. Though these features, game can be used effectively in educational environment.

In the research by Bühler and Hetzer, in 1926, it is concluded that 9% of child's (2–4 months) time is spent on game, during 7–8 months this period reaches 50%, in 11–12 months go up 75% and until the years of school this process goes on, but at the age of 7–8 the time spent on game decreases (Özdoğan 1997, p. 102).

For both children and the adult, it is very difficult to keep their attention on certain point for along time during the education process. Especially, children in the first years of primary education get bored and lose their attention soon. This situation affects permanent comprehension and learning. The most important difference of teaching through games from the other teaching methods is concentrating on the subject to be told and activating students from the passive mood (Hazar 1996, p. 67).

For children game is the device for learning life, according to Dogbeh and Diage (*cf.* Soylu 2001) game possesses seven educational purposes. These purposes were determined in accordance with Bloom's classification.

- Direct information.
- Comprehension.
- Application (use of abstract concepts, principles and rules in new environments) Analysis.
- Synthesis (summarising and planning of the structures of ingredients taken from various sources).
- Evaluation (criticising information, thoughts and methods).
- Creation, discovery (transforming information into creative action).

Game can be used as a tool to realise the purposes above. Because, in a game, the activities below take place (*cf.* Dönmez-Baykoç 1992).

- Perception activities: Physical contact with the object seeing, hearing etc.
- Sensory motor activities: Running, jumping, throwing, keeping rhythm etc.
- Verbal activities: Calling and production of certain words and sentences.
- Sentimental activities.
- Mental activities: Observation, definition, comparison and classification.
- Object production activities.
- Aesthetic and physical activities.

According to the study production (*cf.* Büyükkaragöz 1994, p. 56) carried out by

Philips in Texas University in equal time periods, remember;

- 10% of what they read
- 20% of what they hear
- 30% of what they see
- 50% of what they see and hear
- 70% of what they say
- 90% of what they say and do
- Teaching method in the game displays 90% learning.

There are two points that pedagogues get into difficulty, first is to understand the real capacity of the participants in education and the second is the observation of the degree of what to be expected to give. During the game, child can move in a freer way and reflect his inner world in a more realistic way. Thus, it is possible to observe the real personality, ability, tendencies, mistakes, weak sides and inventions of child (Özmen 1976, p. 101). When J. Piaget's mental development studies are phase of four ones (sensory motor period, pre operation period, concrete operation period, abstract operation period) that is concrete operation period (ages 7–12) is examined, it can be argued that 3–6 ages period which is known as game period is going on (Yörükoğlu 1993, p. 60).

Abstract operations have not been realised yet (Bacanli 2000, p. 69). Since the effect of 3–6 ages periods of game on children, and they are not able to understand abstract matters and also in order to make them love mathematics course, it is inevitable to carry out an education through games.

During the concrete operation period, child begins to situate the concept of size, space, weight, volume, number and time into a primitive and rational logic. He can attribute conceptual names to concrete things. Moreover, he can suggest by means of deduction (Topses 1992, pp. 122–123).

Mathematics is an abstract phenomenon. Though, especially mathematics teaching is started from earlier ages through concrete operations it requires an abstract thinking as “a mental system”. From the outset, mathematics can be fulfilled without using symbolic projections but symbolising facilitates abstracting and it is indispensable for advanced mathematics. Especially, the new beginners in school education must learn to symbolise mathematics as they learn how to read and write through their mother tongue, which they have learned at home.

Number is abstract but countable objects are concrete. Getting comprehended, from the very earlier age. The abstract-concrete relation by means of the examples of everyday life has a very important function to reduce the fear of mathematics (Umay 1996).

Therefore in case the course of mathematics is near concrete through games, abstract concepts will be more permanent especially for the new beginner students. One of the

methods to make Mathematics concrete is game. Because the new beginners, to J. Piaget, are in the period of concrete operation (ages 7–12). Seeing that Mathematics consists of abstract concepts the most appropriate way is make it concrete through games since students cannot be got to the abstract period.

## 2. SOME ACTIVITIES TO PROVIDE FOR THE PERMANENCY IN MATHEMATICS TEACHING

### 2.1. Games Dealing With The Relations Between Things (Big/Small Game)

Name: Big/Small Game

Location: Classroom

Materials-tools: Pencil, Eraser, Bag, Blackboard, etc.

Time: Optional

The Goals and Educational Value of the Game: To make comprehended the relations between things. One group of students are stood before the board by the teacher. The students, as in Figure 2.1 are arranged. The teacher stands before the students and asks “Which one is big, the desk or the table?”. The students who replied answer stands still. Likewise the game goes on asking like these “cat vs. mouse”, “bag vs. notebook”, “apple vs. watermelon”, “school vs. classroom” etc. Finally, the players who answer the question correctly and arrives the teacher first be come the winner. Then the same game is played by the others groups. In the end, the first of the classroom is determined being played by the winners of all the groups and he is awarded.

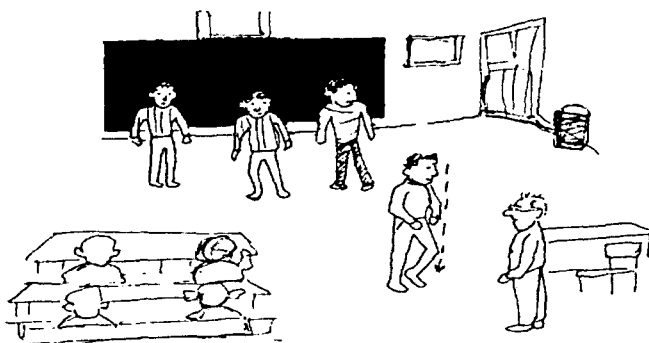


Figure 2.1. Big/Small of Game

In this game, the relations between the objects taken in the Curriculum of Mathematics were attempted to comprehend. In this game, firstly the teacher asks students which of

the objects that he shows are big and small. The students answer the question looking at the objects visually that were put side by side. In the second phase, teacher asks the students “How do we understand which of the objects are big or small?” through the objects he handles. While discussing with students teacher says that this question would be answered although their space they occupy. In next phase, teacher wants students to compare the aspects he showed the students in terms of space, which they occupy. Thus, for further phases, children will have been acquired the basic information on the concepts of area, volume and length. In case child faces such problems in the future he will attempt to find solutions through place, area or volume of the objects when in the action of comparison of largeness-smallness between objects. In this period student cannot interpret the meaning of area or volume but he can relate these concepts according to features of objects and the thus the mental development of the child is contributed.

Thus the children that meet at a young age know them of this kind, carry these advantages to know for them, aptitude and habit in the years to come (Papanostosiou 2000).

Research highlights that for children with in ages 7–11 to learn abstract phenomena such as volume, time, number, quantity, the concept big-small is very difficult and timetaking. Noticing students could not concretize abstract concepts (during activities) with in learning process, using this game a more productive result was obtained.

## 2.2. Games pertaining to the four operations

Name Of The Game: The game link up the kite to the line of numbers.

Location: Classroom

Materials: Scissors, cardboard, rope etc.

Time: Optional

Goal and Educational Value of The Game: To make them comprehend the four operations and the line of numbers.

As seen in Figure 2.2., a line of numbers and figures of kite are drawing on the blackboard. On these kites some questions on the four operations are prepared (Altun 1998, pp. 76–77; 2002). The students are arranged in groups. The game is started by the first group, which is determined by lot. The students in this group tie up the kites to the line of the numbers according to results that they reached at the end of operations on the kite. One point is noted for each correct answer. The same rules are applied for the rest of the groups. The group who takes the highest grade is the winner.

In this game, the practice about subject has priority over comprehension of the subject. Here, the four operations in natural numbers matching one by one and the practice of line of numbers are applied simultaneously. Another goal of this practice is to make practice

concentrating the student's attention on the course for a long time.

In the learning process of the children of ages 7–11, (in the classroom activities) it has been seen that during the operations addition, multiplication, subtraction, division the order of operation was confused and important errors, which would change the result, were made.

In order to minimize the errors on such basic concepts (especially for the students of ages 7–11) this game, considering its entertaining and interesting feature, was to be played and obtained effective result.

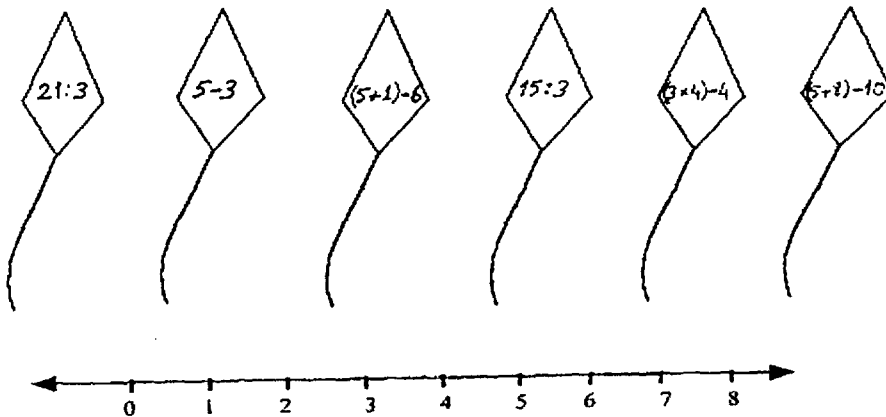


Figure 2.2. The link up the kite to the line of numbers of game

### 2.3. The Game Swamp

Name of The Game: The Swamp of Game

Location: Classroom

Materials-tools: Cardboard, Pencil, Eraser, etc.

Time: Optional

Goals and Educational Values of The Game: To make the multiplication of 8 and other numbers comprehended.

Tony and Lara, as seen in Figure 2.3., are at one side of a dangerous swamp. They are only able to cross it standing on the small islands. But all of these islands are not safe. If they stand on wrong islands they will fall into the swamp.

Besides the swamp there are some tortoises sleeping. They have the keys to the safe islands. Multiply the numbers on the tortoises and put a cross on the islands that Tony& Lara can stand and using these islands make them cross the swamp (Treays 2000, p. 17).

These operations can be repeated with each student preparing the figure below on the blackboard or on a cardboard before, and whenever the students change the operations on



the tortoises and islands can be changed as well.

With this game, teaching of multiplication table is aimed. In this game, to provide the permanent learning concentrating the students in Mathematics on the course for a long time and activating them to create an educational/instructional environment that does not limit their freedom and take them at the centre of the process, and make mathematics concrete which is in fact abstract.

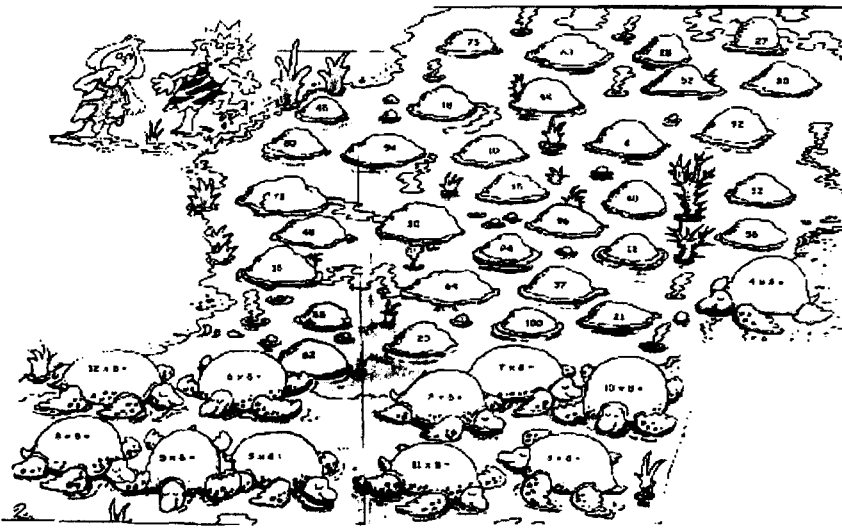


Figure 2.3. The Swamp of Game

In a classroom activity, it was observed that among the students within ages 7–11, they had a difficulty in comprehension of numbers and their times. So as to decline the learning difficulties of students about the times of numbers. This game, which is considered to be interesting, and in which there is a marsh and safe stones on which there is eight and its time, was played by the students and consequently, it was observed that this approach came to be effective.

### 3. RESULT AND SUGGESTION

Up to now, the reasons for failure in mathematics and antipathy towards it has been investigated by many pedagogues and scientists and these investigations have still been going on. As one dimension of the reasons that mathematics lesson is perceived as very difficult, it is suggested that in teaching of mathematics educational and instructional games are not placed enough. The assumptions through the study can be followed as:

- Children in concrete operation period can be taught much more effectively making abstract mathematics concrete.
- The definitions, rules and axioms can be found by the children thus the feeling of discovery, finding is acquired and their self-confidence can be enhanced.
- Situations in games should be given to the students and made them reach some conclusions and generalise on their own so that they can develop positive attitudes towards math and define the mathematical terms on their own. One of the important dimensions of these teaching systems is the teaching of mathematics via games.
- The abilities of children in the four operation; multiplication, division, subtraction and addition can be improved and enhanced.
- Children's interest in mathematics can be enhanced.
- In a teaching environment which is formed through drawing upon the attractiveness of word "Game" mathematics and other courses can be carried out in learner-centred view.
- As for the new beginners, school and mathematics can be liked with games.
- The mistakes, infirmities, discoveries, abilities and tendencies and naturally real personalities of children can be observed and determined.
- From the first years of primary education, students should be confronted, according to their level of development, some mathematical activities so that they develop positive attitudes towards mathematics, and such activities which force their capacity should be avoided. Therefore we realise it through educational-instructional games.
- Especially regarding the fact that is very difficult to transfer mathematics to the students who are in concrete operation period, in the first, second, third, fourth and fifth grades of primary school the subjects can be told by dramatisation instead of teaching them theoretically.
- It is thought that when the books and journals used in grades 1–5 of primary education are examined it will be seen that mathematical games on the subject are not included in the books and journals for the students.
- In primary education, in school games are included in physical education courses towards only physical training and sport education. In other courses, nearly all of them do not include games. That is why, apart from mathematics in other lessons, educational/instructional games can be included.
- The curriculum of mathematics can be re-examined and as an addition to existing programme mathematical games can be taken place.
- They are all highly important for a permanent learning.
- Even though it is not throughout enough in order to take over the problems, the

sources and materials involved should be added. Before all else, all the materials can be benefited and the games in their own cultures of nations must be compiled and adapted to teaching of mathematics.

## REFERENCES

- Altun, M. (1998): *Mathematics Education (6th ed.)*. Bursa, Turkey.
- \_\_\_\_\_ (2002): Degrees of influence of the behaviours taking place in the process of solving verbal problems on the success of problem solving. In: Vakalis, Ignatios; Hughes Hallett, Deborah; Quinney, Douglas; Kourouniotis (Eds.), *2nd International Conference on the Teaching of Mathematics (ICTM-2) at the Undergraduate Level (held at Christos Crete Univ., Iraklion, July 1–6, 2002)*. Crete, Greece: Limenas Hersonissou/New York, NY: Wiley. MATHDI 2002e.04296
- Attifield, J. & Wood, E. (1996): *Play, Learning and the Early Childhood Curriculum*. P. C. P Ltd.
- Bacanli, H. (2000): *Developing and Learning*. Ankara, Turkey.
- Bjorklund, D. E. (1995): *Children's thinking and Developmental*. Function and Individual Differences. Cole Pub. Co.
- Büyükkaragöz, S. & ve Çivi, C. (1994): *General Teaching Methods (6th ed.)*. Konya, Turkey.
- Dönmez-Baykoç, N. (1992): *Game Book*. Istanbul, Turkey.
- Hazar, M. (1996): *Physical Training and Game Education in Sport*. Ankara, Turkey.
- Işık, A. & Kiliç, D. (1998): *Certificate students' opinions in Primary Teacher Education about Mathematics Education*. 3rd National Science Education Symposium (held at Trabzon, Turkey, September 23–25, 1998).
- Johnson, E. J. & Cheristie, F. J. (1998): *Play and early childhood development*. New York, NY: Scott, Foresman and Company.
- Kart, C. (1996): *Mathematics and its Place in Country Improvement*. Journal of Contemporary Education (Ankara).
- Özdoğan, B. (1997): *Child and Game*. Ankara, Turkey.
- Özhan, M. (1997): *The Culture of Child Game in Turkey*. Ankara, Turkey.
- Özmen, Ö. (1976): *Education Triangle in Contemporary Sport*. Izmir, Turkey.
- Papanostosiou, C. (2000): Internal and External Factors Affecting Achievement in Mathematics: Some Findings from TIMSS. *Studies Educational Evaluation* 26(1) 1–7. MATHDI 2001b.01131
- Poyraz, H. (1999): *Game and Toy in Pre-School Period*. Ankara, Turkey.
- Soylu, Y. (2001): *Teaching Mathematics Through Games at the First Stage of Elementary Education*. High License Dissertation (Unpublished). Erzurum, Turkey: Atatürk University.
- Topses, G. (1992): *Human and Psychology in Education Process*. Ankara, Turkey.

Treays, R. (2000): *Multiplication Table, (12th ed.)*. Ankara, Turkey.

Tuğrul, B. (2000): Mathematics and Game. In: *5th Science Education Symposium* (pp. 556–561). Ankara, Turkey.

Umay, A. (1996): Mathematics Education and Measured. *Hacettepe University Journal of Education Faculty*, 145–149.

Wood, Eric (1995): Activities: Gas-Bill Mathematics. *Mathematics Teacher* **88(3)**, 214–218, 224–227. MATHDI **1996c.01872**

Yörüköğlü, A. (1993): *Child Soul Healthy*. Istanbul, Turkey.