



## Investigating Students' Achievement in Mathematics through Non Technological Game Based Teaching

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### Abstract

This paper shows the results of an experimental study about games-based teaching approach, carried out in a third world country. This paper describes how a non-technological game "Guess and Tell" was used as a source of teaching mathematical concepts of 'Mean' and 'Mode' to grade eight children. The paper focused on the questions (1) is the game 'Guess and Tell' effective in improving students' achievement? (2) has the game different effect on male and female' achievement? Based on the results of this study, it can be said that non technological games can play a vital role in improving students' achievement in mathematics and it is equally important for male and female students. The pre-test and post-test results of this research reveal that variation exists in the achievement level of male and female students but these are not statistically significant. On the basis of the findings, the researcher suggests, to investigate more dimensions in using the game, 'Guess and Tell' in the class room.

**Keywords:** Games based teaching, Guess and Tell Game, Non-Technological game, Students' Achievement

Reference to this paper should be made as follows:

Mustafa, J., Khan, A., & Ullah, A. (2011). Investigating students' achievement in mathematics through non technological game based teaching. *International Journal of Scientific Research in Education*, 4(3&4), 151-164. Retrieved [DATE] from <http://www.ij sre.com>.

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## INTRODUCTION

Learning is a complex process due to the complexity of human nature. Rose and Conner (2006) stated that, "learning is a discursive activity that involves social and material resources. Difference in the human nature causes different learning requirements for learning. Different people have different perceptions and process information differently (Miller, 2001). Different students have different learning styles. In order to improve students' performance having various learning styles, there is often a need .to explore various learning opportunities which can address the

complexity of learners in the classroom to capture pupils' interest and purpose and it should be for fast, average and slow learners (Ediger & Rao, 2000).

Learning occurs with the utilization of various resources and utilization of resources is the ability of a person (Lujan & DiCarlo, 2006). The increase in learning happens when the student is enjoying the process (Miller, 2001). The guarantee for real learning is the creation of joy, excitement, and love for learning and these are created through games and it is a way of learning (Haramati, 2000).

Through games-based teaching education can be imparted affectively in all fields particularly in mathematics, as "games have educational values and are played for enjoyment and pupils enjoy games in mathematics" (Ediger & Rao, 2000, p.152). Games are transformed in a particular form when they are used for educational purposes. They are still games but they are used for specific aim to learn particular things, and to develop certain strategies or abilities, (Barbara, Mattson & Chu, 2008). Designing educational games for facilitating games-based learning is highly emphasized in the literature (O'Neil & Fisher, 2004).

Games can be used as a tool in the classroom to engage students. As according to Corti (2006), games engage people psychologically and physiologically and the people engaged in the games can have emotional experiences. Games are the ideal tool for imparting education to students and are helpful in accommodating multiple learning styles and offer decision and interactive context (Holland, Jenkins, & Squire, 2003). Games are means for promoting the interaction, increasing motivation, and advancing students' thinking skills (McFarlane, Sparrowhawk & Heald, 2002).

Games help to create and provide an environment for the users in which they learn the process of explanation, description, construction, assessment, and the evaluation of advanced problem solving skills (Corti, 2005). From the above discussion, it can be concluded that games are considered to be an unavoidable factor for enhancing and accelerating the teaching learning process. With the acceleration of teaching learning process, students' achievement will also be improved in all their respective subjects including mathematics. Here in this paper, achievement in the subject of mathematics refers to the academic performance of students in solving the mathematical questions by the concepts presented in their mathematics textbooks.

Regarding the role in teaching learning process, Barbara & Chu (2008) stated, "Games are effective tools for learning because they offer students a hypothetical environment in which they can explore alternative decisions without the risk of failure". Games are the sources of students' engagement, which can be valuable, and they have a role in learning (Eck, 2006). Research studies support that games can be used effectively for instructions in the teaching learning process (Squire, 2005, Shaffer, 2006). An experimental study conducted by Chuang & Chen (2009) shows that the computer based video games can promote students' learning and performance.

### **Need of Games-based teaching and learning**

It is the age of advanced technology. Whenever there is discussion about games-based teaching and learning, it is considered as technological games or computer games. Technological games are such games in which electronic devices in any form are used. On the other hand such games, in which there is no use of any kind of electronic devices in any form are considered as non-technological games. Here in this paper the game, "Guess & Tell" (Appendix A) is a non-technological game.

### **Technological Games**

The games played through technology in the classroom have their own significance and advantages. For instance, video games have great benefits in the classroom and various subjects can be taught through video simulation games (Deubel, 2006). Such video games provide opportunities to students for exercising practice skills in the classroom. These are helpful for students, in exploring the solution of the new problems they face in life. Creativity of students can be accelerated and sound learning principles can be utilized through good video games (Gee, 2003, 2007).

Various studies in different perspectives had been conducted for evaluation of games-based teaching learning process (see e.g. Lisi & Wolford, 2002, Funk, 2001). Most of the evaluation of games based teaching and learning emphasized the psychological and behavior aspects of learners (Provenzo, 1991, Squire, 2003). Whatever the aspects may be, besides the benefits of the games based teaching, numerous other critics have also criticized it (Connolly, Stansfield & Hainey, 2007). For example Gros (2007) reports that playing videogames provide many undesirable things to learn.

These varied opinions about games-based teaching and learning realize the need to research various dimensions and methods in which the integration of games in the learning process can be possible (Eck, 2006). Some of the researchers justify the need of research in regard to games based teaching and learning and are of the opinion that the evaluation of the effect of the games-based learning approach is limited and in many cases nonexistent (Connolly, Stansfield, & Hainey, 2007). Most of the studies carried out about evaluating and searching out the effect

of games-based teaching and learning are in the context of technological games. No efforts have been made regarding the studies about the effectiveness of non-technological games.

### **Non-technological games**

In fact the need and benefits of technological games will always exist and it is fruitful in teaching learning process. However, ground reality shows that in this global world technological games are not available everywhere. Millions of people in this global village lack basic facilities like water, food, shelter, and electricity and obviously there will be limited or no chance of incorporating technological games for teaching learning process.

It can be said that in spite of all the benefits of technological games, being the citizens of a global village, it is the challenge for all those who are involved in teaching learning process to think about those students who have no technological facilities. In such a situation the need of games with out technology will always exist. So the non-technological games of low cost or no cost can meet the needs of those students who have no technological games in schools. Particularly when non-technological more specifically non-computer based games have the same potential function as of the computer based games (Hamey, 2003).

Generally, it is believed that through game-based teaching the learner needs to be engaged personally in performing the activities himself/herself. The learner should not receive readymade results presented by some one else. Rather he/she should be directly involved in the process for exploring the results (Bransford, Brown & Cocking, 2002). This non-technological game “Guess & Tell” was developed for the purpose of engaging learner himself/herself in performing the activities. The game developed was the modified form of the traditional game which youngster often play for entertainment in the local area. It was about the utilization of thinking and guessing power of the students.

The aim of the game was to check its impact in perspectives other than learners’ psychological and behavioral aspects, cited in the literature (Provenzo, 1991; Squire, 2003; Lisi & Wolford, 2002; Funk, 2001). This game was intended to see its role in enhancing students’ achievement in mathematics. It was used for teaching mathematical concepts of ‘mean’ and ‘mode’ to the eight grade students. Before using an experiment, the game was tested in a situation other than the target sample.

### **Purpose of the study**

This study was carried because of the following objectives;

- 1- To evaluate the effect of non-technological game based teaching on students’ achievement in mathematics.
- 2- To compare the difference in the achievement level of male and female students through the use of non-technological game in teaching mathematics.

### **Hypothesis**

To achieve the objectives, the following null hypotheses were tested:

Ho<sub>1</sub>: There is no significant difference between the pre test and post-test scores of the whole male & female students.

Ho<sub>2</sub>: There is no significant difference between the pre-test post-test scores of male students.

Ho<sub>3</sub>: There is no significant difference between the pre-test post-test scores of female students.

Ho<sub>4</sub>: There is no significant difference between the achievement level of male and female students.

## **METHOD**

### **Sample**

A total of 39 (thirty-nine) grade eight students having an average age of fourteen years of government middle school in rural area of District Karak in the province of Khyber Pakhtoonkhwa (KPK) were selected for the study. The students comprised 16 males and 23 females. Permission from the parents of the students who took part in this study was not taken, as in Pakistan normally permission from parents is not needed.

In this school, co-education is offered. Co- education refers to the education of male and female studying in the same institute and class as well. The class under consideration is unique, as due to the social norms of Pakistani culture and religious constraints there is no trend of co-education in the public sector institutions at elementary and secondary level. As the religious and cultural limitations, discourage parents from sending their daughters to mixed gender schools (Khan, 2008).

## Research design

In this study one group pretest-posttest (Best & Kahn, 2003) experimental design was used. Symbolic presentation of the design is;

$$O_1 \quad X \quad O_2$$

Where  $O_1$ = Pre-test and  $O_2$ = Post-test

The independent variable in this study was the game 'Guess & Tell' and the dependent variable was students' achievement in mathematics. The measurement has been made prior to the exposition to the game and after the implementation of the game. The teaching through this game was carried through a period of two weeks. The duration of period varied from 40 to 55 minutes per working day.

## Instrument

Two instruments were used in this study. The first instrument was the game, 'Guess & Tell' which was used as an instructional tool for teaching mathematical concepts 'mean' and 'mode'. Second instrument was students' achievement test (pre post-test). Tests were used with the intention to evaluate students' achievement in mathematics. For pre test, the achievement test was prepared from the textbook (NWFP, 2006) on the basis of the previous knowledge of the students with the consultation of concerned teacher. In the post-test for determining the achievement level of the students, questions were selected from the chapter taught to the students through game based teaching entitled 'Information handling (chapter 4) from the 8<sup>th</sup> grade Mathematics text book. Furthermore, the test was prepared both by the researcher and the concerned teacher in collaboration.

## Procedure

A pre-test prepared by the teacher was administered for finding the existing achievement level of students. After the pre-test, students of the whole class were divided into two groups, named Gulab Team and Yasmin Team. In each team there were mix gender students. Then the game "Guess & Tell" was applied in the classroom for two weeks in three different forms for teaching the concepts of 'Mode' and 'Mean' to the students. Before administering the game in the classroom, one week training was given to the teacher about how to use the game in the classroom. The teacher played double role in the whole process. On one side he became a participant in game playing and on the other side he taught mathematics to the students. After finishing two weeks games-based teaching, a post-test was administered for determining the effect of the game in improving students' achievement in mathematics.

## Data analysis

For the analysis of data, paired sample t-test was applied. For applying paired sample t-test, statistical software SPSS version 16.0 was used.

## RESULTS & DISCUSSION

### Results of the whole class

On the whole the post-test mean score of male and female was higher than pre-test score (Table 5-a) and there was a strong positive correlation between the pre-test post-test scores of the students as a whole (Table 5-b). The analysis shows that there was a significant change in the students' achievement in post-test scores. Using paired sample test at the significance level of 0.05,  $t(37) = 5.091$  at  $p=.000$  (Table 5-c) enable us to reject our null hypothesis  $H_{01}$ , that there is no difference between the post-test pre-test scores of the students. So by correcting ourselves, we can say that there is a significant difference between post-test pre-test scores and it can be concluded that game 'guess & tell' has positive effective on students' achievement in mathematics.

Table 5-a

|        |           | Paired Samples Statistics |    |                |                 |
|--------|-----------|---------------------------|----|----------------|-----------------|
|        |           | Mean                      | N  | Std. Deviation | Std. Error Mean |
| Pair 1 | Post-test | 16.4211                   | 38 | 6.82852        | 1.10773         |
|        | Pre-test  | 12.6053                   | 38 | 6.08294        | .98678          |

Table 5-b

| Paired Samples Correlations |                      |    |             |      |
|-----------------------------|----------------------|----|-------------|------|
|                             |                      | N  | Correlation | Sig. |
| Pair 1                      | Post-test & Pre-test | 38 | .750        | .000 |

Table 5-c

| Paired Samples Test |                      |         |                |                 |   |         |       |    |                 |
|---------------------|----------------------|---------|----------------|-----------------|---|---------|-------|----|-----------------|
|                     |                      | Mean    | Std. Deviation | Std. Error Mean | Paired Differences                        |         | t     | df | Sig. (2-tailed) |
|                     |                      |         |                |                 | 95% Confidence Interval of the Difference |         |       |    |                 |
|                     |                      |         |                | Lower           | Upper                                     |         |       |    |                 |
| Pair 1              | Post-test – Pre-test | 3.81579 | 4.61991        | .74945          | 2.29726                                   | 5.33431 | 5.091 | 37 | .000            |

### Male Students' Results

Like the whole class results, the male students' mean achievement score in the post-test was higher than their pre-test mean score (table 6-a) and there was positive correlation (.617) between male students' pre-test post-test scores (Table 6-b). A paired sample t-test showed a statistically reliable difference between the post-test and pre-test scores of male students at  $t(14)=3.579$ ,  $p=0$ , at the significance level of 0.05 (table 6-c). This implies that the non- technological game 'Guess & Tell' had positive effect on male students achievement in mathematics. So the null hypothesis  $H_{02}$  that there is no difference in the pre-test post –test scores of male students cannot be accepted.

Table 6-a

| Paired Samples Statistics |           |         |    |                |                 |
|---------------------------|-----------|---------|----|----------------|-----------------|
|                           |           | Mean    | N  | Std. Deviation | Std. Error Mean |
| Pair 1                    | Post-test | 17.9333 | 15 | 5.90964        | 1.52586         |
|                           | Pre-test  | 12.8667 | 15 | 6.55599        | 1.69275         |

Table 6-b

| Paired Samples Correlations |                    |    |             |      |
|-----------------------------|--------------------|----|-------------|------|
|                             |                    | N  | Correlation | Sig. |
| Pair 1                      | PostTest & PreTest | 15 | .617        | .014 |

Table 6-c

| Paired Samples Test |                |                 |   |         |       |    |                 |
|---------------------|----------------|-----------------|---|---------|-------|----|-----------------|
| Mean                | Std. Deviation | Std. Error Mean | Paired Differences                        |         | t     | df | Sig. (2-tailed) |
|                     |                |                 | 95% Confidence Interval of the Difference |         |       |    |                 |
|                     |                |                 |   | Lower   | Upper |    |                 |
| 5.06667             | 5.48331        | 1.41578         | 2.03011                                   | 8.10322 | 3.579 | 14 | .003            |

### Female Students' Results

A difference in the means of post-test pre-test scores of female students achievement was noted as 3.00 (table 7-a), and a positive correlation 0.850 between their post and pre-test scores (Table 7-b) was also observed. There was a significant difference between female students pre and post-test scores with  $t(22)=3.715$ ,  $p=0.001$  at 95% confidence level (Table 7-c). This result suggest to reject the null hypothesis  $H_{03}$  that there is no significant difference in female

students' pre & post test-test achievement scores. So the game 'Guess & Tell' helped in improving female students' achievement in mathematics.

Table 7-a

| Paired Samples Statistics |           |         |    |                |                 |
|---------------------------|-----------|---------|----|----------------|-----------------|
|                           |           | Mean    | N  | Std. Deviation | Std. Error Mean |
| Pair 1                    | Post-test | 15.4348 | 23 | 7.32261        | 1.52687         |
|                           | Pre-test  | 12.4348 | 23 | 5.89935        | 1.23010         |

Table 7-b

| Paired Samples Correlations |                      |    |             |      |
|-----------------------------|----------------------|----|-------------|------|
|                             |                      | N  | Correlation | Sig. |
| Pair 1                      | Post-test & Pre-test | 23 | .850        | .000 |

Table 7-c

| Paired Samples Test |                      |         |                |                 |   |         |       |    |                 |
|---------------------|----------------------|---------|----------------|-----------------|---|---------|-------|----|-----------------|
|                     |                      | Mean    | Std. Deviation | Std. Error Mean | Paired Differences                        |         | t     | df | Sig. (2-tailed) |
|                     |                      |         |                |                 | 95% Confidence Interval of the Difference |         |       |    |                 |
|                     |                      |         |                |                 | Lower                                     | Upper   |       |    |                 |
| Pair 1              | Post-test – Pre-test | 3.00000 | 3.87298        | .80757          | 1.32520                                   | 4.67480 | 3.715 | 22 | .001            |

### Differences in Male and Female Students' Achievement Scores

Results reveal (table 8a & table 8b), that there was no significant difference in male and female achievement scores. A t-test didn't show a statistically reliable difference between the mean achievement that male students have (M=5.0667, SD=5.48331) and that female students have (M=3.00, SD=3.87298),  $t(36) = 0.181$ , at  $p < 0.05$  confidence level. These results compel us to retain the null hypothesis  $H_{04}$  that there is no significant difference in male and female achievement scores.

Table 8-a

| Group Statistics |        |    |        |                |                 |
|------------------|--------|----|--------|----------------|-----------------|
| Test Difference  | Gender | N  | Mean   | Std. Deviation | Std. Error Mean |
| Test Difference  | Male   | 15 | 5.0667 | 5.48331        | 1.41578         |
|                  | Female | 23 | 3.0000 | 3.87298        | .80757          |

Table8-b

| Independent Samples Test |                             |   |      |       |                              |                 |                 |                       |   |         |
|--------------------------|-----------------------------|---|------|-------|------------------------------|-----------------|-----------------|-----------------------|---|---------|
|                          |                             | Levene's Test for Equality of Variances |      |       | t-test for Equality of Means |                 |                 |                       |   |         |
|                          |                             | F                                       | Sig. | t     | df                           | Sig. (2-tailed) | Mean Difference | Std. Error Difference | 95% Confidence Interval of the Difference |         |
|                          |                             |   |      |       |                              |                 |                 |                       | Lower                                     | Upper   |
| Test Difference          | Equal variances assumed     | 1.958                                   | .170 | 1.363 | 36                           | .181            | 2.06667         | 1.51576               | -1.00745                                  | 5.14078 |
|                          | Equal variances not assumed |   |      | 1.268 | 23.040                       | .217            | 2.06667         | 1.62991               | -1.30474                                  | 5.43807 |

## DISCUSSION

The overall impact of the game, 'Guess & Tell' was very positive on students' achievement in mathematics. Performance of male and female students both improved as a result of the treatment of the game. Gender has an important role in playing and selecting a game (Joseph & Kinzie, 2008) and hence generally it is supposed that games based teaching will differently affect the achievement of male and female students. Yet in this experiment, there was no statistically significant difference between male and female students' achievement. However, pre-test and post-test achievement scores (Appendix B & C) show that male students made more progress than their counterpart.. Also the mean difference between pre-test and post-test score of male students was 5.06 and between female students was 3.00. This research supports the research studies that games and simulation are helpful for both genders (Vogel et al, 2006).

Teaching through games play different roles in teaching learning process. It motivate students and help them to develop skills, abilities, strategies (Barbara Martinson, ChiaLing Hsieh Mattson and Sauman Chu,2008) . Similarly this game, Guess & Tell' play an important role in the improvement of students achievement in mathematics. The results of this study support the video games-based teaching findings of Chuang & Chen (2009) study that game has positive effects on the students' achievement while teaching mathematics at elementary level. The game used in the class room for teaching the concept of 'mode' and 'mean' to the students helped to expose each student for engagement practically in solving mathematical concepts 'mode' and 'mean' during teaching. This led to a better understanding of mathematics which enabled the students to achieve better scores after teaching through, "Guess and Tell" game. Hence its results strengthen the idea that game playing is a successful pedagogical approach (Thiagarajan & Parker, 1999).

### Limitations of the study

There were several limitations in this study. The two groups control and experimental would more better for this study, but due to the unavailability of more students in the same school and such mix gender public school in its near surroundings. So the use of a single group experimental design was limitation of the study. The students' achievement pre and post-tests were developed by the researcher in collaboration with the classroom teacher and were not statistically tested for reliability. Hence teacher made test was limitation of the study. Time of the game was not observed and was also limitation of the study.

## CONCLUSIONS

Contrary to the practices made in the previous studies, in which mostly the effect of technological games was examined on students' performance in different perspectives. This study was developed to investigate the role of non-technological games in the enhancement of students, achievement in mathematics. Based on the results and limitations stated earlier the following conclusions were drawn.

The results of this study provide evidence that non-technological games can facilitate students' improvement in mathematics achievement. It can play the role similar to that of technological games in teaching learning process. Students can be uplifted academically through non-technological games without using technology. Such games are the alternatives for the areas where there is no availability of technological games. Further more, such games provide equal opportunities for male and female students to elevate their understanding in mathematics.

This study may be a base for teachers to discover more such type of games in their surroundings and use these games in teaching of their respective subjects. The game used in this study can work as a catalyst for preparing teachers to create their own games for teaching of all the subjects including mathematics. The study also impart the message to the teachers training institutions to establish research cells for the preparation and making of such kind of games.

This game is potentially capable to create more occasions for classroom interaction among students and between students and the teacher. Although the classroom interaction factor was not the focus of this study, however it gives the notion that such kind of games can improve classroom interaction among students particularly between male and female in a mix gender classroom.

### Implications for Further Studies

Consequently, it creates the implication for further studies to find the impact of this game on students' interest in mathematics. This game can be used for further studies on the improvement of classroom interaction among students and between students and teachers. This game also provides opportunity for further studies to find its role in lessening gender discriminatory behavior of students in co-educational institutions.

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## Appendix A

### **Over view of the Game:**

Each team contained both male and female students. Five colors were given to Yasmin team and the students of Gulab team were asked following question, “Guess and Tell which color is in my hand?” There were four chances for guessing. If the answer was correct in the first chance, the students were given 10 scores, in the second chance 8 scores; in the third chance 6, scores in the fourth chance 2 scores other wise Zero was awarded. In each chance the students of the winner team were clapping. During this process one student was writing the score of the team on the black board and the rest of the students were asked to write down the score in their notebooks. After doing the game twelve times, the score of the team was shown on the black board as is in table 1.

Table-1 Score of Gulab Team

| No of games | Score gained |
|-------------|--------------|
| 1           | 2            |
| 2           | 6            |
| 3           | 8            |
| 4           | 6            |
| 5           | 10           |
| 6           | 0            |
| 7           | 6            |
| 8           | 8            |
| 9           | 2            |
| 10          | 6            |
| 11          | 2            |
| 12          | 6            |

Students were asked to tell which score the Gulab team has more frequently gained? They answered that the score 6 has mostly repeated hence it has gained score 6 more frequently. So a prize of six bubbles was given to each student of Gulab team. The teacher explained the students that the most repeated number in any data is called mode, hence in this game the mode was 6 because the number 6 was mostly repeated.

The same game was repeated but this time the students of Gulab team asked the students of Yasmin team the same question, “Guess and Tell which color is in my hand?” After doing the game twelve times on the same procedure as discussed earlier, the score of Yasmin team was shown on the black board in table 2.

Table-2 Score of Yasmin Team

| No of games | Score gained |
|-------------|--------------|
| 1           | 10           |
| 2           | 8            |
| 3           | 6            |
| 4           | 6            |
| 5           | 8            |
| 6           | 10           |
| 7           | 2            |
| 8           | 6            |
| 9           | 8            |
| 10          | 10           |
| 11          | 10           |
| 12          | 2            |

The students were again asked to tell the scores that is repeated most of the time in the table 2. The students answered 10. The teacher told that the ‘mode’ of this game is 10 and ten bubbles were given to each student of Yasmin team as a prize.

The time for playing the game was 40 minutes. This game was carried on for four days. In the next two days, the teacher taught the method of finding ‘mode’ through solving examples given in the textbook. The questions about finding ‘mode’ were solved by students as well.

In the next week, the same game was carried on in the same manner. However, this time in each turn, bubbles equivalent to the score gained by a team were given to a student. At the end one student calculated the sum of the score on the black board (Table 3). The other student reckoned all the bubbles in hand and the remaining students were asked to sum up the scores in their notebooks. The sum was found as 86. The students were asked to divide the sum 86 by the number of games that is 12. One student on the black board and others in their notebooks divided the total score by the total number of games. The answer was told as 7.13, which the teacher told as the mean of the score. To each student 7 bubbles were given for actively participating in the

game. The teacher told the students that the symbol ‘ $x$ ’ is for score gained; ‘ $\Sigma$ ’ is for sum and ‘ $\bar{x}$ ’ for mean. At the end the teacher explained the method of finding mean by simple formula i.e. total sum of the score divided by total turns. Mathematically

we write it 
$$\bar{X} = \frac{\sum x}{n}$$

Table-3 Finding mean of the score gained

| No of games                      | Score gained<br>$X$                   |
|----------------------------------|---------------------------------------|
| 1                                | 10                                    |
| 2                                | 8                                     |
| 3                                | 6                                     |
| 4                                | 6                                     |
| 5                                | 8                                     |
| 6                                | 10                                    |
| 7                                | 2                                     |
| 8                                | 6                                     |
| 9                                | 8                                     |
| 10                               | 10                                    |
| 11                               | 10                                    |
| 12                               | 2                                     |
| Total no. of games i.e<br>$n=12$ | Sum of total score i.e<br>$\sum X=86$ |

Formula for mean is, 
$$\bar{X} = \frac{\sum x}{n}$$

$$\bar{X} = 86/12 = 7.13$$

This game was repeated for few days. Later on the teacher taught the process of finding ‘mean’ from the students’ textbook and students also practiced of solving questions about finding ‘mean’ themselves.

For the purpose of finding mean through other formula, the same game “Guess & Tell” was again carried on with little modification. Before starting the game, the students were divided into groups such that each group had different number of students. The numbers of students in each group were as follows:

- Group 1= 8 students
- Group 2= 5 students
- Group 3= 7 students
- Group 4= 1 students
- Group 5= 9 student
- Group 6= 4 students
- Group 7= 3 students
- Group 8= 2 students

This time the teacher himself asked the groups to guess and tell which color was in his hand. The score procedure was the same as mentioned in the first game. However, the score gained by the group was also considered as the individual score of each student of the group (see table 4). The teacher explained the students that number of students in a group is called its frequency and it is represented by the symbol ‘ $f$ ’. The symbol ‘ $X$ ’ for score and ‘ $\bar{x}$ ’ for mean were also explained again. The teacher told the students the method of finding the mean through this formula. He told that the ‘mean’ can be obtained by dividing the total sum of

‘ $f x$ ’ ( $\sum f X$ ) by the total sum of frequency ( $\sum f$ ). i.e. 
$$\bar{X} = \frac{\sum fx}{\sum f}$$

Table 4 Finding mean in a group data

| Name of the group | Number of students in the group(frequency)=f | Score of the group=x | fx                                   |
|-------------------|--|----------------------|--------------------------------------|
| Group 1           | 8  | 10                   | 80                                   |
| Group 2           | 5  | 6                    | 30                                   |
| Group 3           | 7  | 4                    | 28                                   |
| Group 4           | 1  | 10                   | 10                                   |
| Group 5           | 9  | 2                    | 18                                   |
| Group 6           | 4  | 8                    | 32                                   |
| Group 7           | 3  | 10                   | 30                                   |
| Group 8           | 2  | 8                    | 16                                   |
|                   | Total sum of frequencies i.e<br>$\sum f=39$  |                      | Total sum of fx i.e<br>$\sum fx=244$ |

Formula for Mean in this case is  $\bar{X} = \frac{\sum fx}{\sum f}$

So Mean =  $244/39$   
=6.25

After using the game for few days, the questions on the above pattern in the textbook were solved by teacher in the classroom and the practices of such questions was done by the students themselves in the remaining days of the week. At the end of the game, in the next week the post-test for determining the achievement level of the students was administered in the classroom.

**Appendix B**

Note: All the students’ names are pseudonym. In the pre-test , post test achievement tests the students score is out of 30 marks because the test in both the cases were of 30 marks.

**Male’ Pre test Score.**

| Name of students | Askar | sabir | Najam | Sehar | Akbar | Uzair | Zabeel | Murad | Asif | Hamid | Ghalib | Jawad | Laiq | Rahim | Sarwar | Faiz |
|------------------|-------|-------|-------|-------|-------|-------|--------|-------|------|-------|--------|-------|------|-------|--------|------|
| Pre test<br>n=16 | 03    | 20    | 16    | 10    | 14    | 26    | 21     | 11    | 18   | 14    | 09     | 07    | 12   | 05    | 04     | 10   |

**Male’ Post test Score**

| Name of students  | Askar | sabir | Najam | Sehar | Akbar | Uzair | Zabeel | Murad | Asif | Hamid | Ghalib | Jawad  | Laiq | Rahim | Sarwar | Faiz |
|-------------------|-------|-------|-------|-------|-------|-------|--------|-------|------|-------|--------|--------|------|-------|--------|------|
| Post test<br>n=15 | 10    | 19    | 20    | 26    | 12    | 24    | 27     | 13    | 19   | 21    | 14     | Absent | 20   | 06    | 18     | 20   |

**Appendix: C**

**Female’ Pre test Score:**

| Name of students | Sraa | Zara | Fatma | Subia | Aisha | Pinki | Leema | Bano | Rukia | Jamila | Sakia | Mamila | Nazi | Mala |
|------------------|------|------|-------|-------|-------|-------|-------|------|-------|--------|-------|--------|------|------|
| Pre test<br>n=39 | 08   | 16   | 10    | 13    | 13    | 21    | 07    | 09   | 09    | 05     | 25    | 03     | 14   | 09   |

|       |       |       |        |        |       |       |        |      |
|-------|-------|-------|--------|--------|-------|-------|--------|------|
| Faila | Eshal | Debra | Shamsa | Nigara | Kalma | Asifa | Hadija | Arzu |
| 11    | 08    | 10    | 12     | 25     | 09    | 21    | 16     | 12   |

#### Female' post-test scores

|                  |      |      |       |       |       |       |       |      |       |        |       |        |      |      |
|------------------|------|------|-------|-------|-------|-------|-------|------|-------|--------|-------|--------|------|------|
| Name of students | Sraa | Zara | Fatma | Subia | Aisha | Pinki | Leema | Bano | Rukia | Jamila | Sakia | Mamila | Nazi | Mala |
| Post test n=38   | 14   | 18   | 15    | 12    | 20    | 27    | 11    | 13   | 07    | 03     | 28    | 08     | 12   | 16   |

|       |       |       |        |        |       |       |        |      |
|-------|-------|-------|--------|--------|-------|-------|--------|------|
| Faila | Eshal | Debra | Shamsa | Nigara | Kalma | Asifa | Hadija | Arzu |
| 08    | 09    | 18    | 24     | 29     | 07    | 25    | 17     | 14   |

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