

Mathematics Games as a New Trend in Mathematics Instruction

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Introduction

Mathematics is one of the core subjects in the Nigerian education system. It is recognized by the National Policy on Education (2014) as a compulsory subject in both primary and secondary school levels of education. To this end, much emphasis is laid on its teaching and learning. Many schools, especially private schools, in an attempt, to recognize the relevance of Mathematics has given it more time on the school teaching timetable. Some other schools, both public and private schools have resorted to recruiting only highly qualified Mathematics teachers. But slim stipend given to such teachers, always in turn seem to mal the intention of such arrangement. Furthermore, it is no more a news or rather it has become an old song telling teachers to teach with instructional materials. All these are efforts made into injecting newness in teaching and learning process and thereby sustain the interest of the students.

Researches have shown that Mathematics has not recorded the expected success in both internal and external examinations. There has been poor performance of the students across the years. This situation has put to question, all the efforts made towards making Mathematics instruction a successful one. It has called for more result-oriented measures in teaching and learning of Mathematics. As a result of this, such terms like practical Mathematics instruction, Mathematics laboratory techniques, Mathematics games, etc. are gradually emerging in the school system now. However, serious criticisms have greeted practical Mathematics on account of the fact that many teachers were not trained for it, hence, they lacked the competencies for its proper implementation. Again, for lack of Mathematics laboratories in many schools, especially government owned schools, the use of laboratory techniques has equally hit the rock. In all, the argument was in favour of Mathematics games, owing to the fact that games or plays are birth

right of every child. Children, by nature like to play games. They can play games with full attention for hours. This is the secret of why the use of Mathematics game is becoming the emerging issue in Mathematics instruction, especially in primary and junior secondary schools. This chapter therefore, looks at what Mathematics game is all about and what makes a game, Mathematics. It will also look at the techniques for using Mathematics games and the benefits of using games in Mathematics instruction. Finally, some games were suggested for some selected topics in Mathematics.

The concept of Mathematic Games

When considering the use of games for teaching and learning of Mathematics, educators should distinguish between an “Activity” and a “Game”. A mathematical activity is any activity that exposes students to learning some mathematical concepts and contents. It may not be competitive in nature and as well no rules may apply. It is an activity that is students-oriented and engages the students to test theories and principles in Mathematics. A game, on the other hand, is a type of play that follows a set of rules; aims at a definite goal or outcome; and involves competition against other players or against barriers imposed by the nature of the game itself. Gough (1999) states that a game needs to have two or more players, who takes turns, each competing to achieve a winning situation of some kind, each able to exercise some choice about how to move at any time through the playing. The key word in this statement is that of ‘choice’. In this sense, something like snake and ladder is not a game because winning relies totally on chance. The players neither make decisions nor do they have to think further than counting. There is also no interaction between players – nothing that one does affects other players’ turns in any way. Worthy of note is that all Mathematics games are mathematical activity but not all mathematical activities are Mathematics games.

In their own version, Aldridge and Badham (1993) said that Mathematics games are ‘activities which:

- Involves a challenge. Usually against one or more opponent;
- Are governed by a set of rules and have a clear underlying structure;
- Normally have a distinct finishing point and
- Have specific Mathematical cognitive objectives.’

In the words of Mwalor (1993), Mathematics games are activities involving cooperation and competition guided by standard rules. In other words, a game is a contest (play) between adversaries (players) operating under constraints (rules) in order to achieve an objective (winning or pay-off) (Elligton & Perciva, 1977). To buttress this, Agwagah (2001) asserted that a game is a situation in which two or more participants, the players, confront one another in pursuit of certain conflicting objectives. So, for those objectives to be achieved, it involves skills, chance, and endurance on the part of two or more persons who play the game. However, a game can be considered as mathematical when the players can perceive and/or influence the course of the game on the basis of mathematical considerations (Thiele, 1994). This implies that not all games are Mathematics games. A Mathematics game must have mathematical structure. In specific terms let us look at features or characteristics of Mathematics games.

Features or Characteristics of Mathematics Game

Games abound, but each game has its own specific characteristics. On the general, games have the following features:

- i. **There must be rules:** A bridge of which, results to a discount on the part of the offender or weakening of excellence of the offender, even if he wins the game.
- ii. **It is competitive:** The competition could be between/among individuals or groups, or against the barriers imposed by the nature of the itself.
- iii. **A goal or objective:** There is a finishing point where the winner or the loser is determined.

Specifically speaking, Obodo (1997) summarized Mathematics games as games that must have:

- i. A clear underlying mathematical structure
- ii. A distinct finishing point
- iii. Specific mathematical cognitive objectives
- iv. Enjoyment and recreation and at the same time stimulate mathematical thinking
- v. A deriving force that is capable of motivating students especially slow learners
- vi. The ability to lead to discovery and creativity.

In all, any game that falls short of any of these features cannot be regarded as a Mathematics game. However, after carefully selecting a Mathematics games and applying it appropriately using the principles that will be discussed later, the following benefits will be harnessed.

Benefits of Mathematics Games

Mathematics games can be of benefit to both students and teachers. In general, it facilitates teaching and learning in various ways. The following can be deduced as the benefits of Mathematics games:

- i. Games provide enjoyment and recreation and at the same time stimulate mathematical thinking.
- ii. It facilitates individualized instruction and assessment
- iii. It concretizes abstract mathematical concepts
- iv. It gives the students the opportunity of becoming problem solvers in a non-threatening environment.
- v. It provides students with opportunity to invent and test various strategies and procedures for solving problems
- vi. It creates motivation in learning
- vii. It reduces the cost of training
- viii. It generates and sustains interest
- ix. It provides inexpensive instructional materials for teachers.
- x. It increases the teachers' mastery knowledge of the subject
- xi. It develops collaborative skills and reduces stress.

Meanwhile, in spite of the benefits of Mathematics game, there are yet skills or techniques of using Mathematics Games, without which, the benefits of the game cannot be achieved.

Techniques of using Mathematics Games

For an effective method of teaching with games, the teachers of Mathematics should take into considerations certain precautions. For instance, Jelena (2006) posited that the teacher should ask such questions as:

- i. What is the goal of the game?

- ii. What knowledge, skills and abilities in Mathematics will the students acquire while playing the game?
- iii. How can the students be assessed?
- iv. What method will be used during the game (individual, collective or group work)/
- v. What materials and tools will be needed for the game?
- vi. How can you introduce the rules of the game to the students in the shortest amount of time?
- vii. How will you ensure the involvement of all the students in the game?
- viii. How much time will you set aside for the game?
- ix. What element will you include to increase the students' interest and activity levels?
- x. What conclusions will you announce to the students after the game?
- xi. How will you evaluate each participant's involvement in case of group game?

In order to answer these and similar of such questions, the Mathematics teacher should ensure the following principles/techniques:

- i. The rules of the game must be simple and clearly formulated, and the mathematical game must be appropriate to the students' knowledge level.
- ii. The game must have enough materials to stimulate critical thinking; otherwise it won't provide the support of the teacher in achieving the goals, and it won't develop concentration skills.
- iii. If several games are played during the lesson period, then the easier games must be interspersed within the more difficult ones.
- iv. During the game, the students must formulate mathematically correct answers without errors.
- v. Each student must be an active participant; waiting too long for one's turn will decrease the child's interest in the game. Keep the number of players from two to four, so that turns can easily come quickly.
- vi. When organizing a game that involves team competition, you must ensure that you can control the results of the entire class. The results of the competition must be public, clear and fair.

- vii. If you use games in several class periods and they all include the same kind of deduction, then, the Mathematics concept must be organized by the principle of simple to complicated, specific to general and concrete to abstract.

In all, a Mathematics teacher must be careful in planning how to utilize appropriate games for Mathematics learning. Disorder, for example, can be created in the class if the teacher uses a game incorrectly. To avoid this, there should be emphasis on the needs of the game and not just as time-fillers.

Games for some selected Topics in Mathematics

The games for the following topics are hereby presented as follows:

1. Substitution of Algebraic Expression Game
2. Factors and Multiple Number Games
3. Geoboard Game for identifying and differentiating polygons
4. Geoboard Game for describing and locating coordinate points

(A) Substitution of Algebraic Expression Game

Class: JSS 1, 2 or 3 and SS 1

Number of players: 2 individual students or 2 groups of students

Materials: A coin, two dice of different colours, paper, pencil, a board with an algebraic expression and a stop watch.

Objective: To master the substitution of the values of the unknowns in an algebraic expression and simplifying it.

Procedure

A coin is thrown to determine who starts the game. Players or groups A and B will choose either sides of the coin. The player or group with the side that faces up, begins the game. The first player, say, player A or a student from group A (if it is played between groups); tosses the two dice of different colours (one of which is termed x and the other y , depending on the two variables in the algebraic expression. The second player or group substitutes the numbers on each of the dice, as x and y , in the expression and simplifies. If he/she or the group gives it correctly, as going to be

declared by the referee (the teacher), within the stipulated time, say thirty seconds or one minute, as the case may be, he/she or the group, scores two points. If otherwise, he/she scores zero and then, the next player or group, does the substitution and simplification. If he/she gets it correctly, he/she scores bonus mark of one point. Now it is the turn of the player B or group B to toss the two dice. Player A or group A substitutes and simplifies to score two points if correctly done, otherwise player B or group B substitutes it to score a bonus point of one. The game continues in turns until the agreed number of times/rounds. The person or group with the highest score, wins the game.

Precautions:

1. The time to be allowed for substitution and simplification depends on the intellectual capacity of the students.
2. If the game is to be played in group, the time for substitution and simplification is reduced because every member of the group is expected to be doing the substitution and simplification at the same time. Anyone with the correct answer supplies it to his/her group.
3. Linear algebraic expressions should be satisfactorily mastered by the students before introducing other higher degrees, depending on the intellectual capacity of the students.
4. The game can be made more complex for higher classes, by increasing the degree of the algebraic expression and reducing the finishing time.

(B) Factors and Multiple Number Games

Class: Primary 4, 5 or 6 and JSS 1, 2 or 3

Number of players: 2 individual students or 2 groups of students

Materials: A coin, two dice, paper, pencil, stop watch, a 100 square board and bottle tops or the likes.

Objective: To master the factors and multiples of given numbers.

Procedure

In the same way, a coin is thrown to determine who starts the game. Players or groups A and B will choose either sides of the coin. The player or group with the side that faces up, begins the game. For lower classes and/or students with low intellectual capacities, one die is used. The first

player, say, player A, tosses the die and demands the opponent(s) to place the bottle top against all the factors or multiples (depending on the one agreed on) of the number shown on the die. This must be done within the specified time, say, thirty seconds or one minute, as the case may be. If the opponent(s) gets it correctly, as will be determined by the referee (the teacher), he/she scores two points. If he/she fails to place bottle top on all the factors or multiples of the given number, he/she scores zero. Then, player A does it correctly to earn a bonus mark of one point. Now it is the turn of player B to toss the die and asks player A to place bottle tops on all the factors or multiples of the number of the die. If player A gets it correctly, he/she scores two points, otherwise, player B scores a bonus of one point if he/she gets it correctly. The game continues in turns until the agreed number of times/rounds. The player with highest score, wins the game.

Precautions:

1. Students should be first exposed to mastering of the factors and multiples of numbers on a die before introducing two dice.
2. When students master the factors and multiples of numbers in a die, two dice will be introduced. That is, two dice will be tossed, instead of one, and the factors and multiples of the sum of the numbers on each die is sought for.
3. The complexity of the game can be increased by reducing the time required to place the bottle top on all the required factors or multiples.
4. Each player(s) can replace the bottle top, in case of wrong placement, within the time limit.

Finally, for geoboard games, Obodo (1997) suggested the following games as very important in the teaching and learning of Mathematics:

(C) Geoboard Game for identifying and differentiating polygons

Class: JSS 1, 2 or 3

Number of players: 2 or more

Materials: Geoboard, rubber bands, paper, pencil.

Objective: To identify and differentiate between various types of polygons.

Procedure

Player A uses a rubber band and forms, say, a scalene triangle. He scores 1 point. Player B identifies the shape formed by player A. He scores 1 point. Player B describes the properties of the scalene triangle. He scores 1 point for each correct property. If player B omits one or more properties, player A gives the properties and scores a bonus point for each property.

Now player B forms, say, an isosceles triangle. He scores 1 point. Player A identifies it (1 point) and describes the properties of the isosceles triangle (1 point for each property). Bonus points are similarly scored by B if necessary. They continue with the game for other shapes, for instance, equilateral triangle, quadrilaterals (rectangle, square, parallelogram, trapezium, rhombus, kite, etc.), other regular polygons (pentagon, hexagon, heptagon, octagon, nonagon, decagon). If one has formed a shape, the other is not allowed to repeat the formation of that shape. The player who has the highest number of points, wins the game.

(D) Geoboard Game for describing and locating coordinate points

Class: JSS 2 or 3 or high classes.

Number of players: 2 or more

Materials: Geoboard, rubber bands, pencil, paper.

Objective: To represent and locate coordinate points.

Procedure:

Player A indicates the X- and Y- axes on the geoboard using two rubber bands – one for x-axis and one for y-axis. He points at any pin or nail on the geoboard and asks player B to describe the point, say, (1, 2) and then write it down on paper. Player B points at another pin and asks player A to describe the points, say, (3, -2). Each scores 1 point. The game continues this way until each describes 20 points. If player B fails to describe the point correctly, player A describes the point and gets a bonus mark (1 mark), vice versa.

In the second part of this game, player A mentions a point, say (0, -3) and asks player B to show the position of the point on the geoboard. Then player B mentions another point, say, (-2, 6), while player A locates the position of the point on the geoboard. Each scores 1 point. The game continues this way until each locates 10 or 20 points as desired. Bonus points are scored accordingly. The player who gets higher number of points wins the game.

Conclusion

Mathematics game is an emerging issue, sure and interactive way of teaching Mathematic in both primary and secondary schools. Therefore, all effort should be explored in making it a reality in order to make teaching and learning friendly. In view of this, the paper has x-rayed the concept of Mathematics games, its benefits and the techniques of using them in the classroom Mathematics instruction. Efforts were made to suggest practicable games in some selected topics in both primary and junior secondary schools. It is therefore recommended that Mathematics games, which is the emerging issue in Mathematics instruction for making Mathematics teaching and learning a fun and entertaining adventure, should be championed by all, both public and private schools. Policy makers should ensure that it enshrined in the curriculum as a compulsory way of teaching Mathematics, especially in primary and junior secondary schools.

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