SIMULATION, GAMES, USE OF TOYS AND RECREATIONAL STUDIES IN TEACHING MATHEMATICS

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Abstract

Too often, teachers of Mathematics consider enjoyment of Mathematics lesson through games, simulation and recreation as a thing outside the mathematics lesson procedure. This article discusses the relevance of the use of toys, simulation, games and play in teaching secondary mathematics and its role in increasing the understanding/enhancing enjoyment and broadening the scope of the subject, brightening the lesson and development of students' skills in Mathematics. Teacher's competence in handling the use of games and children's play were also discussed. The following suggestions were proffered: One, there is a critical need for the preparation and encouragement of classroom teachers (and those in training) in the development/design and effective use of simulation game. Two, for effective integration of science and Mathematics simulation game, there should be an appropriate implementation of science and Mathematics simulation game in teacher education course as an important learning/teaching tool. Three, care should be taken to continuously maintain an appropriate balance between direct teaching and student exploration, which can be done during the pre-service and service training of our teachers.

Introduction

Mathematics a study of patterns and relationships was invented because man needs it to solve his domestic and economic problems of buying and selling. This is simply the philosophy behind the growth of the subject and this is also the basis for the philosophy of the teaching and learning. Mathematics has been tremendously useful in many respects of human endeavours. For example, mathematics has been very useful in developing scientific knowledge - the discovery about light, heat and sound in physics, chemicals and machines, in chemistry and biology, economics and sociology in the social sciences, and earth movement in geography. All these have been made possible through skilful application of mathematical knowledge.

Looking at our immediate surroundings however, we see that offices, homes, equipment, instruments, machines, vehicles and even human structure, all bear evidence of mathematics properties and truths. The modern man therefore, needs to have insight into the structure and functioning of these materials. These therefore call for more practical ways of teaching mathematics through the use of aids and games. The Greeks in the primitive days developed the science of mathematics through handling concrete models and the use of diagrams. The importance of aids and instructional materials in teaching and learning process has been widely documented in literature. Obioma and Ohuche (1983), Foxman (1988), Lassa (1978), Alaezi (1989) and Nwachukwu (1979), all emphasized the importance of aids in teaching mathematics as one of the best ways of the instructional process.

By the very nature of mathematics, certain concepts, phenomena are termed difficult or abstract in the average situation for the teacher simulation/games. Use of toys has been found to be an effective and efficient innovative instructional device that could assist the teacher and the learner in such situation (Olurundare, 1995, 2000).

The article examines the definitional nomenclature, problem of simulation/games, its nature, meaning and purposes, how simulation game operates in the classroom and the role of the teacher, further discussions centred on how simulation game can be systematically developed and utilized, advantages and disadvantages, highlighted specific examples of Russian multiplication, magic square and others were treated for practical purposes. Other areas of simulation game outside mathematics discipline were avoided deliberately as it means a great digression from the scope of this article.

Purpose and Use of Games and Recreational Studies

The first and foremost reason for games and recreational study in mathematics is enjoyment. The inclusion of a game, puzzle or recreation is to make the lesson lively, enjoyable and not to be dull. Whether the students are brilliant or dull, they need a mathematics lesson that is lively and enjoyable.

Another reason for games and recreation in mathematics lesson is to deepen the

understanding of the learners. Out of the teacher's busy schedule there must be provision for creating games that will lead to the understanding of concepts in geometry, algebra or any of the difficult concepts like fractions, bearing etc.

Thirdly, games and recreational studies may be used to broaden the subject beyond the boundaries of the syllabus, they are particularly used for stimulating the most able students, and more generally used to compensate for the deficiencies of examination syllabi, which are too restricted in their approach.

Furthermore, the abstract nature of mathematics is reduced when games are introduced appropriately as interlude in the lesson. Games tend to sustain the interest of the learners for a longer time than the talking of the teacher and their doing sums continuously. Pupils are exposed to a variety of activities through games and recreational studies which is dead to development of skills. Also by making use of games, the teacher is taking the advantage of the impulse and as a result, learner's activities are serious, intense and spontaneous.

Games: A game may be defined as an activity in which players strive towards attainment of a set goal within prescribed rules. In such games each player has a role to play, goals to achieve and activities to be engaged in within specified rules and constraints of operations. In many games the player may either win (gain) or lose (a loss) which are either positive or negative as the chance or luck may be. Corbeil et al (1989) listed the characteristics of most games as follows:

Goal to be achieved and activities to be engaged in,

(i) Spirit of competition (not quarrel) or cooperation,

(ii) Rules of conduct which determine role, actions, rewards etc. (iii)
Visible - results,
(iv) Results dependent on pure chance or pure strategy or a mixture of both,
(v) a recreational dimension - which makes the entire activity to be fun. Games may or may not be representation of reality, i.e. they may not be simulation of real/actual life or event/phenomenon. (Eniayeju, 1996; Shay, 1980).

Henderson's (1989) study revealed that the basic look and hands-on-experience found in both simulations and games do actually increase an average individual's confidence and success in mathematics. Games are a very crucial device for motivating and instilling studying mathematics and also help reduce language difficulties. This is because, research has shown that children and even"adults" such as undergraduate students develop their own idiosyncratic strategies that help them to cope. The following examples will explain this.

Example 1 Magic Squares

Cornelius (1982) says that there are informative accounts of the history and theory of magic squares. In general, an n x n square is filled with the consecutive numbers 1 to n^2 such that the numbers of every row, column and diagonal add up to *Vz* n (n^2 + 1). Kordemsky (1975) and Gardner (1961) give some suggestions on how to construct a magic square.

Table 1:3x3 Magic Square
Below is An Example of A 3 X 3 Magic Square

8	1	6
3	*5*	7
4	9	2

The sum of row or column or diagonal =15.

(b) The above can be reconstructed into another magic square by using this rule: Add 20 to each number in the square, and then divide by 8. This will result in a magic square with decimals.

Table 2: A 3 x 3 Magic Square with Decimals

3.5	2.625	3,25
2.875	3.125	3.375
3.0	3.625	2.75

Either row - wise, column - wise or diagonally, the sum = 9.375

Using our formula, can you construct a magic square 4x4 whose row, column or diagonal sum - 34? Note that there will be 16 squares to fill up with numbers 1,2.....

Example 2

Russian multiplication

This is a mathematics game that is quite interesting to students which mathematics teachers at secondary schools can employ.

The game is played as follows (for example):

35x18

Method or rule of the game -

(a) Multiply 35 by 2, divide 18 by 2
(b) Ignore remainders
(c) Continue until the number 1 appears in the division column.
(d) Delete all lines in which there is an even number in the division column.
(e) Add the numbers remaining in the multiplication column to obtain the result.

C.

35 x 18
70 9
440—^
o&o—a
56

1 Answer = 630

A.

69 x 36
~~138—18~~
276 9
~~552—4~~
~~1104—2~~
1
2208

Answer = 2484

Without calculators, students can find answers to multiplication of big numbers with ease if they use Russian multiplication approach.

Example 3

Number Detective work

Bull and Coxeter (1974) identified several ways in which numbers chosen by someone may be found by another person after a series of operations has been performed. This is called number detective work, this is a source of wonder (without algebraic - explanation to the person who chose the number that another person should be able to discover the secret.

For Example-

fa) Ask someone to think of a number (preferable fairly small) and then to
(b) Multiply it by 5
(c) Add 6
(d) Multiply the sum by 4
(e) Add 9
(f) Multiply the sum by 5
(g) Ask the person to tell you the result, subtract from it 165 divide by 100 and the answer will be

the original chosen number.

E.g. Let me Think About **the Number 6**

a. n = 6
b. 6x5 = 30
c. 30+6 = 36
d. 36x4 = 144
e. 144+9- 153
f. 153+5=765
765-165 = $\frac{600}{100}$ = 6 which is the original number chosen.

Other activities

Activity 1: A mystic Rose

This is a beautiful pattern or design by the use of compass and ruler only. This recreational study can be carried out by any mathematics teacher following the simple instructions given below;

(a) Draw a circle of any radius of your choice say 6cm
(b) Divide the circle into given sectors, say 15 each.
(c) Mark these points at the circumference.
(d) Join each point at the circumference to other points on the circumference in sequence.
(e) The final shape is called a mystic Rose.

Activity 2

An Envelope of a Parabola

This is construction of a parabola using your protractor and a ruler. This is a recreational study that uses only straight lines as in the above to produce a parabola. You draw two straight lines to meet at a point producing angle 60E or any other angle. Let the lengths be 15cm each. Bisect the lines 1cm intervals from the meeting point on the two lines. Number them from opposite directions. With your ruler, join No 1 to No 1,2 to 2, until 15 to 15. The pattern produced is an envelope of a parabola.

Other recreational studies include paper folding, origami, tangrams curve sketching and construction of solids which time and space will not permit in this article to explain. The constructions of solids are used in classroom decorations, which add beauty to many lively mathematics departments.

Obodo (1977) listed other games that enhance the learning of mathematics. These include: Ludo or dice game, for probability concepts, draughts, checks, okwe (Igbo), ayo (Yoruba), monopoly, money game, spinner game, geoboard games for geometrical concept etc.

The Role of the Teacher in the Use **of Games and Simulation**

The role of a teacher in the use of games in teaching is seen in Plato's statement in Odu (1985) "Do not train boys to learning by force and harshness, but direct them to it by what amuses their minds, so that you may be better be able to discover with accuracy the peculiar vent of the genius of each".

Olorundare (2001) states that teachers' ability to creating/enabling conditions/environment for this type of learning would depend upon his subject matter mastery, his pedagogical knowledge of specific topics and ability to transform such content (knowledge) into teaching are crucial for the learners' construction of his own knowledge.

Obodo (1997) therefore reiterated that a mathematics teacher therefore must be careful in planning how to utilize appropriate games for mathematics games: He suggests five areas of serious consideration in the appropriate use of the grapples. These are:

1. Choose a game which matches the needs of the students.
2. Use the games appropriately considering the right timing and topics involved.
3. Arrange the games ensuring students' adequate participation.
4. Orderly presentation of the games should be such that the excitement will not over shadow

the purpose; and

5. The relationship between the games and the main lesson to be learnt is drawn out clearly.

Simulations Games and Instructional Method

Simulation game is an instructional method that relies on individualized and/or group learning with the method of introducing change in the learning domain with minimal force, fury, violence or unpleasantness. However, wrong words can engender wrong or inappropriate behaviours. Simulation and games have fallen into the trap of definitional crises judging by the several and varied conflicting and often misleading words used to depict each or both in literature and general language. Some see simulation as being like an informal drama. The dictionary meaning is more confusing and misleading. Chambers 20[lli] Century Dictionary defines simulation as .....to feign and counterfeit. To assume and a false appearance of or to mimic/pretend..." etc. A teacher who is not versed in the use of simulation, will doubt, suspect seeing it as deceit, pretence or counterfeit as means of teaching students.

Garvey (1971) sees simulation as the all inclusive term, which contains these activities, which produce artificial experience for the participation in the activity. It has been observed that simulation is an operational representation of the central features of reality. It can also be defined as the activity, which delineates a range of dynamic representations that employ substitute elements to replace real world components (Taylor and Carter, 1980).

From the ongoing definitions, we see simulation involves students taking on roles and may thus be more open ended than games such as monopoly, ayo etc. Findley (1986), Heinich (1982) observed that for an activity to be a simulation, it must have the following characteristics. These include:

1. It must be based on a model of reality.
2. Objective of activity must be at the level of application.
3. Participants must take responsibilities for their actions and decisions,
4. The student must be a participant and as such be in control.

Advantages of Simulation Games

There are advantages that accrue to the user of simulation games. These include:

i. They provide "learning by doing" learning that occurs in simulation game is based on experience because the participants do things, there is little opportunity for in action in a simulation,

ii. They are enjoyable as they provide fun. The participants are excited as it creates lightenedinterests in the students and adequate emotional involvement.

iii. They motivate students to enquire further the total involvement of participants in what they are doing makes simulation excellent motivators,

iv. They recognise the significance of emotions in the learning process simulation –games contribute to young people's learning in the effective domain,

v. They support interaction between students and learning from each other there is something in a simulation game for everyone, even in a large and heterogeneous class participants play at their own level and no one is handicapped by lack of previous education or experience.

Disadvantages of Simulation Games

I. Disadvantages are not pronounced, as it is just relatively new. Since it is new the resource are limited and are not easily available.

II. Teachers must be familiar with details of the games and its consequences in action. Due to lack of money and time, many teachers are not familiar with this new device.

III. Simulation will generate more noise than classroom activities. In schools where much noise cannot be tolerated, simulation will cause problems.

IV. It is difficult for some to interpret the simulation with the rest of the curriculum due to how narrowly they are viewed.

Conclusion

The article does not tend to suggest that a game is the only way to teach a topic in mathematics, but that it is a weapon in the teacher's armoury which is too often ignored and which if used in a well-organised manner, can make a real contribution to students' understanding and enjoyment of the subject.

• It is hereby emphasized in order to increase their impact; games should be used selectively in the teaching of those topics where they can be of greatest benefit. When pupils are absorbed in the game, they tend to carry out the necessary mathematical operations with an entirely different attitude than would be evident if the same questions were listed in textbooks. During the course of a game, it has been discovered that students will often demonstrate a much higher level of mathematical ability than one had previously thought them to be capable of attaining. If motivation is the key to success in mathematics, then use of game is to be strongly recommended.

As with all strategies of teaching, success does not emerge automatically. The effort of the mathematics teacher in ordering and adequately managing the whole classroom atmosphere depicts the tone of the simulating agent. The scope of simulating students' interest and sustaining their interest in the subject is endless, teachers of mathematics are encouraged to use the games discussed here since there is much to be gained by using them.

References

Alaezi, O. (1989): *The New School Curriculum Issues and Insights.* Jos: Ehindaro (Nig.) Ltd.

Ball and Coxeter (1974) in Cornelius (1982).

Corbell, P. Levenlt, D. Saint-German, M. (1989): *Activities Tools for International Development Education.* Canada: Canadian Dev. Agency.

Cornelius, M. (1982): *Teaching Mathematics.London:* CroornHelm Ltd. 2-10 St. John's Road.

Eniayeju, P.A. (19fc,'6): Teaching Science in Primary Schools: A Practical Demonstration, *Journal of Trends and Issues in Primary Education,* 1 (1): 175-183,

Foxman, D. (1988): *Mathematical Puzzles and Diversion.London:* Penguin Books.

Garvey, M. D. (1971): Simulation: A Catalogue of Judgements, Findings and Hunches. In Tansy, P.J. (Ed) *Education Aspects of Simulation.* London: Me Graw- Hill.

Heinich, R., Molenda, M. and Russel, D. (1982): *Instructional Media and the New Technology of Instruction,~NQW* York: John Wiley and Sons. P. 289-298.

Hinderson, A. (1989): Multi-Sensory Mathematics *Special Children,* No. 34, November.

Kordemsky, B. A. (1975): *Moscow Puzzles* London: Penguin.

Lassa, P. N. (1978): A Study of Mathematics Programmes in Nigeria Secondary School, Unpublished Report Statistics.

Nwachukwu, V. C. (1979): Students Counselling Needs Services in the Correspondence Open Studies Unit, University of Lagos. Unpublished M. Ed. thesis, A.B.U Zaria.

Obioma, G. 0. and Ohuche R. O. (1980): Sex and Environment as Factors in Mathematics

Achievement. Abacus, *The Journal Mathematics Association of Nigeria,* Vol. 15 35 - 39.

Obodo, C.G. (199/): Principles and Practice of Mathematics Education in Nigeria. First Published (1997) at General Studies Division Enugu State University of Science and Technology.

Odu, A.N.C. (1985): *Mathematics Methods.* Onitsha: Africana Fep. Publishers Limited.