Games in the Mathematics Classroom

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Mathematics is often regarded as a difficult but useful subject. Students are exhorted to work hard at Mathematics because of its usefulness although this form of motivation often fails because the students simply do not see the usefulness of some topics in the syllabus. Students also see the mathematics classroom as a boring place where they have to engage in repetitive routines of solving equations, manipulating terms, mechanically applying algorithms, etc.

Besides the ability to explain Mathematics clearly, effective Mathematics teachers seek to teach Mathematics in such a way that students are actively involved in seeking mathematical truths and that students are able to see mathematics as related to reality. Such active involvement of students and the relating of Mathematics to the world outside the classroom are teaching strategies which make mathematics meaningful to students and hence are effective motivational forces for learning.

Using games and puzzles in the Mathematics classroom is yet another means to motivate students to learn. Mathematical recreations and puzzles have been delighting and intriguing many throughout history. Puzzles and games stimulate interest because the players are actively involved in thinking and in planning strategies. The competitive element of games also contributes to the players' interest in participating. Teachers using games in the mathematics classroom should however be careful that the weaker pupils have a good chance of winning at times.

There are many types of games which can be used in the mathematics classroom and the following is a possible classification:

(1) Games for drill and practice

(2) Games for concept reinforcement

(3) Games which lead to concept formation

(4) Games which lead to mathematical investigations

(5) Games which apply mathematical knowledge

(6) Games for fun.

Games may be invented and constructed by the teacher or may be commercially available. Some games do not require elaborate materials but merely paper and pen or just the human players. The following describes some games under each of the above categories.

Games for Drill and Practice

Teachers in primary schools should be fairly familiar with the PMP Games produced by CDIS. These games are in fact mental sums disguised in the form of a game and practice in such garnes produces speed in mental computation and encourages memorisation of number facts. Other games of this type include board games where students move counters along and do "sums" on the way. Many computer games are also of the drill and practice type and the players are expected to be quick in their mental arithmetic.

Because these games do not encourage thinking skills or the active seeking of winning strategies, children will soon realise that such games are mere disguises for drill and practice and they will thus lose interest in them.

Games for Concept Reinforcement

These are games which may be played as follow-up activities after the teaching of a concept in order that the students have a better understanding of the concept.

For example, in Kaye (1987), there is a game "Throw a Number" for primary one/two pupils which reinforces the place-value concept. The first player rolls a die and writes the number shown in either the tens' place or the ones' place. The second player does likewise. Then the first player rolls the die again and fills in the other digit. The second player does the same. The player with the bigger number wins. Students playing the game soon realise the strategy of putting a large number in the tens column and a small one in the ones column. However the uncertainty of the second number obtained adds a flavour of "gambling" although there is a strategy. The game can naturally be extended to 3-digits. In Mosley (1986), there is a similar game "Make the Most" where cards numbered one to nine are drawn instead of rolling a die. Variations of this same game can be found in Kirkby (1986).

A commercially available game at secondary level is "Rogues' Gallery" by Taskmaster (a teaching aids company). The game consists of crime cards which describe a suspect of a certain crime. Players hold cards of rogues which they place in turn on a Venn diagram according to the descriptive property of each set such as "wears glasses" or "has a beard". The game reinforces the concept of sorting according to the description of a set and the criminal is the suspect satisfying all the clues (i.e. the one who belongs to the intersection of the sets.)

The Steeplechase and Truth Chase are games produced by the Weizmann Institute for the reinforcement of Algebraic skills and concepts. A description of the game can be found in Friedlander (1977).

Another game in this category is the "Guess my rule" game for reinforcing the concept of a function. Students take turns to be the rule-maker. Class members then call out numbers (x) to which he must apply the rule and give them the resulting number (the image f(x)). The idea is also to find the rule without calling out too many numbers. The 'rule-maker' should attempt functions other than linear ones to keep classmates from guessing his rule. The game can also be used to encourage the use of graphs to predict the rule.

Games which lead to concept formation

The previous two types of games are used after the learning of the concepts or facts. Games which lead to concept formation however are used to stimulate discussion which will lead to the concept.

Kaye (1987) has a game called lots of boxes which leads to the concept of area of rectangle. Each group of 2 or 3 players needs a piece of squared paper with 1 cm x 1 cm squares and a die. Each player rolls the die for the first time and draws a horizontal line according to the number shown. For example, if he rolls a **4,** he draws a horizontal line **4** cm long. He then rolls the die a second time and marks a vertical line (say 3 cm long) starting from one end of the previous line (see Figure 1). He then completes the rectangle (as in Figure 2) and obtains 12 little boxes. The player with the bigger number of boxes wins. The players will realise that the number of boxes is the product of the 2 numbers thrown.

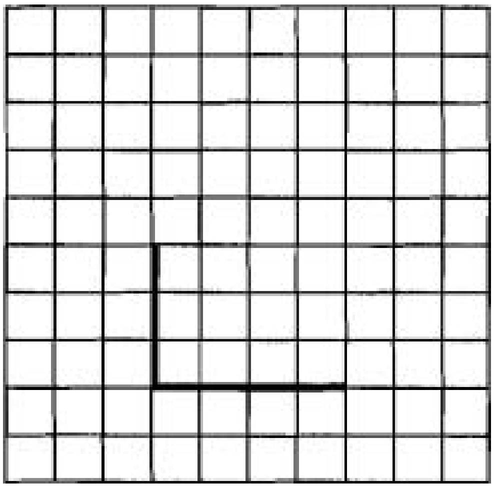

Figure 1

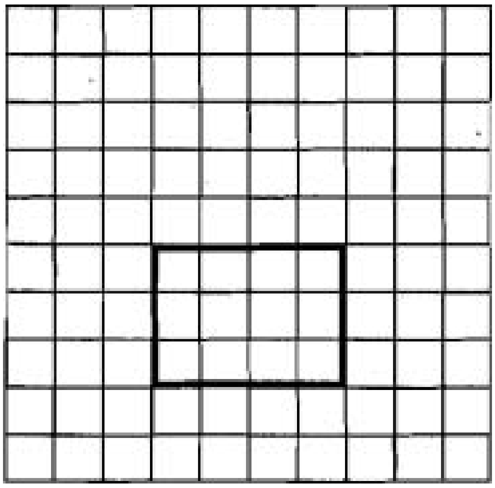

Figure 2

Another game which is related to the above is the Rectangular Number Game by Skemp (1989) where students arrange circular counters in a rectangular array. For example, 12 counters may be arranged in 2 lines of 6 or **4** lines of 3. One line of counters is not considered a rectangle because counters only represent dots in this game. Students play in pairs and each takes turn to give the other a number of counters who has to then make a rectangle with them. If he is able to do this, he scores a point. The giving player can also score a point by making a different rectangle with the same counters. The same total number of counters may not be used more than once. The concepts which may be discussed after the game are those of factors and primes.

Games which lead to Mathematical Investigations

Games which' involve strategies for winning can lead to mathematical investigations and the application of problem solving heuristics. Such investigations may in turn lead to concepts or mathematical rules but are valuable in themselves for the promotion of the processes of logical thinking, of hypothesising, of recognising patterns etc.

Games such as Nim and Sprouts may be first played and then analyzed mathematically. The reader is encouraged to read Gardiner (1987), Chapter 1, or Gardiner (1986) for more of such games and the analysis of winning strategies.

Games which apply Mathematical Knowledge

Games in which students are required to apply mathematical knowledge are different from those which are for drill and practice. Here mathematical knowledge has to be applied and higher thinking processes are called for.

The game Trimatics which is commercially available is one game which is exciting for ages 9 up. It has been played by Mathematics graduates with great enthusiasm although one only needs to know one's times tables to play the game. The game consists of 49 square pieces with a number between 1 and 9 written on each. They are randomly arranged in a square at the beginning of each game. There are also 50 circular counters bearing the numbers 1 to 50. One of these is picked, say 24. All the players simultaneously look for a row (vertical, horizontal or diagonal) of 3 adjacent numbers among the 49 such that when 2 of the 3 numbers are multiplied and the 3rd added to or subtracted from the product, the result is 24 (see Figure 3). The first player who calls out and points to the 3 numbers wins that counter. Another counter is picked and again everyone looks for a combination to get the new number. The player with the most counters when the game is stopped is the winner.

6	3	3	9	1	3	8
4	4	8	1	2	7	7
3	7	5	5	8	5	5
5	2	6	2	1	3	4
9	2	1	8	9	6	1
9	4	5	3	8	7	7
2	8	9	6	4	2	6

$4 \times 4 + 8 = 24$

$9 \times 3 - 3 = 24$

Figure 3

The computer game Green Globs by Sunburst Company is also extremely versatile and is enjoyed by secondary school students as well as by Mathematics graduates. The objective of the game is to shoot down green globs which appear on a grid using a graph which passes through them. This game allows students to apply their knowledge of graphs and curve fitting. Secondary students may use linear and quadratic graphs while higher level students can use trigonometric functions, absolute values and even conics.

Games for fun

Games for pure fun are garnes which do not contribute much to mathematical concepts and which are simply used to stimulate interest or to inject fun and humour into the Mathematics lesson.

One such game is based on the television game show "Catch Phrase." The language of Mathematics, borrowing many normal English words and using them in precise and different ways, lends itself to puns which can be put to use in Mathematical Catch-phrases.

In the appendix, I have given examples of Mathematical catch phrases. In some of the questions, the phrase is mathematical while in others, mathematics is used in the illustration but the phrase itself is not mathematical.

Conclusion

In Ernest (1986), it is noted that games should be used in the teaching of Mathematics not merely as time-fillers and fun activities but also because games can teach Mathematics effectively. With the new Mathematics syllabus placing more emphasis on the development of good problem solving strategies, on understanding meaning in Mathematics and on developing desirable attitudes towards Mathematics in our students, there is certainly a place for a games in the teaching of Mathematics and it is up to the teacher to creatively modify and use games to enhance the effective teaching of Mathematics.

References

1. Ernest, P., (1986). Games - a rationale for their use in the teaching of Mathematics in school. *Mathematics in School,* 15(1), 2-5.

2. Friedlander, A., (1977). *The Steeplechase.* Mathematics Teaching, 80, 37-39.

3. Gardiner, A., (1987). *Discovering Mathematics.* New York : Oxford University Press.

4. Gardiner, T., (1986). *Winning Strategies. Mathematics in School,* 15(1), 13-15.

5. Kaye, P., (1987). *Games for Math.* New York : Pantheon Books.

6. Kirkby, D., (1986). *Maths Games Workshop.* Mathematics in School, 15(1), 35-39.

7. Mosley, F., (1986). Count me in - games for all. *Mathematics in School,* 15(1), 6-9.

8. Skemp, R.. (1989). *Mathematics in the primary school.* London: Routledge.

Appendix

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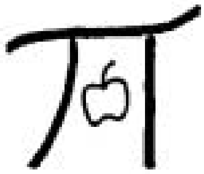

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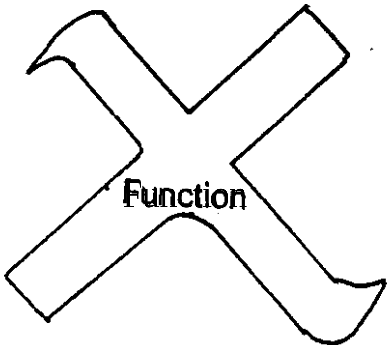

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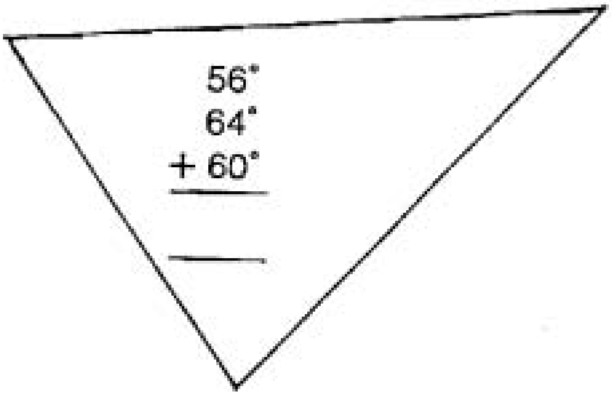

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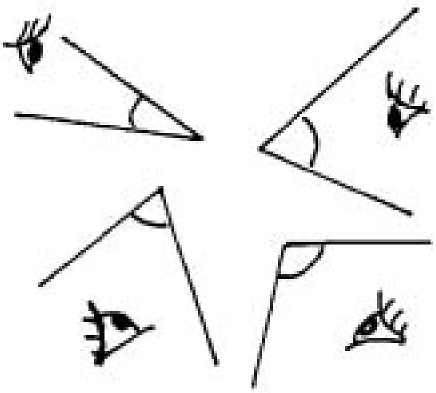

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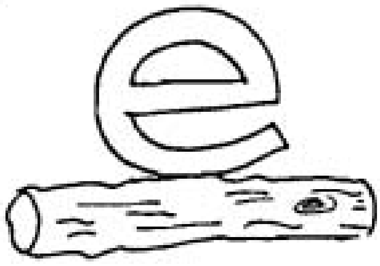

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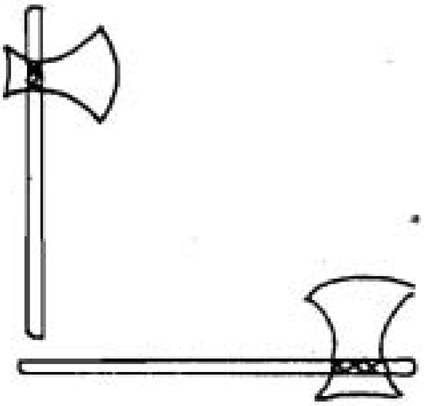

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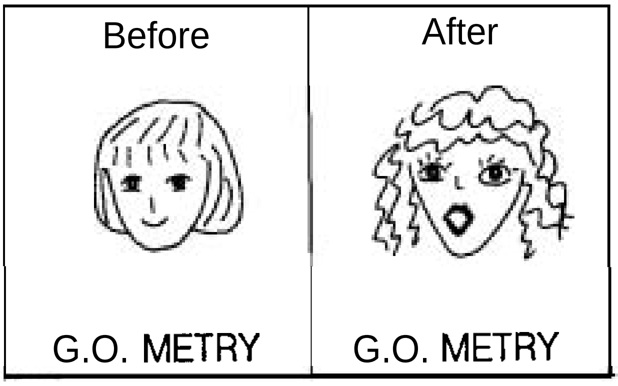

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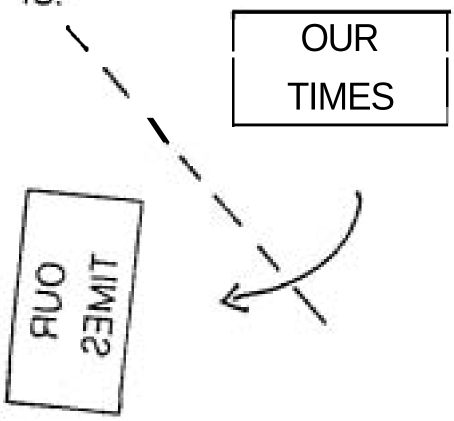

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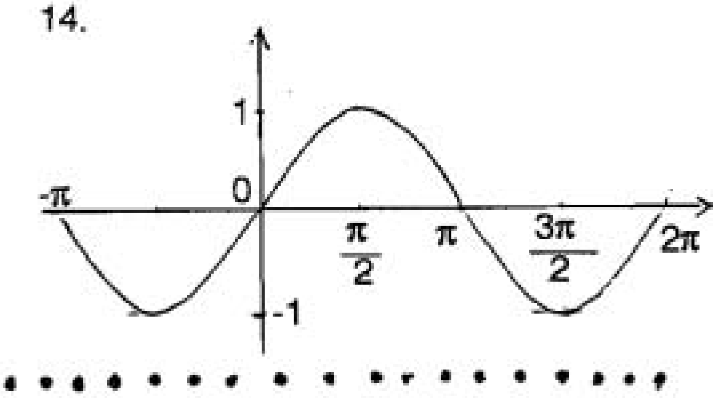

ANSWERS

1. Apple pie 2. A function in x 3. The sum of angles in a triangle

4. The division of labour 5. Looking from different angles

6. Fraction in lowest terms 7. Trade union 8. An angle of three degrees

9. Log to the base e 10. Integrated society 11. A pair of perpendicular axes

12. Transformation geometry 13. Reflection of our times

14. Sine on the dotted line