

Games in the Primary Mathematics Classroom

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A fundamental aspect of the new Alberta elementary mathematics program is that mathematics learning should occur within a dynamic and active learning environment. Such an environment is created and maintained through the implementation of a wide variety of fast-paced activities that encourage exploration, manipulation and problem solving. Teachers need to include a selection of activities, such as manipulative explorations, problem solving tasks, games, applications, and calculator and computer explorations. The need for such a spectrum of activities is especially important in the primary grade levels to account for shorter attention spans and to capitalize on natural student enthusiasm.

Using Games in Mathematics Instruction

Games represent one of the most compelling and motivating activities teachers can introduce into the primary mathematics classroom, but games have several strengths beyond their simple motivational qualities. First, games represent a form of problem solving. Problem solving may be defined as a process whereby the solver attempts to reach a goal from a set of given conditions, but the means to achieve the goal is not immediately or intuitively obvious. A game, like a problem, also has a goal (how to win or finish the game) and conditions (the rules under which the game is played), and the solver or player must find the route to the goal. Further, success in instructional games often requires application of various problem solving skills and strategies, such as estimation, constructing a list, reading a table or even looking for a pattern.

Second, games provide an interesting way to involve parents, guardians and siblings in a child's education. Games can be sent home with students with the intention that they be played with family and friends, thus facilitating the home/school connection. In this way, parents can be kept informed as to the topics being covered in school while at the same time spending some enjoyable time with their children.

Third, games provide an alternative to standard drill and practice exercises. Children need to drill and

practise any new concept to achieve *automaticity* (the ability to recall and apply learned concepts and skills quickly and efficiently). Unfortunately, standard drill and practice exercises (for example, textbook pages) often quickly become mundane, and students resist completing them. To play a game, the player must repetitively apply required knowledge and skills in each turn; in other words, the player is engaging in a form of drill and practice. Games thus represent a significantly more motivational form of drill and practice.

Finally, games can be integrated easily into the instructional environment. It is important that games be related to specific objectives and goals in the mathematics curriculum, because this is how we ensure that students are receiving a quality, dynamic and active learning experience.

There are many reasons for introducing games in the primary mathematics classroom besides those listed above. Leonard and Tracy (1993) suggest several others, including that games

- allow students to apply what they know to the real world,
- create a positive mathematical environment,
- maximize student problem solving competence,
- increase ability to communicate,
- increase ability to reason mathematically,
- enhance student perception of the value of mathematics and
- develop students' self-confidence.

The benefits of using games are many, but smooth implementation can be tricky. The following hints on introducing games may be helpful.

Games in the Classroom

When introducing a new game in a math lesson, teachers may wish to consider a few variables. Such considerations will lead to less frustrating implementation and will enhance the game's learning potential.

First, teachers may hold a class discussion about winning and losing. Children should play both competitive and cooperative games and learn that sometimes you win and sometimes you lose. Children must

learn to focus on the act of participating and the enjoyment of simply being part of the game. Teachers may introduce the game such that the students (as a class) compete against the teacher. This playful competition effectively and efficiently acquaints students with the game, allows for a brief discussion of strategy and enables a short discussion of winning and losing (the teacher inevitably loses and thus communicates that it is quite acceptable to lose).

Second, teachers will want to carefully consider the skills and knowledge required to participate in the game. Given that games are primarily drill and practice activities, it is important to remember that students must already possess the skills and knowledge to be rehearsed. Teachers may also want to consider the vocabulary necessary for playing the game. Such vocabulary may need to be introduced before the game begins and reinforced while it is in progress.

Third, teachers should consider how the game is to be introduced. One method (where the teacher plays against the class) has been discussed, but a second effective method is to invite one or two students to remain in the classroom at recess to try a new game. These students typically enjoy the special attention and later serve effectively as useful helpers when the entire class is exposed to the activity.

Finally, teachers should collect flexible games, those that can be easily adapted to more or less difficult concepts to account for individual learner abilities. An ideal game allows a strong student to play with or against a less strong student while both enjoy and learn from the experience. Typically, games that have a strong element of luck (for example, involve rolling dice or twirling spinners) are most effective for pairing advanced students with less advanced students.

Four games introduced early in the year to a Grade 1 class are provided below. The first two games, *Shade* and *Up to 10*, have a stronger strategy component while the other two, *Unlucky Sixes* and *Tic Tac Add*, have a larger element of chance. All games can be easily adapted to suit higher grade levels or more advanced students.

Game 1: Shade

Students shade figures to represent values rolled on the die. In essence, as students play, they are repetitively building models or sets of a size specified by the die. This game builds in excitement as it is played and especially when students realize the gameboard is shrinking as squares are shaded. Teachers will want to discuss and model appropriate ways to shade (discussed in more detail below) as some

students may find this aspect confusing at first. As a fun and interesting adaptation, allow students to construct their own gameboards of varied shapes and sizes!

Objective

Represents numbers by creating sets, using manipulatives and diagrams. Describes a number using different arrangements and combinations of objects.

Materials

Shade gameboard (Figure 1), pencil crayons, 1 six-sided die

Number of Players

Two or more

Goal

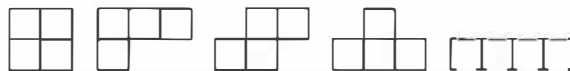
To be the last player in the game, the others having been eliminated when they were unable to shade a number of adjacent squares as rolled on the die.

To Play

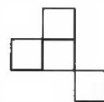
- Players decide who will go first by rolling the die. Lowest roll starts.
- The first player rolls the die and shades the same number of adjacent squares as the value rolled on the die.
- The second player now takes a turn.
- If a player rolls a 6, he or she will skip a turn.
- The players continue taking turns rolling and shading until one player rolls a value greater than the spaces available to shade (for example, there are only three spaces left and the player rolls a 4 or 5). This player drops out of the game.
- If there are more than two players, play continues until there is only one player left, and this player is the winner.

Rules

- Spaces that are shaded *must* be touching each other on at least one side. These are possible arrangements for a roll of 4.



- This is *not* an acceptable shade pattern for a roll of 4.



- If a player rolls the correct value such that he or she shades in the last space, remaining players must roll a 6 to stay in the game.

Variations

- Use a 10-sided die (that contains the values 0 to 9).
- Change the shape of the gameboard.
- Each player uses his or her own gameboard. The first player to fill the gameboard completely and exactly wins.

Game 2: Up to 10

Up to 10 is patterned after the familiar game of Nimh, the major difference being that students are counting up to a target rather than down using markers. Teachers may wish to play both versions with their students. This game has a large element of strategy, and it is surprising to see how many Grade 1 students intuitively look for this strategy.

Objective

Writes the numbers 0 to 10 in order.

Materials

Paper, pencil

Number of Players

Two players

Goal

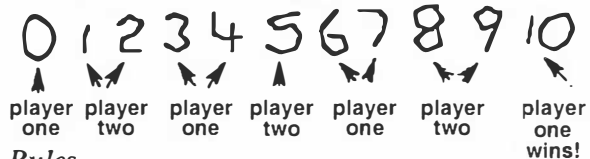
To be the player who writes the number 10

To Play

- Players decide who will go first.
- The first player may write either the first number or the first two numbers when counting from 0 to 10 (that is, the student may write either a zero or both a zero and one).
- The second player may write either the next consecutive number or the next two consecutive numbers when counting from 0 to 10.
- Players continue writing one or two numbers on a turn until one player writes the number 10. This player is the winner.

Examples

- Assume the first player writes in just a zero.
- The second player may now choose to write in either a one or both a one and a two.
- The complete game is shown below.



Rules

- A player must write at least one number on a turn.
- A player may write in both nine and ten on a turn to win the game.

Variations

- Change the rules so that the player who writes the 10 loses.
- Extend the game to include larger numbers (up to 20 or 100).
- To make the game a little easier, use a gameboard that has the values written in, so that students merely cross off one or two consecutive numbers.
- Change the rules so that players may add either one, two or three numbers on a turn.
- Change the rules so that players will write the numbers all the way to 100, but they score a single point for each zero that they write (for example, score one point for any multiple of 10 to 90, and two points for 100). The player with the most points when all the numbers have been written wins.

Game 3: Unlucky Sixes

The main objective of this game is to involve students in constructing pictures and models of simple addition and subtraction facts that sum to five. This game includes a large portion of chance in the rolling of the die, but this seems to add great excitement for Grade 1 students. This game may be easily adapted to include larger sums or even multiple addend equations.

Objective

Adds or subtracts numbers to 5.

Materials

Unlucky Sixes gameboard (Figure 2), 1 six-sided die, pencil crayons, pencil

Number of Players

Two players

Goal

To be the player to construct and model the greatest number of addition sentences before rolling three 6s.

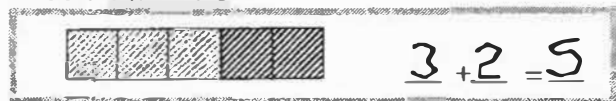
To Play

- Players roll the die to see who goes first. The player with the highest roll starts.
- The first player plays on the left side of the gameboard; the second player plays on the right side.
- The first player rolls the die. If he or she rolls a 6, then he or she must cross out one of the circled sixes at the bottom of his or her side of the gameboard.
- If the first player rolls a value other than six, he or she can shade that number of spaces on any one row on his or her side of the gameboard.

- The die is now passed to the other player who also rolls and shades either a six or the appropriate number of spaces on any row.
- The players continue taking turns rolling the die, shading the rows, constructing addition equations and/or crossing off 6s until both players have crossed off all three 6s. The player with the greatest number of completed rows wins.

Example

Assume a player rolls a 3 and shades the first three boxes on a row. To complete that row, that player must now roll a 2 (on any later turn) to construct the addition equation $3 + 2 = 5$.



Rules

- A player must use two or fewer rolls to complete a row.
- A roll of 5 automatically fills any row, and the player can enter either equation: $5 + 0 = 5$ or $0 + 5 = 5$.
- Once a player has crossed off all three 6s, the other player will continue to roll on his or her own until he or she rolls three 6s or completes the gameboard.
- Any player to complete the gameboard automatically wins.

Variations

- Adapt the game to model subtraction equations.
- Adapt the game to use great sums, for example, sums to 10.
- Change the game so that a player merely passes his or her turn if he or she rolls a 6. Instead, the first player to complete his or her side of the gameboard wins.

Game 4: Tic Tac Add

This game has a larger element of luck than strategy, but students enjoy the game's simplicity and its format. Students are usually familiar with the game Tic Tac Toe and find this simple extension easy and enjoyable to play. This game can be readily adapted to include more difficult addition sentences or even a mixture of addition and subtraction sentences. Tic Tac Add has a strong drill and practice dimension.

Objective

Adds and subtracts numbers to 5.

Materials

Tic Tac Add gameboard (Figure 3), overhead spinner, two types of colored markers (approximately 15 of each)

Number of Players

Two players

Goal

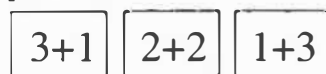
To be the first player to construct a straight line horizontally, vertically or diagonally on either Tic Tac Add board.

To Play

- Players decide who will go first.
- The first player twirls the spinner.
- This player may now place his or her marker on any space occupied by any addition sentence with the same sum as the value spun.
- The other player now gets his or her turn to spin and place a marker.
- Players continue to take turns spinning and placing markers until one player constructs three in a row or until all spaces on both boards have been claimed.
- The first player to achieve three in a row on either board wins.

Example

Assume a player spins a 4. This player may place his or her marker on any of the following spaces:



Rules

- Once a marker is placed, it may not be moved until the end of the game.
- If neither player can make three in a row, the player who has placed the greater number of markers wins.

Variations

- Change the addition sentences to subtraction sentences.
- Mix addition and subtraction sentences.
- Enlarge the range of numbers spun (and the addition sentences on the Tic Tac Add boards) to include sums to 10.

Bibliography

- Leonard, L. M., and D. M. Tracy. "Using Games to Meet the Standards for Middle School Students." *Arithmetic Teacher* 40 (1993): 499-503.
- Loewen, A. C., and B. J. Firth. *Mathematical Games Made Easy*. Barrie, Ont.: Exclusive Educational Products, 1994.

Figure 1
Shade Gameboard

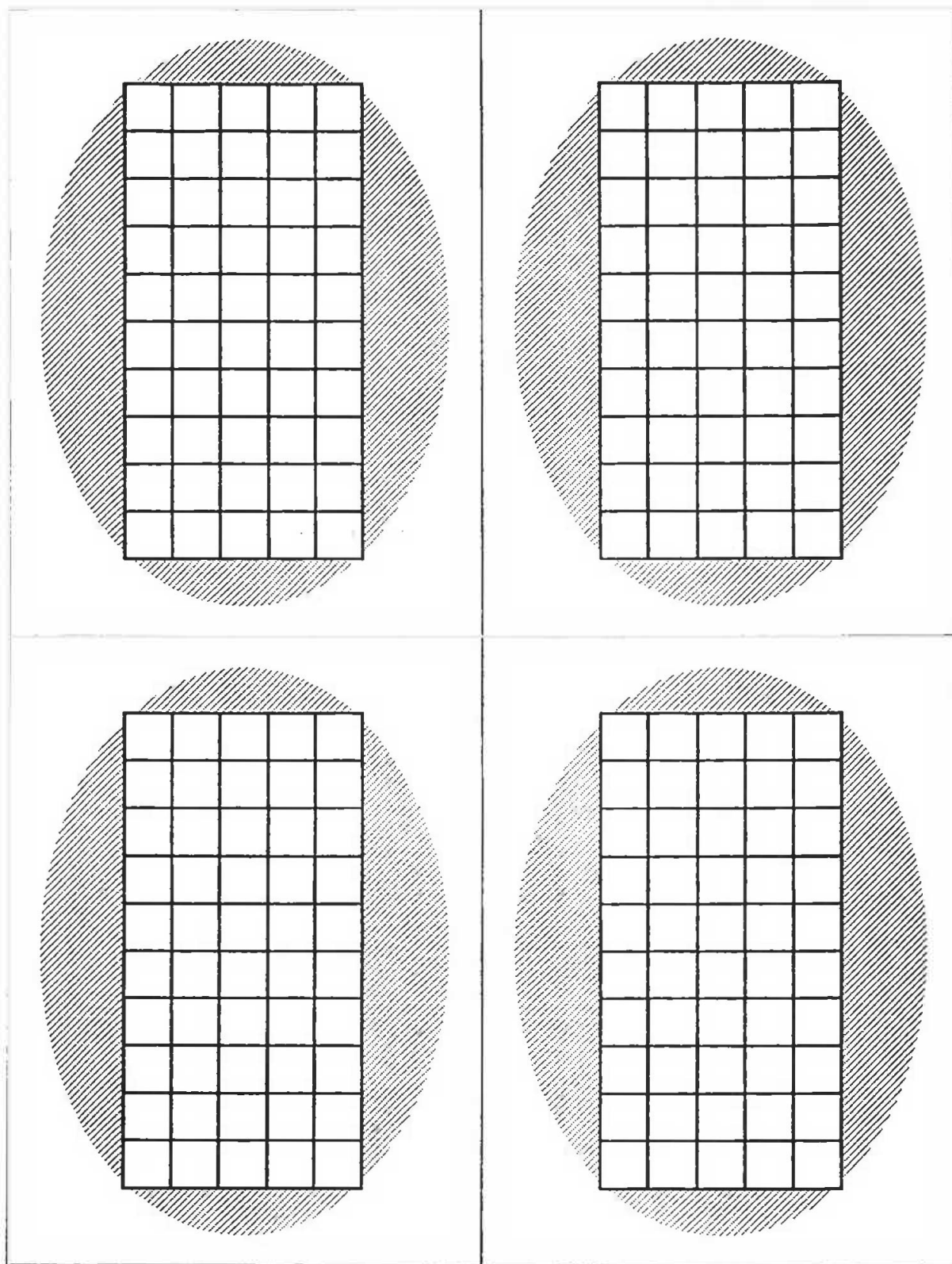


Figure 3
Tic Tac Add Gameboard

