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TWO SIDES TO ZERO: AN ARITHMETIC GAME WITH INTEGERS

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In the *Mathematics Teacher,* Miller and Jeffrey (1977) describe an addition game with integers. They begin by remarking on the importance of making available to junior and senior high school students games providing skill practice whose rules are sufficiently simple. However, they claim that many of the available games for these students are so complicated that only those students not needing skill practice can learn them.

It is true that a survey of the existing literature on the subject revealed many more games that offer practice with natural numbers and positive fractions than with integers. However, there are also some simple games involving integers that are appropriate for older students. Smith and Backman (1975) list at least seven games on this topic, of which five are comparatively easy.

The mathematics group in the Department of Science Teaching in the Weizmann Institute has developed several simple mathematical games as part of their general curriculum development program. The object of these games is to provide practice in skills that are usually encountered in junior high school. The games are designed to be an integral part of the curriculum. They have been tested in the classroom and have been enthusiastically endorsed by both able and less mathematically able students. One game dealing with the substitution of integers in algebraic expressions was described by Freidlander (1977); another we describe here.

Two Sides to Zero

This game deals with the addition, subtraction, and multiplication of integers and is intended for two players. The equipment for play is as follows:

1. A section of the number line between $^{-}32$ and 32 with the integers marked (fig. 1). Above the number line are two tracks for the two runners.
2. Two runners (or counters), one for each player.
3. A number disc with a pointer (fig. 2). On the disc the integers between $^{-}4$ and $^{+}4$ appear. (This disc can easily be made from cardboard, with a Popsicle stick as the pointer.)

Directions

At the beginning of the game, both players take runners and place them on their tracks above 0. The players then agree on a number (or are given one by the teacher); for definiteness we shall suppose the number is 17. Each game then consists of two rounds. In the first round one player aims

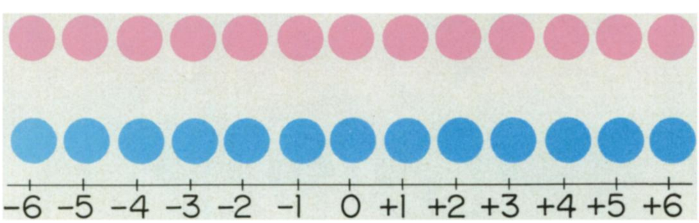

Fig. 1. A section of the game board with a number line and two tracks. The full-sized board measures 10 cm × 69 cm.

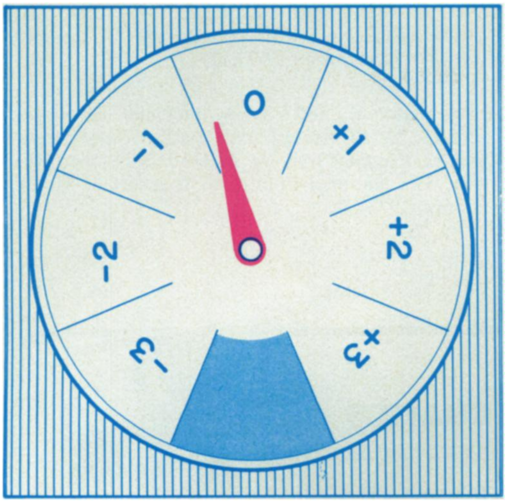

Fig. 2. Number disc with pointer (full size 9.5 cm × 9.5 cm)

to reach $^{+}17$ and the other $^{-}17$; in the second round they interchange goals.

Each player in turn (1) obtains a number from the disc by "flicking" the pointer; (2) chooses which operation—addition, subtraction, or multiplication—will give the most advantageous result when the number obtained from the disc is combined with the number below the player's current position; and (3) moves the runner accordingly.

A round is finished when a player lands exactly on the agreed number (± 17). If the pointer lands in the shaded area or on the line separating two integers, the player spins the pointer again.

The following rules were added to make the game more interesting.

1. A player who turns up zero on the number disc can use it to "nullify" the opponent, that is, return the opponent's runner to zero.

2. A player who occupies a position corresponding to a multiple of five has to return to zero.

Discussion

Each move has essentially two parts: the choice of operation and a calculation. Students struggling with the topic tend to use only addition at first. Others test each of the operations before each move. Still others overdo the use of multiplication, using it even when it is not to their advantage. (For example, multiplication by $^{+}1$. They learn by experience that the sum is greater than the product when one of the numbers is $^{+}1$.)

It is worth remarking that the board on which the game is played is deliberately designed as a number line. We feel that as far as possible, games that are an intrinsic part of the curriculum should use the conventions of the curriculum. Commercial games often fail to do this.

Another advantage of "Two sides to zero" is that it can be played in different ways at different stages in the learning process. For instance, it can be played when the students have been introduced to addition and subtraction only, and again when they need practice on multiplication.

It is also worth changing the rules occasionally. The rule that the runner must stop on the agreed number (in the example ±17) can be changed so that a round is finished when the first runner exceeds the agreed number. This makes the end game easier. Also, the rule against landing on multiples of five can be dropped or another number can be chosen. Another variation is to change the penalty number to some number other than zero.

Weaker students have some difficulty in following the written rules, but a brief explanation to the whole class is usually sufficient to remove this obstacle. It also appears that the game is extremely suitable when both players are of average ability or above or when one is strong and the other weak (because the stronger does not usually let the weaker make any mistakes). When both players are weak, it becomes difficult to supervise the game effectively, and their mistakes go unnoticed and uncorrected. Hence, the teacher may want to have students record their moves on a tally sheet so that their calculations can be checked.

Conclusion

We have described a game that is designed to give students practice with operations on integers. One of the major strengths of the game is that the rules can easily be changed to provide more (or less) challenging situations. "Two sides to zero" has been enthusiastically endorsed by students of all ability levels.

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