

Snakes and Ladders for Integer Consolidation

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INTRODUCTION

In the Senior Phase the minus symbol takes on a new meaning. It no longer just means *subtract*, but can also mean *negative*. So in an expression such as $5 - (-7)$, the first minus symbol is an *operator* while the second minus symbol indicates the *sign* of the number. Further confusion arises in algebra. For example, the coefficient of x in $4 + 7x$ is $+7$ ('positive 7') while the coefficient of x in $4 - 7x$ is -7 which we refer to as 'negative 7'. But in the case of $4 - 7x$ we can also speak of subtracting $7x$ from 4 , in which instance the minus symbol is translated as 'subtract'.

Learners' difficulties in operating with integers are well-known, and their errors can have far reaching implications. If learners struggle with integers, the associated problems may haunt them throughout their secondary school career. While working in the Wits Maths Connect Secondary Project we identified the need for learners to practice operating with integers without simply carrying out tedious and repetitive calculations. In this article I share a game that I developed which provides learners with a meaningful context in which to practice the addition and subtraction of integers.

DESCRIPTION OF THE GAME

The game is an adaptation of the classic *Snakes and Ladders* board game. In Snakes and Ladders, two players move in a sequential manner around a board. The amount that each player moves in their turn is determined by the throw of a die. If you land on a space occupied by the base of a ladder you can immediately climb up to the top of the ladder. If you land on the head of a snake you immediately slide down the snake to its tail. The player who reaches the end of the board first is the winner.

My adaptation requires the use of two dice, each of a different colour. Before the game starts, players decide on one die to represent *positive numbers* and the other to represent *negative numbers*. When a player throws the dice, one number will thus be positive and the other negative. By way of example, if we take the white die as representing positive numbers, then the throw shown on the dice in Figure 1 would represent $+3$ and -4 . The player can then choose an operation, either addition or subtraction, in order to move an 'advantageous' number of spaces. So, for example, the operation $+3 - (-4)$ would allow one to move 7 spaces forwards, the operation $+3 + (-4)$ would allow one to move one space backwards, and the operation $-4 - (+3)$ would enable one to move seven spaces backwards.



FIGURE 1: A dice throw representing $+3$ and -4 .

STRATEGY AND MATHEMATICAL PRINCIPLES INVOKED

In general, learners should realise that subtracting the negative value from the positive value will result in the furthest distance being gained. Thus, the notion of subtracting a negative being the same as adding a positive could be realised. Learners will need to explore the different results that can be obtained from the throw of their dice as at times it may be advantageous to move a smaller number of spaces in order to miss a snake, or even move backwards to catch a ladder. The first player to reach the end of the board is the winner. There is an additional element involved in the game whereby the second player is required to do similar mental (or written) calculations in order to *check* his or her opponent. Players are thus carrying out a large number of calculations without the tedium of long exercises from textbooks.

LIMITATIONS

This game provides practice for concepts already 'learnt'. It is not recommended as a means to *teach* operating with integers. Models which may be appropriate would be a consistent number line approach or the use of integer chips which would fit well with notions of adding negatives or subtracting negatives.

INSTRUCTIONS TO PLAYERS

You will need 2 dice, a Snakes and Ladders board, and paper on which to write.

- One die will represent *positive numbers* and the other will represent *negative numbers*. Make this decision before the game begins.
- You throw both dice. You will get a positive number and a negative number.
- You can either add or subtract these numbers, in any order. For example, if you throw 5 on the positive die and 2 on the negative die your answer could be -7 , 3 or 7.
- If the final result of the calculation is positive you move forwards. If the final result is negative you move backwards the appropriate number of places.
- To start, each player throws both dice. The person with the lowest answer starts.
- The winner is the first person to reach the end of the board.
- You cannot go further back than the Start block.

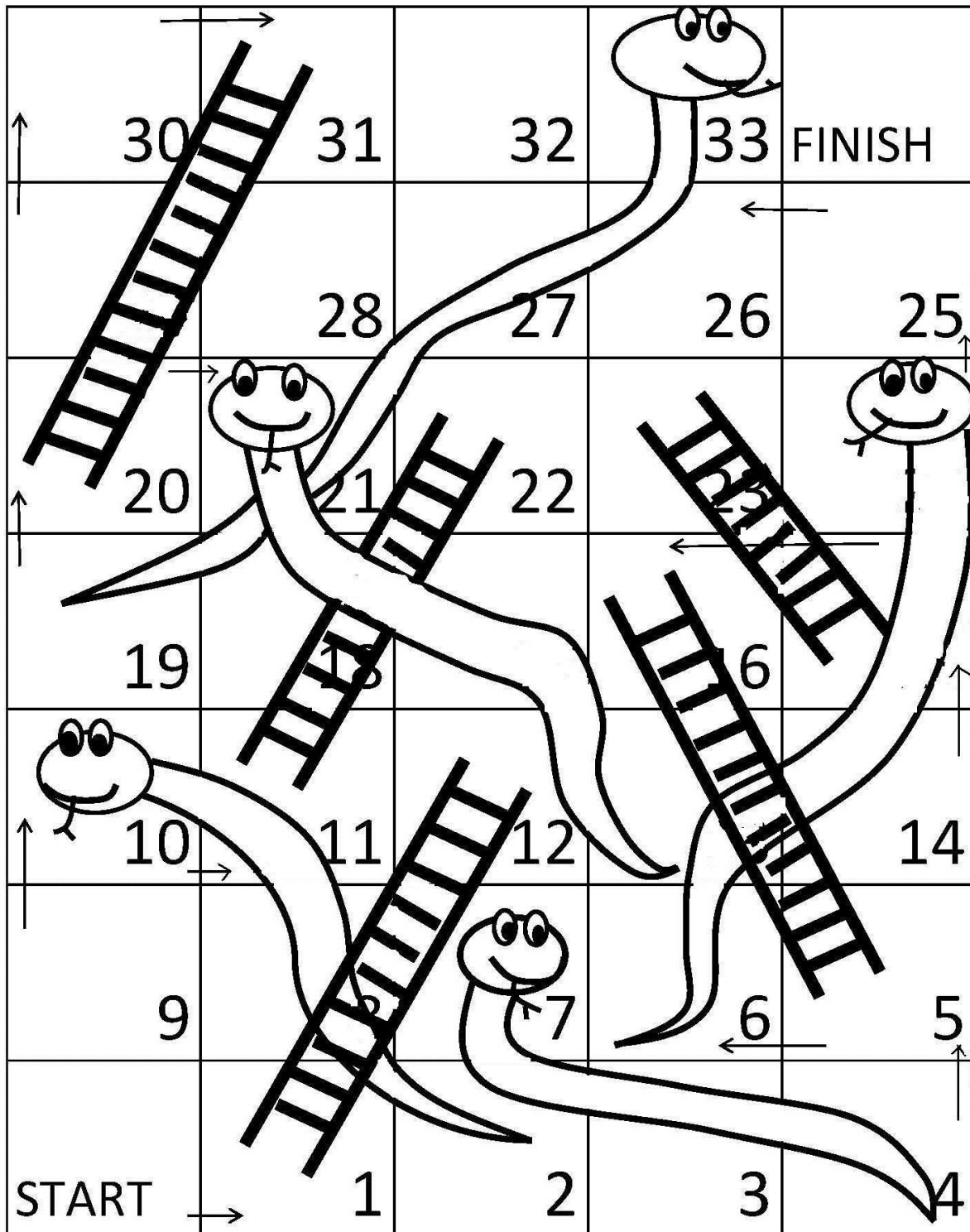
VARIATIONS

Here are some suggestions to adjust the complexity of the game:

- 1) Changing the level of difficulty:
 - a) Level 1 – Addition only. A roll of $+3$ and -4 , for example, can only result in a move one space backwards since $(+3) + (-4)$ and $(-4) + (+3)$ both yield -1 .
 - b) Level 2 – Subtraction only. A roll of $+3$ and -4 , for example, can result in either a move forwards of 7 spaces or a move backwards of 7 spaces since $(+3) - (-4) = 7$ and $(-4) - (+3) = -7$.
 - c) Level 3 – The game as originally described where the players can choose whether to add or subtract.
- 2) The winner has to land *directly on the final space*. If a player requires a final result of $+2$ in order to land on the final space, and throws $+5$ and -2 , their options would be $+7$, $+3$ or -7 . Choosing either $+7$ or $+3$ would cause them to 'bounce back' after landing on the Finish block.
- 3) A player can choose the sign of each die *after* the dice have been thrown.
- 4) *Both dice are negative*, but the operation can be chosen by the player. The roll of -3 and -4 can result a move forwards or backwards one space (subtraction), or backwards 7 spaces (addition).

THE BOARD

One can use a regular Snakes and Ladders board for this game. Alternatively, make use of the following board which can readily be duplicated.



[Source: <http://www.craftscope.com/images/snakes-and-ladders-game-board-free-colouring-kids-1.jpg>]

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