Integer Board Game

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In the early years of our education, we embark on a journey of numbers and arithmetic (besides other topics), learning the basic rules and operations that govern them. When learning subtraction, we are taught that higher numbers cannot be subtracted from lower numbers, since it appears illogical. The understanding of natural and whole numbers, and to some extent, some of their basic properties, shapes our arithmetic foundation until we reach grade 6. Here, we encounter a significant leap into a whole new realm of numbers. Suddenly, we are introduced to an infinite extension of numbers in the opposite direction. The concept of integers seems somewhat counterintuitive. It is as if we have entered a whole new mathematical universe, where we must learn new rules and adapt our thinking to grasp these unfamiliar entities. This transition challenges our preconceived notions and requires us to reorient our understanding of numbers. What follows is an extensive exercise of drill and practice with worksheets full of problems on operations of integers, which is mostly monotonous and drab.

I have grown up playing "saanp-seedhi" (snakes and ladders) with my family. I remember feeling excited and proud of myself when I grew out of the need to count my position on the board by skipping over numbers one by one and could easily calculate my position in my head. My teachers however missed the opportunity of using this game (or the number chart version of this, made into a game by Jodo Gyan) as a supplementary material or an exciting context for solving addition and subtraction problems.

Gamifying drills and practice can make learning interactive and enjoyable for students, and perhaps something similar can be done with integers as well. While the NCERT textbook chapter

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on integers in grade 6 itself suggests such a game, I have taken the liberty to gamify it a little more by incorporating opportunities to strategize and solve problems. In this article, I shall make a case for why such a game should supplement existing resources and what other avenues an integer board game can open up in a classroom.

Integer Board-Game: Rules and Game Setup

The game setup consists of the following things:

1. A board with two rectangular areas, divided by a "zero" zone in the middle. One of the zones is marked with numbers from 1 to 300 and the other zone is marked with numbers from –1 to –300. The middle "zero" zone is the starting point, where all the players must place their counters in the beginning.
2. Two blue dice signifying positive integers and two pink dice signifying negative integers.
3. Two Operations dice:
   a. One Operations die with the signs +, – marked on three faces each (Grade 6)
   b. One Operations die with the signs +, –, × marked on two faces each (Grade 7)
4. A set of wild cards and bonus cards with different instructions on them, that the teams might have to pick up on reaching certain specially marked positions on the board.
5. Counters (of different colours) to indicate position on the board.

In the beginning, the counters of all teams are placed on zero. Players then start by rolling dice picked blindly from a bag, accompanied by an Operations die. The combination of these rolls guides them in performing computations on dice numbers, which dictate the number of steps taken on the board. For example:

On the first turn, the players first draw a blue die and get 3 on rolling it, it is read as "+3". Then they draw a pink die and get 6 on the roll and read it as –6. Now they get a + sign on rolling the Operations die. Then the number of steps will be: (+3) + (–6)= –3 and thus we have to add –3 to the current position, which is zero, and thus land on –3.

Face 1	Operation	Face 2	Number of steps
			– 3

Figure 1: Example of what the first turn could look like

On their next turn, if the players arrive at –10 number of steps, then their counter moves from –3 to –13. Or, if on the next turn, the players arrive at +10 number of steps, then their counter moves from –3 to the other side of zero, landing at +7.

If a special "wild" position is landed on, a wildcard is drawn and its instructions are followed. The game becomes more challenging as progress is made, with different rules for different stages. Whichever team reaches either end of the board (±300) first, wins the game.

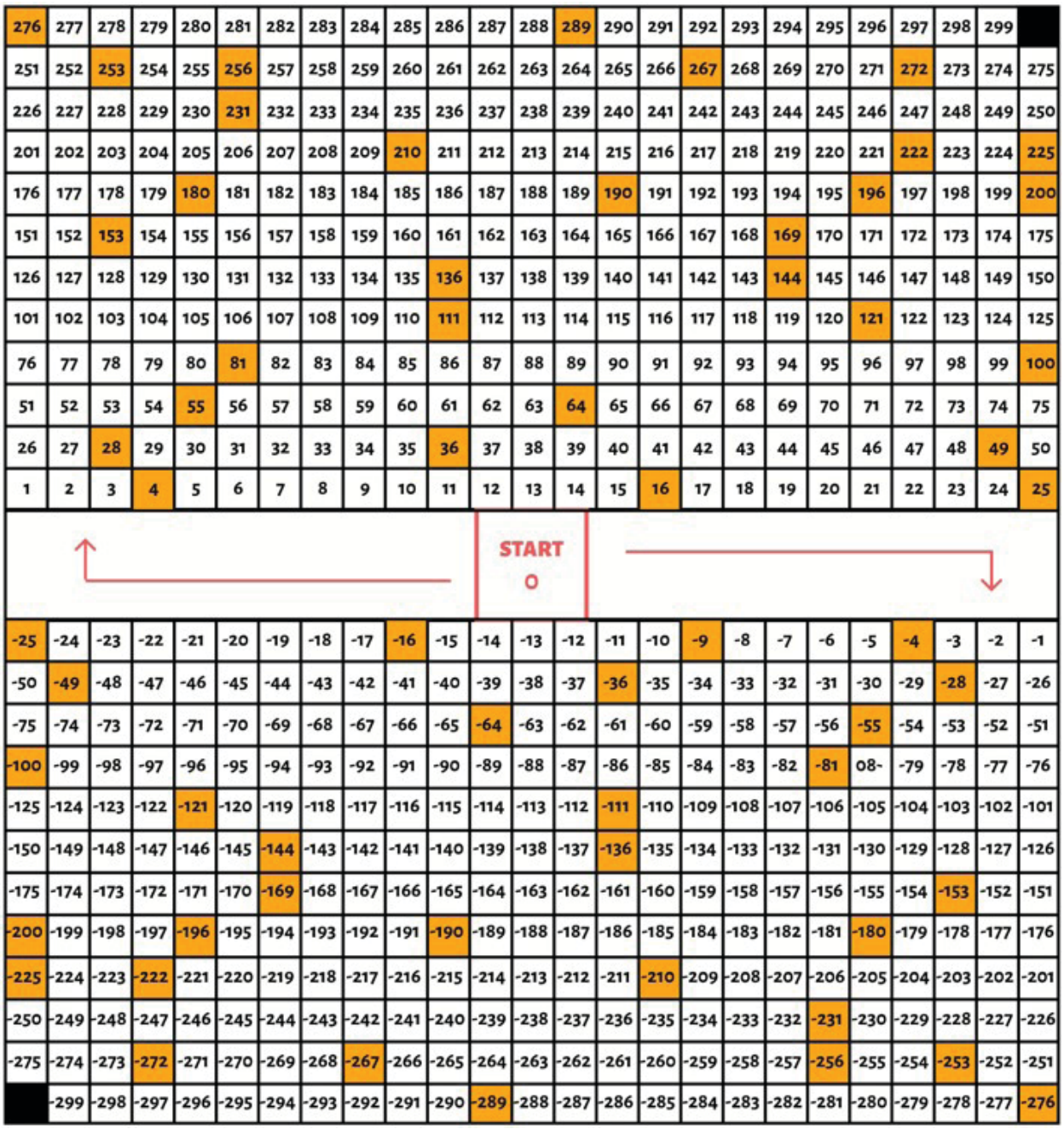

Figure 2: The game board with the full set of dice, with end points up to ±300

Progression. The operation of multiplication should be included in grade 7, after they are introduced to multiplication of integers. In both the versions of the game (grades 6 and 7+), the game can be made progressively difficult by introducing rules such as: increasing the number of times the number dice is drawn after every few turns, increasing the number of times the operations die is rolled, allowing teams to choose the number of operations, etc. The idea is to offer students opportunities to handle more calculations and take into account more considerations while strategizing.

Table 1 is a suggestive progression of complexities / levels that can be introduced in the game:

Complexity level	No. of times number dice is drawn and rolled	No. of times operations die is rolled at each turn	Operations	Description
1	2	1	+, –	Introduce basic operations. Order in which operation is applied depends on the order in which number dice were drawn. E.g.: If +3 is drawn first and –6 is drawn next, and subtraction symbol comes on the Operations die, then operating equation will be: (+3)–(–6)= +9
2	3	2	+, –	Enhance computational skills by introducing more numbers to operate and two operations to be done sequentially.
3	3	2	+, –	Strategic operation order. Let students decide the order in which numbers drawn are operated on.
4	2	1	+, –, ×	Introduce basic operations. Order in which operation is applied depends on the order in which number dice were drawn.
5	3	2	+, –, ×	Enhance computational skills by introducing more numbers to operate and two operations to be done sequentially.
6	3	2	+, –, ×	Strategic operation order. Let students decide the order in which numbers drawn are operated on.

Table 1: Complexity levels

Wild Cards

Besides adding an element of excitement to the game, the wild cards also add an exploratory flavour to the game, allowing students to solve problems, strategize and explore certain properties of operations of integers.

Figure 3: Deck of Wild Cards

These wild cards ensure that students get opportunities to operate on bigger and both positive and negative numbers, think about and put into practice multiplication facts of even negative integers, and strategize so as to minimize closeness to either end for the opponent team. A suggestive list of wild cards that can be used is given in Table 2 below.

S. No	Wild Cards	No. of cards in the deck
1	Subtract –12 from your position and place your counter there	4
2	Subtract 13 from your position and place your counter there	4
3	Subtract –25 from your position and place your counter there	4
4	Add –14 to your position and place your counter there	4
5	Add 18 to your position and place your counter there	4
6	Add –25 to your position and place your counter there	4
7	In the next turn, roll only two number dice of your choice	6
8	An extra turn! It's your turn to play again	4
9	Move to the nearest multiple of –9	1
10	Move to the nearest multiple of 10	1
11	Move to the nearest multiple of 6	1
12	Move to the nearest multiple of 4	1
13	Move to the nearest multiple of –8	1
14	Choose two number dice that the next team has to roll on their turn	4
15	In the next turn, choose your own operation	4

Table 2: A list of wild cards that can be used, along with the minimum number of such cards that should be in a 4-team game deck

While this game provides an exciting context for practicing operations on integers, it is to be noted that the game only provides one model (number line) of conceptualizing integers and assigning meaning to integer operations. Another limitation of the game is its inability to incorporate operations on large numbers (the sums or products of which might be too large) and use division as an operation on integers.

Usage in Classrooms

Concrete Representations: Due to the abstract nature of integers, especially the lack of ability to map negative integers to concrete objects, students often struggle to understand integers. The board game—an extension of a number line model representation of integers—provides students with a tangible context to understand integers and integer operations.

Application and practice of operations: The game offers an exciting setting to reinforce concepts learnt in the classroom, discover properties of integers (say, commutativity under selective operations, while strategizing on which order to perform the operations in) and a fun way to practice.

Context for assessment: The game can be used as a context for assessment questions, pushing students to both use operation rules, as well as strategies to solve problems. While the game also presents avenues for instantaneous assessment through post-game discussions and analysis of game transcripts, the game context can be extended to a more systematic formative assessment as well as summative assessment questions.

Strategizing and reflecting on strategies: At each turn, students should be encouraged to keep track of the calculations that they are carrying out. This can be done by noting down the numbers and operations that come up on the faces of the dice at each turn on a notepad or game transcript sheet. Using these notes as reference, explicit discussions on use of certain properties of numbers or strategies to one's advantage can be discussed and verified. Post-game discussions with peers and teachers—where better strategies that could have been adopted at certain points are discussed—can be used as a pedagogic tool as well.

The "Integer Board Game" offers an innovative approach to conceptualize integers and apply operations on integers and makes the concept more accessible and relatable. By providing an engaging and interactive experience for drill and practice, it supplements existing problem-solving exercises in the textbook, while providing an opportunity to learn, discuss and work together while playing a game during school hours.

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