Some games for supporting learning

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A smorgasbord session at the conference allowed practical 'hands on' activities to be shared. The games presented here use cards, dice and a game board to provide basic number and algebraic skill practice in a fun way.

Target

This is a game which uses a set of 50 number cards. Its purpose is to provide students with opportunities and encouragement to combine numbers in a variety of ways so that they both practice skills and explore possibilities in a problem solving environment where they may be supported by fellow students.

As with most games I would recommend students work cooperatively so that this becomes not a competitive game between individual players but rather a series of problem solving tasks.

The cards

The game uses a set of cards which can be made from cardboard. It is possible to buy blank playing cards and write on then with permanent overhead projector pens or other such non-erasable ink. The set has three each of the cards 1 to 8, 2 each of the cards 9 to 17 and one each of the cards 18 to 25.

The basic game

Players, or pairs or teams of players, are dealt out five cards each.

One card is turned face up in the centre. This card becomes the target.

Players rearrange their cards trying different combinations and using any of the operations +, –, × or ÷ to join the cards. The aim is to use as many of the five cards as possible to make an expression equal to the target.

Each card can be used once and once only.

Example

The deal gives a 'team' [4] [7] [2] [18] and [23] with a target of [15].

One member of the group sees that 18 – 3 is 15 and 7 – 4 is 3 so with a little thought they find 18 + 4 – 7 gives the target 15.

Another then notices that 5 × 3 is 15 and 23 – 18 is 5 while 7 – 4 is 3. They arrange the cards on the table as [23] [15] [7] [4] and explain the operations and their thinking.

It is usually, though not always, possible to use all five cards. In this case one way is to use 14 + 1 by making the 14 as 7 × 2 and the 1 as 23 – 18 – 4.

Variations and comments

It has been suggested to me that I should make a collection of operation cards and brackets. I did try that once and found the players generally did not use them. Not using them also means that the players must group the cards and give an explanation verbally, which assists in the retention of the number facts. I also think it is good for some things to be imagined and for people to have to try to visualise.

There are many ways to use the task and the set of cards. I have sometimes used it as a quick task dealing out 5 cards for the whole group and putting a target up. They are then all working with the same set of cards and the task is to find many possible ways of reaching the target using any or all of the numbers.

Operation Switch

This is also a card game but this is more focussed on practicing the number facts for numbers below 10.

The cards

This set of 45 cards is based on a nines domino set without zeros. Each card has two numbers written on top with a space between. The larger number is always first so the cards are:

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

The game

This one really is a game between individuals. Three or four players is a good number but more is possible – it just means waiting longer for a turn.

The game starts with a player dealing out 5 cards to each person and one card being turned up in the middle with the rest of the pack face down also in the centre.

The aim is to be the first person to play all of their cards.

Each card can assume a range of values according to which operation is used. The players imagine +, –, × or ÷ between the two numbers. The card can have the value of any of those operations so, for example, the card 8 4 could have the value 12, 4, 32 or 2.

Players take turns to play a card on top of the face up card in the centre. A card may be played only if one of its values is the same as one of the values of the top face up card. Each player must justify aloud their play. If a player cannot play a card for that turn they pick up a card from the face down pile instead.

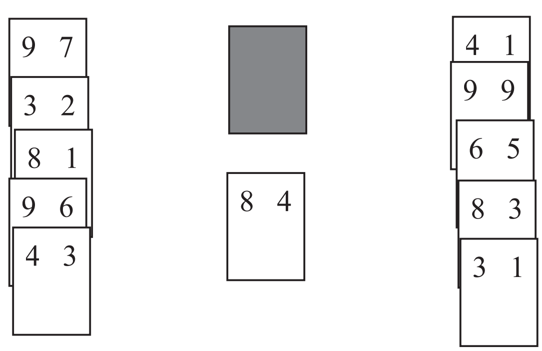

Figure 1. Two players' hands at the start of play

Example

If the card 8 4 was the card on top and a player had the cards shown in the hand on the left in Figure 1, then the player could play either 9 7 or 4 3 justifying the play as $8 \div 4 = 2$ and $9 - 7 = 2$ or $8 + 4 = 12$ and $4 \times 3 = 12$. If the first option was chosen then the new top card on the table would be 9 7 and the next player (the hand on the right of figure 1) needs to find a card to play. The possibilities are the values 16, 2, 63 and $1\frac{2}{7}$. The player on the right cannot find a matching value so must pick up a card.

Comments

It is a lot easier holding the cards vertically as in figure 1 than fanning out the cards as normal.

The name of the game is because the operation changes or switches and the value may also change each time so if a player played a card justifying it as 3 + 2 = 5 the next player may change the value and use 3 – 2 = 1. It is acceptable though for there to be a series of additions or a series of subtractions where the operation does not change for a few turns.

3 for 30

This is a dice game which again is focusing on manipulating numbers and using the basic operations. There are many easy variations to this game.

The basic game

Players or teams of players each have a board (see figure 2) and a set of counters for covering squares on the board. Three dice are used. Players take turns to roll the three dice then cover squares on the board justifying the play.

A square may be covered if the player can use all three numbers rolled and two operations (they may both be the same) to make that number. On each turn a player may cover up to three squares on the board. The aim is to cover all 30 numbers.

1	2	3	4	5
6	7	8	9	10
11	12	13	14	15
16	17	18	19	20
21	22	23	24	25
26	27	28	29	30

Figure 2. Board for 3 for 30

$2 + 5 - 6 = 1$;	$2 \times (6 - 5) = 2$;	$2 + 6 - 5 = 3$;	$2 \times 5 - 6 = 4$;
$2 \times 6 - 5 = 7$;	$6 \div 2 + 5 = 8$;	$6 + 5 - 2 = 9$;	$6 + 5 + 2 = 13$;
$5 \times 6 \div 2 = 15$;	$6 \times (5 - 2) = 18$;	$5 \times (6 - 2) = 20$	$6 \times 5 - 2 = 28$

I may have missed some. The player, though, must make a choice as only three of these can be used on any one turn.

Variations and comments

There are many different variations to this, some of which are indicated here:

- Changing the dice: use ten sided dice instead of six sided dice; use four dice.
- Change the board: use different boards; give the players a blank 6×6 grid and allow them to choose the numbers to write in (they must all be different).
- Change the operations: allow indices to be used as well.
- Change the criteria for a win: allow any block of 4×4 to be a win.

Algebra Camel Race

This is a board game which focuses on the use of formulae and, in particular, substitution. It also provides practice at mental arithmetic and can be extended to include negative numbers.

The game

This game works well with the players being pairs of players and three (or four) pairs playing on each board. Each team needs a set of four counters of one colour (to represent the camels with their jockey silks). A game board and two dice of different colours are also needed.

The teams take turns to throw the two dice. On each turn they may move ONE camel according to the formula next to the row they are on. The object is to be the first team to get all four camels home.

Depending on the colours of the dice each colour needs to be assigned to one of the two letters on the board. For example if a yellow and a green dice are used the assignment may be let g be the number on the green die and r be the number on the yellow die. It is important that the students say the number on the green die and not just g is the green die.

The first move to bring a camel on to the board is $r + g$. After the first camel is on the board then for their next turn, after they have rolled the dice, the team has to decide which camel to move.

As in any race they camels just have to cross the finish line (going forward!) after completing a circuit of the board.

The camels do not need to keep in any one track and two or more camels can be on the same row at any one time.

The board is shown in figure 3.

Variations and comments

There are three 'squares' on the board which were deliberately set up to cause difficulty. They are the three with the denominators of 60. The substitutions here will all give very small numbers which would round to zero. Once on those rows it is not possible to move forward. Effectively the camel has sprained its ankle and needs to rest a turn before coming back on at the start. I usually wait until the players realise that they have a problem then give them the solution also warning them that if the camel is hurt too often we may have to shoot it to put it out of its misery. This becomes a joke but the purpose is to force the players to plan ahead to try to avoid the 'bad' rows.

The first time this game is played players make the moves without thinking ahead but as they become used to the game they begin to see where the camel will be after the move and consider how well it will be set up for later moves.

Other rows that cause comment are the formulas such as '$r + 2$' and the one that is just '3'. These are important as even though both dice are rolled they may not affect the outcome.

There are many different variations possible, some of which are indicated here:

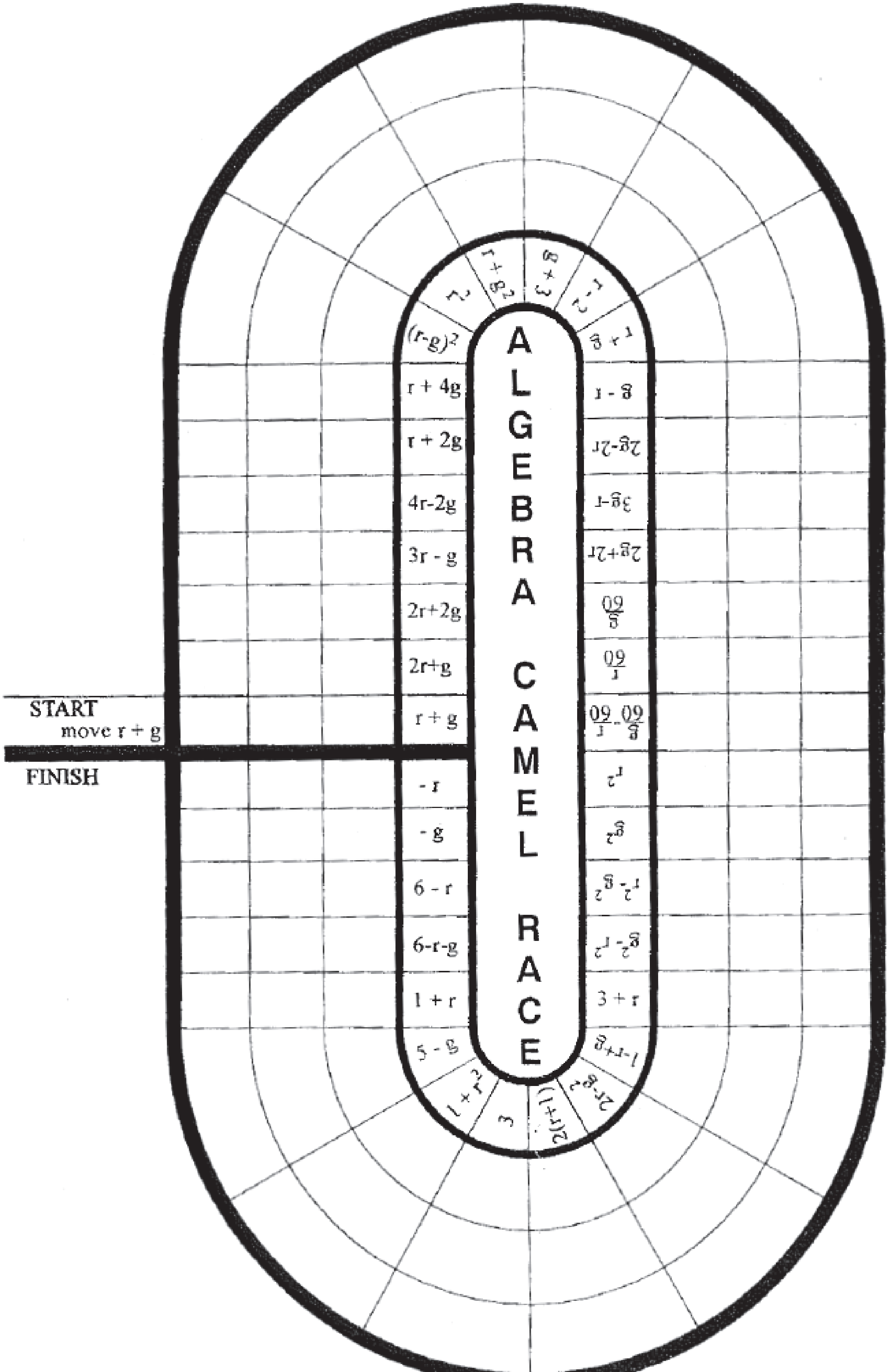

Figure 3. Algebra Camel Race board

Use only three camels in order to speed up the game. It is important though to have more than one camel so that the players have t make a conscious choice each time.

- Change of board. I have a number of different boards – all A3 in size. The simplest board uses just one die and has only one variable. More complex formulae could also be used. This one works well though and has been well tested over at least 25 years.
- Change the dice. It is possible to use ten sided dice but it does make the game faster. The game becomes more complex if new dice with both positive and negative numbers are created. I use one colour with 0, $^{+}1$, $^{-}2$, $^{+}3$, $^{-}4$, +5 and the other with $^{-}1$, $^{+}2$, $^{-}3$, $^{+}4$, $^{-}5$ and $^{+}6$.

One final comment – the game has changed its name. I used to call it Algebra Horse Race but I then encountered the problem that in some places horses run clockwise around the track and in other places, anti-clockwise. It is even different between the States within Australia. There is also the difficulty that horses usually do not run backwards. I once attended the camel races in Alice Springs in Central Australia. One of the camels, which was in a winning position, turned around and ran in the other direction leaving the poor powerless jockey embarrassed. I decided if we changed the name to Algebra Camel Races the differences to reality would not be such a problem.