

## Learning mathematics through games

### Introduction

Children, and adults enjoy playing games. Way (2011) states that “experience tells us that games can be very productive learning activities”. She also raises the following questions:

- What should teachers say when asked to educationally justify the use of games in mathematics lessons?
- Are some games better than others?
- What educational benefits are there to be gained from games?

When considering the use of games for teaching mathematics, educators should distinguish between an ‘activity’ and a ‘game’. Gough (1999) states that “A ‘game’ needs to have two or more players, who take turns, each competing to achieve a ‘winning’ situation of some kind, each able to exercise some choice about how to move at any time through the playing”. The key idea in this statement is that of ‘choice’. In this sense, something like *Snakes and Ladders* is not a game because winning relies totally on chance. The players make no decisions, nor do they have to think further than counting. There is also no interaction between players, and nothing that one player does affects other players’ turns in any way.

### Iota

Building a set of pieces that share an attribute is a common feature of many classic games, such as *Rummy*, *Mahjong*, *Rummi-kub*, and even *Connect Four*. *Iota* is another example of these types of classic games, but, interestingly, it combines some of the features of two-dimensional dominoes, and crosswords. Players score points by adding matching cards to a vertical and horizontal grid.

*Iota*, as the ninth letter of the Greek letter, means an ‘extremely small amount’. The *Iota* game

is published in a surprisingly small tin, about the size of a Keens mustard tin, and contains a pack of special cards. The publishers say that *Iota* is “the great big game in the teeny-weeny tin”.

*Iota* is designed by Gene Mackles, and published by Gamewright (2012). In Europe, it is also known as *Kwatro*, and is published by White Goblin.

*Set*, and *Qwirkle* are two other games with a similar theme to *Iota*, but they use larger cards or special counters, and have different rules. *Iota* seems to be slightly more focused, and fortunately, easier to play, giving it an edge over its close relatives.



Figure 1. *Set* and *Qwirkle* games.

### Equipment

*Iota* uses a special pack of attribute cards. Each *Iota* card is either red, yellow, green, or blue; it shows either a circle, square, triangle, or a cross; and it is numbered 1, 2, 3, or 4. The complete

set includes two wild cards, which are identical and blank. The 'tame' cards are unique from one another. That is, an *Iota* pack consists of 64 unique regular cards plus 2 wild cards.

## Number of players

2 to 4.

## Aim

Players aim to score the most points in a game by placing cards in a row or column, so that cards in a row or column all share one attribute.

## Preparation

Shuffle the cards, and deal 4 cards, face-down, to each player. Deal one card, face-up, in the middle of the table—the Starter. Place the remaining stock of undealt cards face-down at the side of the table.

## Playing

Players takes turns, with turns passing clockwise around the table. In each turn a player either places or passes.

When a player places, the player puts 1, 2, 3 or 4 of his or her cards on the table, in a single line, fitting it beside one or more of the cards already played, according to the basic matching-rule, that rows or columns of adjacent cards must all share at least one attribute, or, must have no shared attribute. This is the fundamental match-or-not rule of *Iota*.

The player then records his or her score, and completes the turn by drawing as many cards as needed, from the remaining stock of unused cards (if any cards remain), so the player finishes the turn holding 4 cards (if possible).

When placing a card or cards, all cards placed must be part of a single straight line (horizontal or vertical), with at least one of the placed cards connecting (being horizontally or vertically adjacent) to one of the cards already placed in the grid in a previous turn.

It is possible that some of the cards placed in the turn may also add to or create another line. For example, one of the cards being placed may be horizontally adjacent to another card already in the grid created in previous turns, but other cards being placed are vertically adjacent to this placed card.

It is also possible to create or extend a line by adding cards at both ends of the line.

The player scores by adding the numerical face-value of all cards in the line or lines created

or extended in this turn. A card that is part of two lines (one horizontal, and the other vertical) is counted twice in this scoring. That score for the turn is doubled for each line of 4 cards that is completed in the turn. Double this again if the player uses all 4 of his or her cards in this turn.

The maximum length of a row or column is four cards.

When a player passes, they return one or more of their cards to the bottom of the remaining pack, and draw new cards, face-down, from the top of the pack to replace the card or cards returned.

It is important to understand how lines are formed using the match-or-not rule.

Adjacent pairs of cards have either one or more of their attributes the same, or else none. This means that it is possible to make pairs freely. However, before adding a third (or fourth) card to an existing line of two (or three), consider the possible addition.

Does that possible new third (or fourth) card have:

- The same colour as the other cards in the line, or are they all different?
- The same shape as the other cards in the line, or are they all different?
- The same number as the other cards in the line, or are they all different?

If the answer to any of these match-or-not questions is 'No', then the possible new card cannot be added to that line.

The official rules do not explain how a wild card may be used: presumably, when played, it can represent any specified card. In later turns, presumably, it must still represent the same card or, perhaps, not, leaving it free to be given different attributes. Alternatively, play the game without the wild cards, to simplify the game.

When no more turns are possible, the player with the highest score wins the game.

## Variants

A simpler version of the game omits scoring: the winner is then the first player able to use all of their cards after the unused stock of cards is emptied by drawing fresh cards at the end of each turn, or is the player with fewest remaining cards when no further turns are possible.

Figure 2 shows an in-progress game of *Iota*. The game shown is incomplete but the layout of the cards identifies some of the rules that have been applied. Note the face-down stock of unused cards at the bottom right, and the hint of unused cards

in the player's hand, at the top left. Can you tell how many cards have been played?

*Iota*, like *Set* and *Qwirkle*, is a descendant of the many attribute domino and matrix-pattern games that were popular during the era of New Maths, using sets of plastic attribute blocks, where each block was a particular shape (circle, square, oblong, or triangle), a particular colour (red, blue or yellow), a particular size (big or small), and a particular thickness (thick or thin). Sets of sturdy attribute blocks were manufactured by Invicta. These blocks were popularised by the great mathematics education pioneer Zoltan Dienes, who may have actually created the basic design of these 'logic blocks'.

However, all of these games used a traditional match-or-miss-a-turn rule. By contrast, the misere-like possibility of *Iota*'s match-or-no-match rule adds a twist that opens and sustains the playing very effectively. *Iota*'s rule also suggests a twist on standard *Rummy*, and similar set-making games, aiming to make sets that have no matches

at all. (This would need to be tweaked so that the two colours of a standard 52-card pack of playing cards are ignored in deciding when a set of four cards has no match.)

Incidentally, the match-or-no-match rule has been borrowed from *Set*, a 1988 card game that evolved from Marsha Falco's work in genetic coding. *Set* uses a pack of cards consisting of combinations of colours, shapes, and shadings, each consisting of three different types: green, purple and red; oval, diamond and squiggle; and solid, shaded and outlined. The *Scrabble*-like grid-play of horizontal and vertical lines has been borrowed from *Qwirkle*.

## References

- Gough, J. (1999). Playing mathematical games: When is a game not a game? *Australian Primary Mathematics Classroom*. 4(2), 12–15.
- Way, J. (2011). *Learning Mathematics Through Games Series: 1. Why Games?* Retrieved 5 August 2015 from <http://nrich.maths.org/2489>