Section I. Co-operative logic problems

Introduction

Co-operative logic problems are an excellent way to encourage students to think mathematically, to problem solve and to share their mathematical knowledge and language. And they have fun doing it. They can be written to cover a range of content areas and skill levels. Some of the co-operative logic problems here cover number, shape, location and basic algebra skills.

As mentioned in the Introduction, games and activities promote and support the communication of mathematical skills and concepts. Co-operative logic problems are explicitly structured so that students must talk to each other during the game and in doing so explain actions, strategies, concepts and facts that are based around mathematical concepts and skills.

Instructions

You need to photocopy each of the pieces for each problem, preferably onto coloured paper or card, and then cut them out and store each set in an envelope or plastic clip lock bag. The pieces could be laminated to extend their lives. You need to have enough sets for each group of 4 to 6 students.

Usually there are different sets of pieces for solving each problem:

- the problem or question to be solved/answered
- moveable pieces of supporting information and materials (e.g. a map, a set of digits, names of people/cities, etc.)
- the clue cards.

You need to organise students to work in small groups of 4 to 6 to jointly solve the problem they are given. You need to explain that the aim is to solve the problem by working together co-operatively. Each student is to have at least one clue card and they read out their clue to the group, then discuss what that means and use the supporting information and materials to work out a solution that satisfies everyone's clues.

It is important to tell students that they need to listen carefully as each clue is read out. If you are aware that some students have reading difficulties, pair them with someone who reads well and they can work together jointly with their clues.

Some students may be tempted to take all the clues and solve the problem themselves — leaving the other students bewildered, unengaged and not understanding how the problem was solved. This defeats the whole purpose of the problem solving activity. So it is important to explain carefully how the group is to work co-operatively to solve the problem.

Once students are familiar with the process they are usually very keen for more problems to solve.

Instructions for each group of students

- Empty the contents of the envelope or bag on to the table
- Place the question card on the table along with the other supporting information and materials
- Share out the clue cards so that everyone has at least one clue card
- Take it in turn to read out your clue to the rest of the group and work together to find an answer that you all agree with
- Use the supporting information and materials to help solve the problem — move them around each time to satisfy each clue
- Don't give your clue card(s) to another student
- When you think you have an answer, go back through each clue to double check that they are all satisfied.

Teacher's role

The teacher's main role is to observe how each group is going and to support and encourage students if they are stuck.

If you notice that they have misinterpreted a crucial word or term, help them to work out or discuss what it means. Encourage students to explain to each other any words or terms that are causing confusion or are not understood. You may find that there are some key maths skills or knowledge that they don't know or understand – so the activity can indicate to you what areas they may need some teaching in.

Often a group will want you to tell them if they have the "correct" answer/solution. It is best if you simply ask them if they are all happy with the solution — have they double checked their answer? Whilst you should know the answer in advance, it is best to prompt and stimulate their thinking rather than saying they are wrong — if you are aware that their answer is incorrect ask questions such as: "Do you want to read out your clue to the group again?" or "Are you happy with the group's answer?".

Problem solving strategies

The co-operative logic problems are structured with their clue cards and moveable pieces to demonstrate at least three key problem solving strategies:

- using visual aids and hands-on materials to give a picture of what is to be solved
- guessing and checking/trial and error — an important problem solving strategy
- working with others — co-operating and working together and talking a problem through.

After students have solved a few co-operative logic problems it may be useful to have a class discussion about problem solving strategies. You could ask them to come up with a list of the different skills and strategies they used to solve the problems. This could include:

- guessing and checking — taking risks
- explaining and talking to each other
- making sure the problem is clear and everyone understands what has to be done
- listening carefully
- thinking logically
- using hands-on materials

- discarding irrelevant information
- co-operating and working collaboratively – not in isolation.

Making your own co-operative logic problems

You or your students could make more co-operative logic problems. A process for doing this with students could be:

- provide a model of the type of co-operative logic problem for them to solve
- give each group any supporting information they would need to create a similar problem (e.g. sports results, maps, populations, etc.)
- give them coloured paper, pens, scissors
- get each group to make up their own set of clues and matching moveable pieces
- solve the problem to check it works
- when each group has made one up, each group swaps with another group and tests/trials the other group's problem
- each group gives feedback and suggest improvements to the other group
- groups finalise their co-operative logic problem and could design and format them.

Other co-operative logic problems

These activities have been based on many that I have used from other sources over the years. EQUALS from the USA has produced a book of only co-operative logic problems:

- *Get it together*, EQUALS, Lawrence Hall of Science (1986)

The following EQUALS resource also includes co-operative logic problems:

- *SPACES: Solving Problems of Access to Careers in Engineering and Science*, EQUALS, Lawrence Hall of Science (1982)[1],

These adult numeracy resources also include a number of co-operative logic problems:

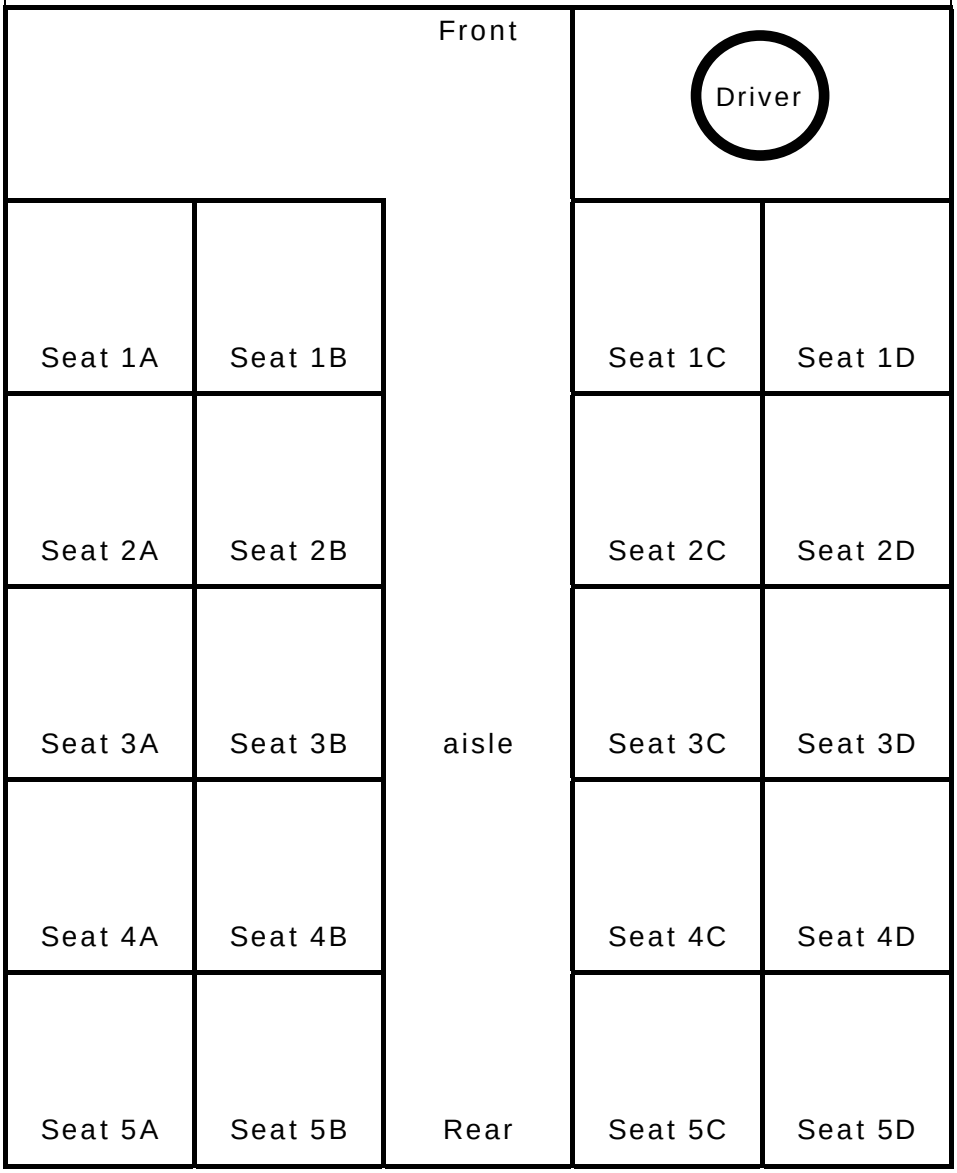
- *Mathematics: A new beginning. A resource book for teachers of adults returning to study*, Beth Marr, Sue Helme (1987)
- *Numeracy on the Line. Language based numeracy activities for adults*, Beth Marr, Chris Anderson, Dave Tout (1994)
- *Strength in Numbers. A Resource Book for Teaching Adult Numeracy*, Ruth Goddard, Beth Marr, Judith Martin (1997) [2]

[1] Both available in Australia from: Objective Learning Materials, PO Box 377, Berwick, VIC 3806, Australia. Telephone: (03) 9796 1177. Facsimile: (03) 9796 1832.

[2] These resources are available from: CAE Book Sales, CAE, 253 Flinders Lane, Melbourne, VIC 3000 Australia. Telephone: (03) 9652 0611. Facsimile: (03) 9654 6759.

CL17. Minibus 1

Map of seating in minibus



Note: You need a copy of the bus seating plan for each of the Minibus co-operative logic problems.

CL17. Minibus 1

Where is Sally sitting?

A class of eight boys and one girl, Sally, are going on a trip in the school minibus. Use the clues to figure out where Sally is sitting.

Boy who gets car sick	Boy who gets car sick	Teacher	Boy who gets car sick
Sally	Boy 5 - Bob	Boy 6 - Bill	Boy 7 - Ben
	Boy who gets car sick	Boy 8 - Baz	

Four boys are sitting in the rear seats	The four boys who get car sick are in the first row
The teacher is not sitting on the driver's side of the bus	Bob doesn't sit behind the teacher
The teacher's seat is next to the window	Sally is sitting two seats directly in front of the teacher
Bob and Bill won't sit next to each other	Bill and Baz are sitting next to each other with Bill on the aisle

CL18. Minibus 2

Where are they sitting?

The Jo family are going to the movies in their Mum's minibus. Use the clues to work out where each of them sit and who is driving

Mum	Dad	Suzy Jo	Barry Jo
Billy Jo	Spotty Jo	Sally Jo	Bobby Jo

Dad is directly behind Spotty Jo	The dog, Spotty Jo, always sits in seat 1A.
No one sits in the back two rows	Mum and Dad are on opposite sides of the bus
Mum is sitting at the front of the bus	Dad, Billy Jo, Bobby Jo and Barry Jo are sitting in row 2
Barry Jo is sitting in 2D next to the window	Bobby Jo is sitting directly behind Mum
Mum isn't driving	Sally Jo is sitting directly behind Dad

CL33. Algebra 1

a	*b*	*c*	*d*	*e*	*f*	*y*	=	+	–
1	2	3	4	5	6	7	8	9	—

Note: You need a set of the pronumerals and symbols for each of the Alegebra co-operative logic problems.

What is the equation?

The equation is to work out the value of *b*	The independent variables are *e* and *f*	The pronumerals in the equation are *b, e* and *f*
b includes 7 times the value of *e*	You need to subtract five times *f* to work out *b*	The equation does not have an *x* or *y* in it

CL34. Algebra 2

What is the equation?		
The dependent variable is *f*	The independent variables are *a* and *b*	The pronumerals in the equation are *a, b* and *f*
The equation includes 3 times the value of *a*	You need to add seven times *b* to work out *f*	The equation does not have an *x* or *y* in it

CL35. Algebra 3

What is the equation?		
The equation tells you the value of *f*	The equation does not have an *x* or *y* in it	The coefficient of c is 5
The answer for *f* includes 8 times the value of *e*	You need to subtract a half of *d* to work out *g*	The pronumerals in the equation are *c, d, e* and *f*

CL36. Algebra 4

What is the correct formula?

Steph sells cakes at the local Sunday market. What is the correct formula for working out Steph's profit?

Steph's profit depends on how many cakes she sells	You need to take off her costs to work out her profit	One of her costs is the hire of the market stall, which is $80
Each cake costs her $2 to make	Steph sells each cake for $5 at the market.	Use P for the profit Steph makes in dollars
The number of cakes she sells is represented by n		

$P = 3n - 80$	$P = 3n + 80$
$P = 5p – 2n$	$P = 5n – 2n$
$P = 5n – 80n$	$P = 3n$