

Problem Solving Inset

This package is designed to promote the teaching of and raise the awareness of problem solving in schools. It is an outline for an Inset day that lends itself to adaptation to suit the needs of any school.

Throughout the package there are helpful hints for the organiser of this Inset to help them through the day.

Problem Solving Inset

Programme of the day

- 9:00** **Coffee and Introduction**
- 9:15** **Skills pupils need to solve problems**
- 10:15** **Problem solving strategies**
- 10:45** **Coffee**
- 11:00** **Act it out**
- 11:30** **Draw it out**
- 11:45** **Use Equipment**
- 12:15** **Using a diagram**
- 12:45** **Lunch**
- 1:30** **Use a list**
- 1:50** **Trial and Improvement**
- 2:10** **Draw a table**
- 2:30** **Working backwards**
- 2:45** **Why use stories**
- 3:00** **Problem Solving within a Story**
- 4:00** **Tea and Plenary**

9:00

Give a brief introduction as to the focus of the day, which is to look in detail at the different aspects of problem solving.

9:15

The checklist on the next page needs to be explained briefly before the participants complete the task.

For example systematically searches for information - an example of this could be observed behaviour of child checking work; child starts at the beginning and checks through.

If you as leader of this Inset need any help as to what these items on the checklist mean refer to the 'Helpful Hints for Thinking Skills' sheet.

Task for participants

Each person needs a copy of the checklist. They need to work in pairs and fill in the Checklist of problem Solving Skills for two pupils that they teach. It would be useful to consider two very different pupils. It is important that the participants work in pairs or groups to encourage discussion. The focus should be kept on identified children and specific examples of their use of strategies.

You now need to give out copies of the 'Helpful Hints relating to Problem Solving Checklist'.

Task for participants

*Relate these helpful hints to the previous task and discuss how the 'Helpful Hints' could be used to overcome specific problems.
At this time other suggested activities could be added or shared.*

Checklist of problem solving skills

| | Never | Always |
|---|-------|--------|
| Input/seeing | | |
| 1 Systematically searches and looks for all information | | |
| 2 Is precise in gathering information | | |
| 3 Can consider information from more than one source | | |
| 4 Recognises pattern | | |
| 5 Understands stability of characteristics | | |
| Elaboration/thinking | | |
| 6 Understands the spatial relationships of elements of a problem | | |
| 7 Understands events and their relationship in time | | |
| 8 Identifying there is a problem | | |
| Understands the relationships between the terms of the problem | | |
| Understands when something is missing from these terms | | |
| Understands what terms are relevant | | |
| 9 Can summarise relevant terms | | |
| 10 Can compare like terms or attributes | | |
| 11 The ability to organise information | | |
| 12 Good short term memory | | |
| 13 Can summarise experience and comment on relationship to goal | | |
| 14 Can give logical reasons for opinions and relates information to possible outcomes | | |
| 15 Can test hypothesis | | |
| 16 Can plan future actions | | |
| 17 Understand logical multiplication | | |
| Output/generating | | |
| 18 Can give clear unambiguous instruction | | |
| 19 Understands the vocabulary for the task | | |
| 20 Plans responses not just the first thing which comes into their head | | |
| 21 Has the confidence to fail | | |
| 22 Understands the importance of the process as well as the outcome | | |

Helpful Hints relating to Problem Solving Checklist

Thinking skill 1

Systematically searches and looks for all information.

Suggested Activities

Key Stage 1

Try hiding an object in the class and ask a child to search for it, encourage a systematic approach

Lay out a set of picture cards face down and in rows. Ask the child to find a particular card by turning over one at a time, turning over the card and turning it back over if it is not the right one. In between doing this the children can turn round three times, encouraging the child to maintain a visual picture of which cards have been checked. This will also encourage a strategy of searching in rows or columns. The emphasis in this activity is to promote a systematic search.

Key Stage 2

Using simplified games of battleships to promote systematic searching.

Try various scanning texts activities searching for particular words or letters.

Thinking Skill 2

Is precise in gathering information

Suggested Activities

Key Stage 1

Ask the child to find out how many chairs in the next classroom

Ask child to count objects arranged in a circle

These activities encourage children to remember where they started and count in a systematic way.

Key Stage 2

Ask the child to find out how many pupils will need to go home on the bus, walk or in cars. Check that the total is the same as the number of children in the class.

Ask the pupils to find out what type of book children prefer to read. Check that the total is the same as the number of children they were asked to survey.

Thinking Skill 3

Can recognise information from more than one source.

Children need to be able to collate information from more than one source.

Suggested activities

Key Stage 1

Ask child to find out information about polar bears.

Ask child to find out information about different kinds of footwear.

Key Stage 2

Ask child to find out about the different prices of pizzas sold by a variety of companies.

Ask child to find out the total number of tables in the school.

Ask the child to find out how many books are in several classrooms.

Thinking Skill 4

Recognises pattern

Suggested Activities

Key Stage 1

Give the child a pattern drawn on paper and ask them to explain the pattern – when does it repeat itself etc.

Give the child a number pattern and ask them to show you when the pattern repeats itself

Key Stage 2

Give the child the start of a number sequence and ask them to tell you what the pattern is and continue the sequence.

Give the child the start of a pattern made out of matchsticks. Ask them to describe the pattern and continue it.

Thinking Skill 5

Understands stability of characteristics.

The child needs to understand that if something is mathematically possible one day it will still be possible the next day.

Suggested activities

Key Stage 1

Give the child a selection of counters that they then count. Rearrange the counters and ask them if they still have the same number whether or not they are spread out or bunched together.

Give the pupils a selection of cubes, which they then count. Then group the cubes more closely and ask them if they still have the same number.

Key Stage 2

Give the pupil an 8cm x 8cm square and ask them to divide into 4 equal squares. Give them the same task the next day and they should realise that it is still possible.

Thinking Skill 6

Understand the spatial relationships of elements of a problem.

The children need to be able to put measurements in the correct contexts.

Suggested activities

Key Stage 1

Tell the child my house is 5km in front of where I am standing. Another house is 3km behind where I am standing. What is the distance between the two houses?

Have children sitting on chairs at the front of the class. Ask questions about who is next to whom. Who is 4 chairs away from someone else etc.

Key Stage 2

Give pupils information, which spatially links a set of objects, and ask them to draw the position of the objects on the plan and the distances between each object.

Thinking skill 7

Understands events and their relationships in time.

Children need to understand the vocabulary such as before, after and sequencing words.

Suggested activities.

Key Stage 1

Give the child a set of pictures that tell a story and ask them to put the pictures in order.

Give the child a few sentences of instructional text and the child has to put the sentences in the correct order.

Key Stage 2

Child to put a selection of instructional text in order.

Thinking Skill 8

Identifying there is a problem.

This skill has several elements

- A. Understanding the relationships between the terms of the problem
- B. Understanding when elements of the problem are missing
- C. Understanding when there are irrelevant elements in the problem

Understanding the relationships between the terms of the problem

This is most often the numerical relationship between objects and numbers

An example would be measuring the lollipop persons (crossing supervisor) stick with cubes or bricks. The number of bricks represents the length of the stick.

Another example could be the weight of an apple in grams. The number of grams represents the weight of the apple.

The more difficult relationships are where two terms relate to each other to produce a third value.

Multiplication: Sets of numbers based on the idea of repeated addition.

Example

Fractions: $\frac{2}{5}$. The two relates to the five showing that 2 is part of the set of 5.

Example

Ratio and proportion: 2:3. The two relates to the three, which together represent a relationship value.

Example

Area: Height x length, the length and the height relate to each other to produce a value for the area.

Example

Problems involving these types of relationships rely on the understanding of the concepts. These are not necessarily problem solving skills in themselves.

Example

Understanding when elements of the problem are missing

This is the most common example of problems. There is a missing term or part of a set of relationships

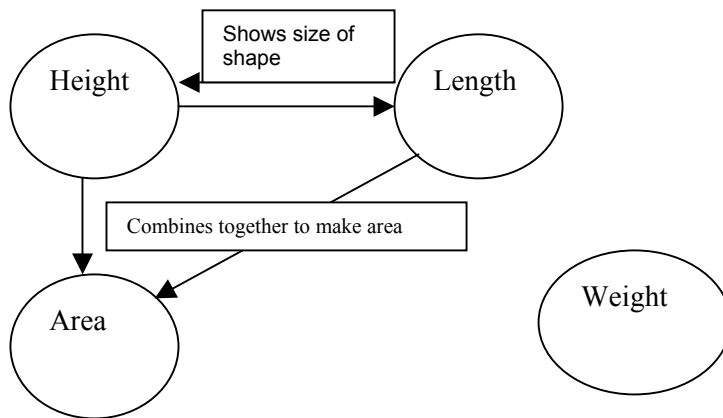
Example

Understanding when there are irrelevant elements in the problem

This is when there is information, which is not relevant to the problem. Children will try to use information even if it is not relevant.

Suggested activity

Map the terms of a problem and draw lines between the terms to explain the connections.



Example

Thinking Skill 9

Can summarise relevant terms

We know there's a problem but how do we narrow it down. Write down the facts to solve the problem.

Suggested Activities

Key Stage 1

Describe picture, scene or event.

Feely bag

Key Stage 2

Drawing pictures on white boards from verbal instructions.

Two children each have paper and scissors. The first child cuts out a shape while giving instructions to the second child who will hopefully end up with the same shape.

Thinking Skill 10

Can compare like terms and attributes.

Suggested activities

Key Stage 1

3 bottles of milk and 3 bottles of coke. How many bottles of milk are there? 3 not 6 as some pupils might say. How many bottles of drink are there- the answer is 6.

Key Stage 2

0.5kg is the same as 500grams

Thinking Skill 11

The ability to organise information

Using appropriate display

Suggested Activities

Key Stage 1

Ask pupils to record pets, brothers, and sisters do they record numbers?

Key Stage 2

Give pupils a cake and ask them to carry out a 'guess the weight of the cake' competition. Do the pupils record the information in an appropriate way? They must record both the names of the people guessing and the weight that they guess else the information is useless.

Thinking Skill 12

Good short term memory

Suggested Activities

Key Stage 1

Memory games.

Kim's games.

I went to the shop and I bought.....

Key Stage 2

Remembering sequence of numbers

Spellings backward

Audio, visual and kinaesthetic activities

Thinking Skill 13.

Can summarise experience and comment on relationship to goal.

In long term problem when they say what they have achieved so far, comment on progress.

Suggested Activities

Key Stage 1

Pupils explain to teacher how far they have got with an investigation and what they need to do next.

Pupils explain that they are doing in science and what they are going to do next.

Key Stage 2

Pupils explain how far they have got with a problem solving activity and what will be the next steps and why they need to do them.

Thinking Skill 14

Can give logical reasons for opinions and relates information to possible outcomes.

Why do things happen and what if certain things happen.

Suggested Activities

Key Stage 1

Why / what if?
What if all cars were red?
What if the sun stopped shining?

Key Stage 2

What if a blue light was introduced at the traffic lights?
What if cows ate sand?

Thinking Skill 15

Can test hypothesis

Saying if something is true and then trying to prove it.

Suggested Activities

Key Stage 1

Does blue and yellow make red?
Can you make every colour if you have red, yellow and green?

Key Stage 2

What numbers are prime numbers; can you test them out?
Will any two triangular numbers make a square number?

Thinking Skill 16.

Can plan future actions

Asking what they are going to do next.

Key Stage 1

If you are going to paint what do you need to do first.

Key Stage 2

If you are having a cake stall what do you need to do and in what order.

Thinking Skill 17.

Understanding logical multiplication

Suggested Activities

Key Stage 1

Repeated addition- use multilink that are blocks of different colours. E.g. red, yellow, blue. 5 blocks how many cubes altogether.

Key Stage 2

Sets of 6 eggs I have 32 sets how many eggs do I have?

Cakes are packed in boxes of 12. I need 25 boxes, how many cakes will I need?

Thinking Skill 18

Can give clear unambiguous instructions.

Can use and understand time and direction prepositions

Suggested Activities

Key Stage 1

Directional instructions. E.g. left and right

First, next, before,

Key Stage 2

Can give a set of instructions as to how to get from one place to another e.g. home to school.

Thinking Skill 19

Understands the vocabulary for the task.

Understands that language is abstract.

Do not assume that the children understand the words used

Suggested Activities

Key Stage 1

Put in a missing word into a sentence. Children work out word through looking at the answer.

I went to the shop and bought a _____. I didn't need it, as it wasn't raining.

Key Stage 2

Pupils explain the meaning of words such as operation in maths.

Prediction and conclusion in science.

Thinking Skill 20

Plan responses not just what comes in to their heads.

Ask why? Where is your evidence/ show me?

Suggested activities

Key Stage 1

Pupil measures lollipop lady's stick, says that it was 120cm and can show how they know.

Key Stage 2

Pupils state that the height of a tree is 12m and can show how they calculated it.

Thinking Skill 21

Has the confidence to fail

Having a buddy for oral responses

Thinking Skill 22

Understands the importance of the process as well as the outcome.

Realises that progress in solving problems is important rather than just saying how it was done.

Suggested activities

Key Stage 1

Ask pupils to tell teacher the steps that they would need to take to do an activity i.e. go to the office and bring back the register.

Key Stage 2

Ask pupils to explain the steps that they would need to go through to solve a 2 or 3 step word problem.

10:15

You now need to look at ‘Problem Solving’ and the different aspects of it – see next page.

The rules

The solution of the problem is a combination of the method and the answer. Problem solvers do not necessarily begin at stage 1 of the model and work through the steps in order; they often need to move backwards and forwards through the model. I.e. re-reading the problem during the solving stage.

The Strategies

This list is hierarchical in the way it is learnt but once all the strategies have been learnt they should be used according to their suitability to the problem. At this point it might be useful to discuss how the school will refer to the strategies and the language used. It is a good idea to have a whole school approach.

Thinking

This is not a definitive list but is a good starting point as a framework for problem solving in school.

Problem Solving

The Rules

- 1. Understand and explore the problem**
- 2. Find a strategy**
- 3. Use the strategy to solve the problem**
- 4. Reflect on the solution and how useful the strategy was**

The solution to the problem is the combination of the method and the answer.

Problem solvers do not necessarily begin at stage 1 of the model and work through the steps in order; they often need to move backwards and forwards through the model. I.e. re-reading the problem during the solving stage.

Problem Solving Strategies

The most common problem solving strategies can now be considered.

- 1. Act it out**
- 2. Draw it out**
- 3. Use equipment**
- 4. Draw a diagram**
- 5. Make a list**
- 6. Trial and improvement**
- 7. Draw a table**
- 8. Work backwards**
- 9. Thinking**

At any time in the primary (and beyond) education, the children may be using any of these and although the earlier ones may be more suited to the younger children, it would be entirely appropriate in some problems for older children, for them to use act it out.

The final strategy on the list is a 'catch –all' situation because it contains the strategies that are not generally used in isolation but in combination with others strategies.

Thinking

- ◆ **Being systematic**
- ◆ **Visualise**
- ◆ **Looking for patterns**
- ◆ **Using known skills**
- ◆ **Testing the answer.**

11:00 – 2:45

(For the next part of the programme you need copies of the nine different strategies for solving problems which can be found on the disk. E.g. Act it out, Draw it out, Use equipment etc. Teachers might like to work in pairs for these activities. There are notes with each activity that you might find useful. Some of the activities are open to interpretation and therefore have more than one answer. You will need to decide how you are going to interpret them. E.g. Is Boris allowed to retrace his steps in the 'Act it Out' activity?)

2.45 – 4:00

Why use a Story?

- **Stories help put the child in to the context of the problem. They engage the child in the fantasy of the problem.**
- **Stories are an easier way to remember a problem type and refer back to it**
- **Stories aid the child's ability to explain problems**
- **Story types are endless and because of their flexibility can be used to contextualise problems of any sort.**

(For this part of the programme you will need to print out copies of the stories that again can be found on the disk. You may wish to focus on one year group or look at a selection. It is not necessary for teachers to complete these stories but they need to get an idea of what they are about and how the problems set within the stories require one or more of the strategies talked about earlier to solve them.)