THINKING AND REASONING SKILLS

SKILL 6: EXPLANATIONS

Creative thinking is useful when it comes to the evaluation of explanations used in arguments. Being able to recognise subtle, logical errors in the explanations of others as well as being able to come up with alternative ways of explaining something requires creativity. Creative thinking of this kind benefits from guidance and skill development, which is what this section of the course will focus on.

By teaching and assessing this skill, the aims and objectives are as follows:

ALTERNATIVE EXPLANATIONS

Teachers should aim to:
Explain the nature of an alternative explanation.
Guide students in generating alternative explanations for a range of factual phenomena.
Explain the importance of plausibility in explanations.

STUDENTS SHOULD BE ABLE TO:

Look at how something has been explained already and come up with different (yet realistic) ways of explaining how or why that something came about'. Ths seems to have been taken from a different skill in error during design

NECESSARY AND SUFFICIENT CONDITIONS

Explain what it means to say that something is a necessary or sufficient condition of something else.
Guide students in differentiating between these and give them strategies for recognising them.

STUDENTS SHOULD BE ABLE TO:

Say whether something is a necessary or a sufficient factor of something else.

UNDERSTANDING CAUSAL CONNECTIONS

Teachers should aim to:
Expose students to a range of explanations involving causation.
Guide students in recognising that just because events are linked in time (e.g . one after the other or at the same time) it does not necessarily mean there is a causal connection.

STUDENTS SHOULD BE ABLE TO:

See that when an event happened after another event or at the same time, one might not have caused the other.
Spot when an argument or explanation makes this mistake.

UNDERSTANDING CORRELATION

Teachers should aim to:
Explain the nature of correlation as different from causation.
Expose students to a range of explanations involving correlations and give guidance on generating different ways of explaining them.

STUDENTS SHOULD BE ABLE TO:

Understand that when there is a relationship between different events or data, there are often many different ways of explaining this relationship.
Come up with different ways of explaining relationships between events or data.

ALTERNATIVE EXPLANATIONS

Sometimes, people include explanations in their arguments (or they assume a certain way of explaining something) that might not be correct. A very common mistake in thinking is to assume that a certain way of explaining how or why something came about is the only way of explaining it, but that is often not true. Consider the following example:

The apple pie I left to cool on the table has gone, so the dog must have eaten it. The dog should be punished!

This clearly offers an explanation for the missing pie – the dog ate it – and the conclusion is then drawn on that basis. However, there are other possible explanations:

- A family member came home for lunch and thought it was for them, so ate it.
- Someone else in the family saw that it had been left out and thoughtfully put it away in the cake tin.
- A hungry traveller passing by saw the pie through the open window and was so tempted that he took it.

If we let our imaginations run wild there are many more possibilities – alien pie-hunters, for example, or science experiment on an apple has gone wrong and made it come to life and it has taken the pie in order to dignify their loved ones baked in it with a decent burial...

A good explanation, however, should be plausible (believable) and fit with other available and commonly accepted facts.

Alternative explanations printable worksheet.doc

Sometimes, we have to think laterally (in other words, look at it from a different angle). You won't be expected to do any lateral thinking in skill 6, but it is useful to be able to think 'outside the box' when thinking of alternative explanations sometimes, and a good way of practising this skill and getting the creative juices flowing is to tackle lateral thinking puzzles.

The following support materials can be found within the **Skill 6 pdf portfolio**.

6.01 Alternative explanations printable worksheet.doc

Task: look at the following image and, by adding one single, straight line, transform it into nine-fifty:

IOIOIO

Before I give away the answer, try asking yourself these questions (this is a good lateral thinking strategy!):

- What angle are you are looking at it from? (which metaphorical hat are you wearing?)
  Hint: because there are numbers involved, you are probably looking at it mathematically.
- What other angles could you look at it from?
  Hint: when else might you see numbers? Measurements, bar codes, clocks...
- When I look at the puzzle from these other angles, what can I do/see differently?
  Hint: from which of these angles can this image be written a different way?

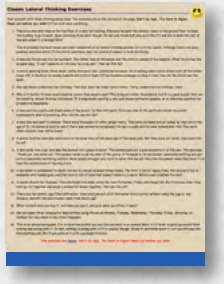
If you've already worked it out, give yourself a big pat on the back. Otherwise read on. Numbers are used in telling the time, and we sometimes tell the time using a mixture of words and numbers, for example, half past 10. Try adding a short, horizontal line to the top of the second line in the image and what do you see?

Reveal

Another way of reading this is ten to ten, which is also another way of saying nine-fifty in terms of telling the time. This is a tough one. There are some other good examples available on various websites.

Here are a couple to try:

A selection of puzzles and brainteasers can be found at:
www.intelligencetest.com



A selection of short, funny puzzles to demonstrate laterial thinking can be found at:
http://wilk4.com/humor/humore14.htm

Here are some more activities involving coming up with alternative explanations:

The following support materials can be found within the **Skill 6 pdf portfolio**.

6.02 Answers on a postcard printable worksheet.doc

Stanley goes to war

6.03 Why did Stanley join the army.doc

6.04 Clues about Stanley.ppt

NECESSARY AND SUFFICIENT CONDITIONS

The word 'condition' here means something that plays a part (a factor) in making something what it is. For example, rhubarb is one of the conditions making a rhubarb pie what it is; pastry is another. Another example: a visit to the doctor might be brought about by certain conditions e.g. a fever or a pain.

Sometimes a condition plays a **necessary** part in making something (let's say x) what it is – in other words, it *must* be present for x to be what it is. Let's take the rhubarb pie example:

Condition: rhubarb	**x: rhubarb pie**

The rhubarb is a *necessary* condition. It must be present for the rhubarb pie to be a rhubarb pie!

Some conditions are **sufficient** in making something what it is – in other words, it is enough to make it what it is. Let's take the doctor example:

Condition: fever	**x: visit the doctor**

A fever might be *enough* to make me visit the doctor, so either of these would be a sufficient condition of visiting the doctor.

Sometimes, a condition is both necessary and sufficient:

Condition: It is 25th December	**x: Christmas Day**

It *must* be the 25th December to be Christmas Day, and if the date were 25th December that would be *enough* to make it Christmas day.

At other times a condition is neither necessary or sufficient:

Condition: Bob loves Sandra	**x: Sandra loves Bob**

It is not a *must* that Bob love Sandra for Sandra to love Bob, nor is it enough that Bob loves Sandra to make Sandra love Bob – the two things are independent of one another.

To work out whether a condition is necessary, you should ask:

Could x be x without it?

To work out whether a condition is sufficient, you should ask:

Would this on its own be enough to make x what it is?

Task: Consider the following examples and work out whether the condition is necessary, sufficient, both or neither:

Being a mammal as a condition of being a human.

Having your head chopped off as a condition of being killed.

Today not being a Saturday or Sunday as a condition of it being a weekday.

The following support materials can be found within the **Skill 6 pdf portfolio**.

6.05 Necessary and Sufficient Conditions printable worksheet.doc

6.06 Necessary and Sufficient Conditions printable answers.doc

UNDERSTANDING CAUSAL CONNECTIONS

When things happen around the same time, it can sometimes seem as though they are connected in some way. It is a basic scientific principle that all events have a cause, but there are often many causes for one event and it is easy to get confused over what has actually caused something to happen. For example, if you put a red shirt in the washing machine with a white shirt and when you take them out of the machine the white shirt has turned pink, we can safely say that what caused it was mixing red and white colours in the wash. However, if the morning weather forecast said it was going to rain in the afternoon, and then it rains in the afternoon, we wouldn't say that the weather forecast made it rain! In both cases, one thing has happened after the other, so what is the difference? In the second case, there are much more likely explanations for what caused it to rain – there is a relationship between the forecast and the weather, but it has not been correctly understood. In other cases, there might be no connection at all between two events, yet the fact that one happens after the other might lead a person to see cause and effect when there is no such relationship. For example, you sing in the shower and then the glass mirror breaks – it is highly unlikely that there is any causal connection between the two.

The following worksheet provides an opportunity to explore causal links in more detail:

The following support materials can be found within the **Skill 6 pdf portfolio**.

6.07 Introducing causal links printable worksheet.doc

When one thing happens after another and we assume that there is a causal link this is flawed reasoning. This is illustrated by Sheldon in the following funny clip from US sitcom ***The Big Bang Theory***:

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Consider the following examples:

Sally walked under a ladder this morning, then this afternoon she lost her purse. It is obviously really bad luck to walk under a ladder!

I had cheese for my supper last night and I had a really bad nightmare. I should have listened to my Mum when she said you shouldn't eat cheese at bed time!

In both of these examples, it is being assumed that one thing has caused the other just because they happen after one another. In reality, though, both things could have been caused by something completely different – the purse could have been left at home accidentally (which has more to do with organisation than luck) and the nightmare could have been the result of a stressful day.

UNDERSTANDING CORRELATION

Correlation is the word used when there is some kind of relationship between two different factual events or data. Consider the following relationships:

Increased cases of sunburn and a spell of hot weather

Increased cases of sunburn and an increase in ice-cream sales

In both cases there is a correlation. In other words, they are connected in some way – in both cases the two events happen at around the same time and they are out of the ordinary – increases in sales, sunburn and hot weather.

However, in the first example, the reason for the correlation is causal. We are able to explain the causal link between the two (exposure to sun causes sunburn, so an increase in sun can lead to an increase in sunburn). In the second example though, there is no such connection – they both happen at the same time, but we cannot explain the correlation by making a causal link. We can, however, offer a different explanation for the correlation – People are more likely to buy ice-cream in hot- weather, and so there has probably been an increase in hot weather which can cause sunburn . . .

A friend of mine became convinced that eating beetroot made him a faster runner. He drank beetroot juice every day whilst he was training for a marathon, and the time it took him to run the same distance decreased every day. A much more likely explanation is that he was getting faster because he was in training.

The following support materials can be found within the **Skill 6 pdf portfolio**.

6.08 Correlation does not mean causation printable worksheet.doc

6.09 Necessary, sufficient and causal links.ppt

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