Centre for English Teaching Specialization

MOOC 2: Problem-Solving Skills for University Success

3.1d Strategies for Understanding a Problem

Using key words

What is a key word?

There are two different types of key words: content words and function words.

Content words tell you "what" you have to write about.

Function words tell you "how" to write something.

Content words are the main words in a sentence. They give you the topic and any key ideas you should address. They are usually nouns or adjectives, but can be verbs as well.

In the examples below, content words have been highlighted.

Function words are the words in sentence that give instructions. See page 2 for a list of different function words and their general descriptions.

In the examples below, function words have been underlined.

Note: not all questions have function words, which is why looking at your assessment criteria is important.

1. In 2006, Mt Red High School, a public school in Sydney's inner-west, ranked 1st in NSW for HSC Physics and Biology. Since 2013, however, there has been a sharp decline in Physics scores and this year only 3 students signed up for the course. A study was done that indicates students are losing interest in Science during year 9. Design a curriculum outline with the aim of increasing interest in Science. Your curriculum outline should include a rationale, the sequence of units, descriptions of each unit, and all assessments for the course.

2. In what ways will Information and Communication Technologies (ICTs) fundamentally change the nature of how we learn?

3. Ildal, a Korean electronics manufacturer, has developed a new virtual and augmented reality enabled mobile phone. You are part of the marketing department, and are responsible for taking the phone to market in your country. Identify which parts of the market you will target, and explain how you will market the item.

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Common Function Words

Descriptive

Summarize: Explain the main ideas and connections between those ideas in brief without going into too much detail.

Illustrate: Give an example to help clarify an idea.

Define: Explain the meaning of something.

State: Write the main points or factors clearly.

Outline: Explain key points but do not give examples or evidence.

Calculate: Use mathematics to provide an answer.

List: write down main ideas or factors in a list.

Explain: Make something clear by detailing the features and the reasons for it.

Analytical

Compare: Take two things and explain the similarities and differences between them.

Analyse: Detailing features and reasons and critiquing them.

Contrast: Similar to compare, but focus much more on the differences.

Criticise: Generate and express your own opinion or judgement on a topic or theory.

Discuss: Explore an issue or idea by writing about the advantages and disadvantages or by comparing/contrasting multiple different views of the issue or idea.

Examine: Closely explore something; investigate it by looking specifically at small elements or features.

Describe: Report on something by recounting details, relating a sequence, outlining etc and in doing so give your own view on the phenomena being reported about.

Evaluate: Make a decision about the validity or plausibility of something using a particular objective or theoretical framework.

Account for: Give reasons for the occurrence of something, or for selecting or using some process.

Examine: Investigate something closely, and possibly identify good and bad points of a theory or idea.

Consider: Write and examine your observations and thoughts on a particular subject or issue.

Comment on: Present ideas for and against a certain point, and clearly state your position with reference to evidence and examples.

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Argue: Present the case for an idea, and defend it against possible counter-arguments.

Justify: Provide reasons for a conclusion or statement, and support your position with evidence.

Clarify: Make something clearer, and show the relationships between items and ideas.

Trace: Chronologically set out the historical development of a theory or practice, and in doing so give reasons for its emergence, decline or trajectory

Interpret: Translate or solve a problem or issue, or make its meaning clear.

Relate: Show the relationships, similarities and differences between ideas, facts or statements.

To what extent: Consider and/or compare both sides of an argument or issue, and give your own opinion.

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Assessment Criteria

Assessment criteria are designed to make the marking clear for both students and markers.

They can be as simple as the instruction to “show your working” on a maths test to a complex table of the different requirements for each section of an assignment.

> Assessment criteria are also known as assessment rubrics, marking criteria or marking rubrics.

When understanding a problem, assessment criteria become very useful in order to define what you are going to be marked on and therefore what you need to include.

Take, for example, the following group assignment task:

> *In a group of 3 students, create a poster for a year 7 science classroom explaining Newtown’s laws of motion.*
>
> ***Assessment Criteria***
>
> - *All three laws of motion clearly stated and explained*
> - *Graphics and explanations are targeted at a year 7 audience*
> - *Graphics and explanations clearly reflect Mallet’s principles of poster design.*
> - *Graphics are professional*
> - *Poster is A2 in size*

> If you are unsure how something will be marked, always ask your lecturer or tutor.

From this assessment criteria and the question, we can see that the students are required to create an A2 poster that: states and explains the three laws of motion, includes professional graphics, and is aimed at a year 7 audience. Criterion 3 is the most interesting, as it specifically states that the poster should reflect “Mallet’s principles of poster design” – an element that is not mentioned at all in the question statement. Moreover, three of the four criteria mention the need for graphics – meaning that students cannot simply explain the problem in words, but would need to include images as well.

These might seem like relatively minor things, but when it comes to assessment they are often a great place to start.

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Using Units

Units can be a really useful way of understanding a question (and also, later, evaluating and communicating your solution).

Take, for example, the following example of a classic problem:

> *A car travelling at 60km/hr takes 2 hours to travel 120km.*
>
> a. *If the car continues to travel 60km/hr for another hour (thus, 3 hours in total), how far will it have travelled in total?*
> b. *If the car increases its speed to 80km an hour, how long will it now take to travel 120km?*
> c. *If the car decreases its speed so that it takes 4 hours to travel 180km, how fast is the car travelling?*

Traditionally, this strategy is used in mathematics, engineering or the physical sciences, but it is also a very useful tool for helping to understand social science and humanities problems.

In each of the questions, the function word indicates the unit of measurement we are looking for.

How far means we are looking for distances (so metres or kilometres).

How long indicates time (seconds, minutes or hours).

How fast indicates speed (m/s or km/hr).

Knowing this helps us to understand what we are looking for.

The equation for speed is speed = distance/time (s = d/t): therefore, for each question we just need to rearrange the formula so that we can get the unit we need as an answer.

a. Distance = Speed X Time
b. Time = Speed/Distance
c. Speed = Distance/Time

At university, problems are rarely that simple. Take the problem below:

> In 2006, Mt Red High School, a public school in Sydney's inner-west, ranked 1st in NSW for HSC Physics and Biology. Since 2013, however, there has been a sharp decline in Physics scores and this year only 3 students signed up for the course. A study was done that indicates students are losing interest in Science during year 9. Design a curriculum outline with the aim of increasing interest in Science. Your curriculum outline should include a rationale, the sequence of units, descriptions of each unit, and all assessments for the course.

The function words here – design and include – do not tell us the units of measurement that will be used. For this problem the "unit of measurement" is the product you are required to produce: in this case, a curriculum outline that increases interest in Science. The "curriculum outline" is well-defined as needing to include "a rationale, the sequence of units, descriptions of each unit and all assessments". Your final submission, therefore, will have at least four sections.

Now, let's look at the first part of the question in a little more detail: a curriculum outline that "increases interest in Science". This section is ill-defined and as the case is fictional we can't just implement the curriculum and then survey the students afterwards to see if it worked. Therefore, we would need to define what makes something "interesting" to year 9 students, and then apply that to science. The rest of the assignment would then be justifying why the units you've chosen and the activities and assignments within each unit will interest students and thus motivate them to continue their study.

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Visualising or Drawing a representation

Visualising a problem or drawing a representation of a problem is one of the most common ways to understand what a problem is really asking.

In order to do this effectively, you need to first identify the key content words within the question.

Take, for example, the brain-teaser from Module 2: Key content words have been highlighted.

A picture is worth 1,000 words.

You, along with three other people are put into a line facing forward. The last person is separated from the others by a screen, so he/she cannot see the others nor can he/she be seen by them. An officer then places either a red hat or a green hat on each person's head. You know there are exactly two red hats and two green hats. You are not allowed to a) look at your own hat OR b) turn around and look at the person or people behind you (if you do, everyone is killed). You can see the hat(s) of all the people in front of you except the person behind the wall.

If one person in your group can correctly guesses the colour of his or her own hat, everyone is free. However, if one person guesses wrongly, everyone will be killed.

How can a person be certain that he or she calls out the correct hat colour and save everybody's lives?

After you have decided on the key words, you need to figure out what the physical elements of the problem are. For example, we know there are 4 people in a line facing forwards and the last person is behind a screen. We could represent it like this:

Draw the physical elements. It can be helpful to use symbols (such as arrows for directions, stick figures for people, circles or crosses or stars etc.) for different elements of a problem.

→ OOO /O

Where the arrow indicated the direction the people are facing and each circle represents a person. The dash is the screen that separates the last person.

Now, we draw every possible combination of hat colour distribution by changing the colour of the circles:

→ OOO /O	→ OOO /O	→ OOO /O
→ OOO /O	→ OOO /O	→ OOO /O

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The question asks us to decide which person can know with 100% certainty the colour of the hat on their head. The person at the end, behind the screen, has no way of knowing at all.

The first person, however, can see two hats. He/she is the most likely to be able to call out a colour and save everyone.

O→ OO /O S	O→ OO /O D	O→ OO /O D
O→ OO /O S	O→ OO /O D	O→ OO /O D

As we can see from the first column, if the starting person sees two hats of the same colour, he/she can easily call out the colour on their head as it must be the opposite of the colour in front.

However, if he/she doesn't see the same colour, the starting person has no way of knowing what colour their hat could be.

O→ OO /O D	O→ OO /O D
O→ OO /O D	O→ OO /O D

From this image, it now looks like there are four different options. However, no one can see the person behind the wall. By drawing the image, we can see there are actually only two options: a red hat followed by a green hat, or a green hat followed by a red hat.

OO →O /O D	OO →O /O D

Now, here comes the tricky bit. If the starting person stays silent, it means that the hat colours of the two middle people are *different*. The last person in line cannot see anyone else's hat, but the second person can see the person in front's hat.

Who can call out the colour of his/her own hat, now, knowing all of the above?