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Skills for Computing

Topic 5:

Problem Solving

V1.0

Learning Outcomes for this Topic

By the end of this topic, students should be able to:

- Analyse a problem and propose solutions
- Define the success criteria for solving a problem
- Evaluate solutions against success criteria, and select a solution

General Model for Solving a Problem

1. ***Define*** the Problem
2. Identify ***success criteria***
3. Identify many ***possible solutions***
4. ***Evaluate*** solutions against success criteria
5. ***Select*** solution

1. Define the Problem

- In topic 3 (Writing), we covered analysing a question in order to answer it correctly.
- Defining problems is a similar process.

- Ask yourself:
  1. What are we being asked to do?
  2. What is the scope / what are the boundaries?

2. Identify Success Criteria

- We cannot successfully solve a problem unless we have a clear idea of what is considered a successful solution.
- The success criteria tell us what we need to achieve, or what characteristics a solution must have, in order to solve a problem

Example of Success Criteria

- Problem: select the ‘best’ solution for getting from Point A to Point B on public transport.
- Success Criteria must define what ‘best’ means; this often means making choices.
- In this case – Fastest? Cheapest? Or best compromise between the two?
- You must make that decision

Further Examples

- For a business problem;
  - Generate the most sales? Or which require the smallest investment? – Or most often, a balance of the two
- For a technical problem;
  - Users are able to carry out a specific activity in a system (the solution may not be technical though; it could involve training the users, for example).
- For a learning problem;
  - Being able to do something, or to know or understand a particular idea or aspect of a topic

3. Identify Many Possible Solutions

- The more possible solutions you can think of, the more likely it is that your chosen solution will be a success.
- Be as imaginative as possible
  - Think back to topic 1, when we discussed Creative Learning (Lateral Thinking, thinking in metaphors etc). We will look at this more in the seminars for this topic, and topic 6 will also investigate creative thinking techniques in more depth.

4. Evaluate Solutions

- This means that we need to examine each solution and determine whether it meets each success criterion.
- In simple problems, this may be a basic ‘yes/no’ answer – returning to the earlier example, ‘is this the fastest solution? It either is or it is not.
- However...

Evaluation Continued

- ... In most problems, there will be multiple solutions which address the success criteria to a varying extent.

- The following slides demonstrate some simple tools to aid such evaluations.

Evaluation: Ranking

- Let us continue with the previous example. We have two success criteria: cheapest (cost), and fastest (speed). Let us imagine there are five possible solutions (v, w, x, y, and z).
- For each criterion, rank the five solutions in order.
- Your lists might look something like this:

Cost (1 = cheapest)	Speed (1 = fastest)
1. Solution X	1. Solution W
2. Solution Z	2. Solution V
3.Solution V	3. Solution X
4. Solution Y	4. Solution Z
5. Solution W	5. Solution Y

Evaluation: Scored Ranking

- Now we have established that Solution X is the fastest, and Solution W is the cheapest. But we still don't know which is the "best" solution.
- To help us, we can give a combined score based on the two criteria. To do this, first add together the position in each column as follows:
  - Solution V = 3rd + 2nd = ***5***
  - Solution W = 5th + 1st = ***6***
  - Solution X = 1st + 3rd = ***4***
  - Solution Y = 4th + 5th = ***9***
  - Solution Z = 2nd + 4th = ***6***

Evaluation: Scored Ranking - 2

- Now we order these ***lowest to highest*** to determine which had the overall highest position:
  - Solution X = 1st + 3rd = ***4***
  - Solution V = 3rd + 2nd = ***5***
  - Solution W = 5th + 1st = ***6***
  - Solution Z = 2nd + 4th = ***6***
  - Solution Y = 4th + 5th = ***9***
- We can see that Solution X emerges as the 'best compromise' solution against both criteria.

Evaluation: Scoring Grids

- We can cut out some of those steps in a more complex environment by scoring in a grid:

	Criterion A	Criterion B	Criterion C	Criterion D	Criterion E	TOTAL
Solution T	1st	4th	1st	2nd	6th	**14** (1st)
Solution U	2nd	1st	5th	3rd	4th	**15** (2nd)
Solution V	4th	2nd	6th	5th	2nd	**19** (5th)
Solution W	6th	3rd	4th	1st	3rd	**18** (=3rd)
Solution Y	3rd	6th	2nd	6th	5th	**22** (6th)
Solution Z	5th	5th	3rd	4th	1st	**18** (=3rd)

5. Select Solution

- Sometimes the results of an evaluation give a clear solution.
  - In our previous example, if one solution had been fastest and cheapest, it would have been the clear preference.
- However, the situation is usually more complex. Often a detailed evaluation leaves us a few good options rather than one clear choice.

Making Your Choice - 1

- Often making the final choice of solution is the most difficult stage
- When the choice of solutions is narrowed down, there are some questions that can help
- However making that decision is always, in the end, down to the person who is responsible for it – this is part of being a professional

Making Your Choice - 2

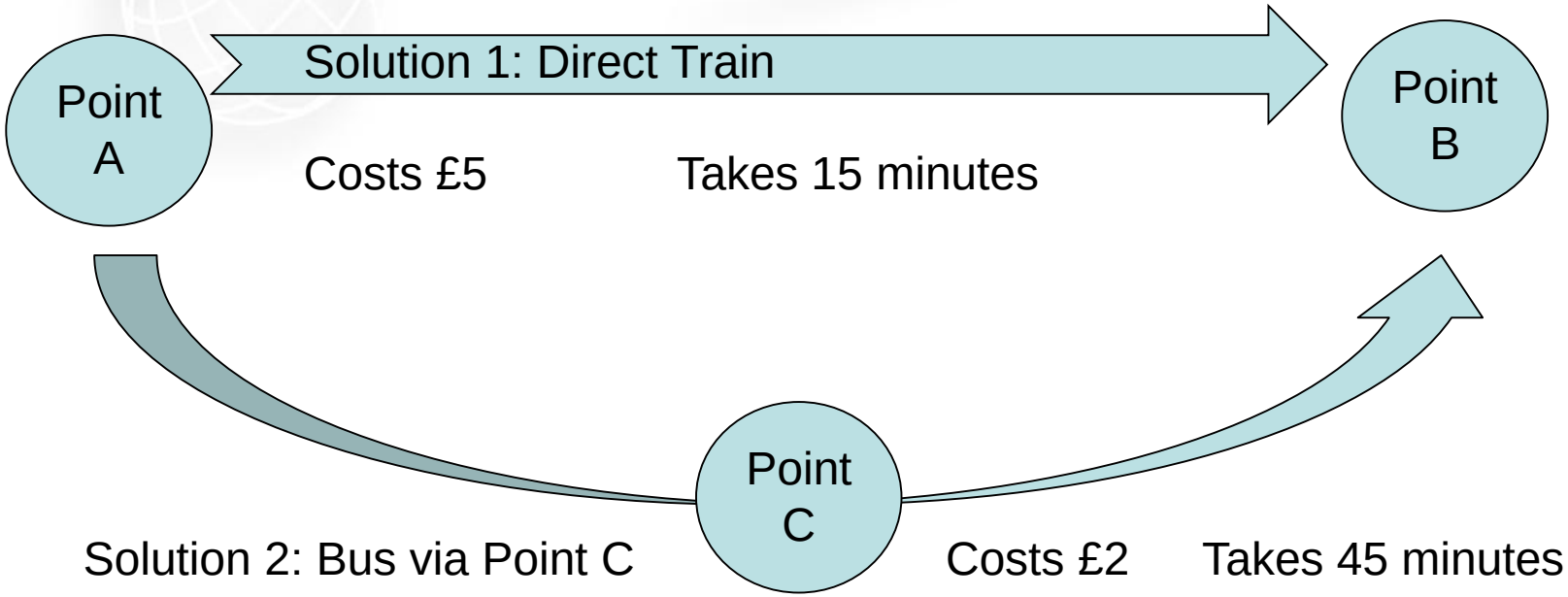
- Helpful questions to ask yourself:
  1. Which solution has the widest range of potential positive outcomes?
  2. Which solution has the most beneficial potentially positive outcomes? And who benefits the most?
  3. Which solution has the lowest number of risks associated with it?
  4. Which solution has the least serious potential risks associated with it?
- Remember: the ideal path is usually a ***low risk, high benefit*** solution.

Using Diagrams

- A diagram can help the process of getting to grips with a problem, even if it seems peripheral at first.
- With business or technical problems, it is often the case that the cause of a problem is in a process; drawing out the processes visually can also help us locate the root cause or the area to focus on

Using Diagrams: Example

- To return to our public transport problem again; if we draw out two possible solutions, comparing the visually is very straightforward:



Imperfect Problems

- In ‘real life’, we often do not have access to all the information we would like in order to solve a problem.
- Key points to remember in these situations are:
  1. Not only the solution, but also the question needs to be flexible.
  2. Part of the problem-solving process is recognising inappropriate objectives and redesigning the problem itself.
  3. Make assumptions if you need to; always be transparent and clear about the assumptions you have made

Problems Over Time - 1

- Another added complexity in many real-world problems is that they happen – and develop – over time.
- A key concept here is the ***milestone***
- Milestones are a definite step towards a full solution and a date by which this will be achieved
- This need to be expressed in terms of ***concrete deliverables which can be achieved***, not objectives or value judgements

Problems Over Time - 2

- For example; *“by the end of month two we will have results from a focus group from which we can determine the potential market for this new product”…*
- ***...not;*** *“we will have an estimate of market size”*, or “*we will have improved our commercial viability study*”

References and Further Reading - 1

- There are a large number of sources on problem solving both online and in print, and an equally large number of approaches to explore.
- Cottrell 276-284 - proposes similar approaches to research and critical thinking, and has useful notes on evaluating (research evidence) against criteria.
- Bearley, W., Corkrum, S., and Harvey, T.. The Practical Decision Maker: A Handbook for Decision Making and Problem Solving in Organizations; Maryland, The Scarecrow Press, 1997. Summary document ('Six-Step Process') available at http://tinyurl.com/62w6skg

References and Further Reading - 2

- Web Resources (small sample from thousands)
- http://www.businessballs.com/problemsolving.htm; University of South Australia - http://www.unisa.edu.au/counsellingservices/balance/problem.asp

Topic 5 – Problem Solving

Any questions?