Topic support guide

Cambridge International A Level

Cambridge International AS & A Level Information Technology

9626

For examination from 2017

Topic 1.1 Data, information and knowledge

Cambridge Advanced

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Introduction

How to use this guide

The aim of this guide is to facilitate your teaching of Cambridge International AS & A Level Information Technology, syllabus topic 1.1 Data, information and knowledge. This topic defines some of the fundamental concepts used in topic 1 Data, information, knowledge and processing, as well as in the syllabus as a whole

Section 1 lists some key terms used in this topic and their definitions. Section 2 Theory provides the basic theory that you will need for teaching this topic, including illustrative examples. Section 3 indicates what your learners need to know, understand, or be able to do for this topic in the examination. Section 4 lists some useful websites relevant to the topic for you or your learners to use. Section 5 provides activities for you to carry out with your learners to teach this topic, to consolidate, and to check learning.

Learning objectives

Reading this guide should help you guide learners to cope with the following syllabus learning objectives:

- define data, clearly identifying that data has no meaning
- define information and show how data can become information through context and meaning
- define knowledge and understand that information becomes knowledge when human experience is applied.

Prior knowledge

Before you begin teaching this topic:

- If you look for information about data, information and knowledge make sure you only look at computing or information technology (IT) resources – many researchers in a variety of fields such as sociology, economics and science use the terms data and information to mean the same thing.
- The term ‘data’ as used in the syllabus is often referred to in other fields as ‘raw data’. Make sure you are aware of this before you research the topic.

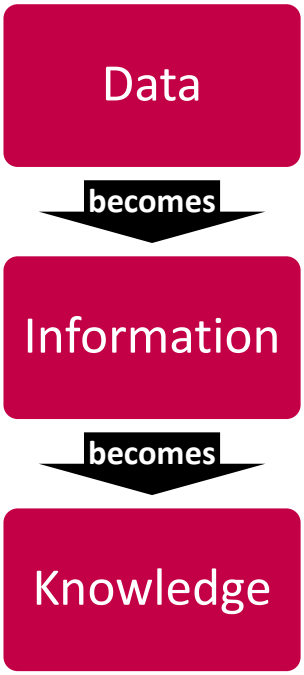
1. Key terms

Word/phrase	Meaning
data	A collection of text, numbers or symbols in raw or unorganised form
explicit knowledge	Knowledge, such as facts, that can be easily passed on to others
information	Data that has been processed, e.g. grouped, normally by a computer, to give it meaning and make it interpretable
knowledge	The acquisition by a person of information such as facts, or the understanding of information such as how to solve problems
raw data	Similar to data, the raw input of text, numbers and symbols that needs to be processed to give it meaning
tacit knowledge	Knowledge that is difficult to pass on to someone else, such as knowing how to do something

2. Theory

2.1 Introduction

We live in the information age. In the same way that the development of industry created the industrial age, the development of information technology systems, and especially the internet, has created the information age. It has been a long-held belief by many philosophers that **knowledge** is power and that knowledge stems from understanding of **information**; information, in turn, is the assigning of meaning to **data**. To develop learners' understanding of information technology, we start by defining these three related concepts. The topics are hierarchical in that:



2.2 Data

2.2.1 What is data?

The concept of data as it is used in the syllabus is commonly referred to as ‘raw’ data – a collection of text, numbers and symbols with no meaning. Data therefore has to be processed, or provided with a context, before it can have meaning.

Example

- 3, 6, 9, 12
- cat, dog, gerbil, rabbit, cockatoo
- 161.2, 175.3, 166.4, 164.7, 169.3

These are meaningless sets of data. They could be the first four answers in the 3 x table, a list of household pets and the heights of 15-year-old students but without a context we don’t know.

2.3 Information

2.3.1 What is information?

It is important that students learn the concept of what 'information' is as used in information technology. Information is the result of processing data, usually by computer. This results in facts, which enables the processed data to be used in context and have meaning. Information is data that has meaning.

2.3.2 When does data become information?

Data on its own has no meaning. It only takes on meaning and becomes information when it is interpreted. Data consists of raw facts and figures. When that data is processed into sets according to context, it provides information.

Data refers to raw input that when processed or arranged makes meaningful output. Information is usually the processed outcome of data. When data is processed into information, it becomes interpretable and gains significance.

In IT, symbols, characters, images, or numbers are data. These are the inputs an IT system needs to process in order to produce a meaningful interpretation. In other words, data in a meaningful form becomes information. Information can be about facts, things, concepts, or anything relevant to the topic concerned. It may provide answers to questions like who, which, when, why, what, and how.

If we put Information into an equation it would look like this:

Data + Meaning = Information

Example

Looking at the examples given for data:

- 3, 6, 9, 12
- cat, dog, gerbil, rabbit, cockatoo
- 161.2, 175.3, 166.4, 164.7, 169.3

Only when we assign a context or meaning does the data become **information**. It all becomes meaningful when we are told:

- 3, 6, 9 and 12 are the first four answers in the 3 x table
- cat, dog, gerbil, rabbit, cockatoo is a list of household pets
- 161.2, 175.3, 166.4, 164.7, 169.3 are the heights of 15-year-old students.

2.4 Knowledge

2.4.1 What is knowledge?

When someone memorises information this is often referred to as 'rote-learning' or 'learning by heart'. We can then say that they have acquired some knowledge. Another form of knowledge is produced as a result of understanding information that has been given to us, and using that information to gain knowledge of how to solve problems.

Knowledge can therefore be:

- acquiring and remembering a set of facts, or
- the use of information to solve problems.

The first type is often called explicit knowledge. This is knowledge that can be easily passed on to others. Most forms of explicit knowledge can be stored in certain media. The information contained in encyclopedias and textbooks are good examples of explicit knowledge.

The second type is called tacit knowledge. It is the kind of knowledge that is difficult to pass on to another person just by writing it down. For example, saying that Paris is the capital of France is explicit knowledge that can be written down, passed on, and understood by someone else. However, the ability to speak a foreign language, bake bread, program a computer or use complicated machinery requires additional pieces of knowledge (such as that gained through experience) that are not always known explicitly and are difficult to pass on to other users.

2.4.2 How are data, information and knowledge linked?

If we put Knowledge into an equation it would look like this:

Information + application or use = Knowledge

Example

Looking at the examples given for **data**:

- 3, 6, 9, 12
- cat, dog, gerbil, rabbit, cockatoo
- 161.2, 175.3, 166.4, 164.7, 169.3

Only when we assign a context or meaning does the data become **information**. It all becomes meaningful when we are told:

- 3, 6, 9 and 12 are the first four answers in the 3 x table
- cat, dog, gerbil, rabbit, cockatoo is a list of household pets
- 161.2, 175.3, 166.4, 164.7, 169.3 are the heights of the five tallest 15-year-old students in a class.

If we now apply this information to gain further **knowledge** we could say that:

- 4, 8, 12 and 16 are the first four answers in the 4 x table (because the 3 x table starts at three and goes up in threes the 4 x table must start at four and go up in fours)
- The tallest student is 175.3cm.
- A lion is not a household pet as it is not in the list and it lives in the wild.

3. Exam preparation

The topic of Data, information and knowledge requires learners to define and understand the meaning of these terms, as well as to be able to demonstrate how the topic is hierarchical (i.e. how data becomes information and how information becomes knowledge). Learners must know and understand these things in order to be able to answer any exam questions which may come up on this topic.

4. Further resources

Useful websites

www.teach-ict.com/as_a2_ict_new/ocr/AS_G061/ 311_data_info_knowledge/ data_info_knowledge/theory_data_info_know.html

newstrainers.wordpress.com/2009/11/10/data-becomes-information/

5. Class and homework activities

5.1 During teaching

The following activities are suggested during the teaching of this topic.

5.1.1 Data

1) Start by asking learners to brainstorm the meaning of ‘data’, asking for definitions. An effective way of getting ideas is to tell learners that they are not allowed to comment on other learners’ ideas throughout the activity of brainstorming.

2) Ask learners to search for ‘data’ on the web and find definitions and examples. Make it clear that they will need to be careful and investigate only those sites that give IT/computing definitions. You could then bring the group together to discuss their findings and collectively come up with a definition and examples you are happy with.

5.1.2 Information

1) Start by asking learners to brainstorm ‘information’, asking for definitions. Then ask them to search for ‘information’ on the internet to find definitions and examples. Make it clear that they will need to be careful and find only those sites that give IT/computing definitions. You could limit them to the three sites given in Section 4.

Bring the group together to discuss their findings and then collectively come up with a definition and examples you are happy with.

2) Explain the following to your learners as a way of demonstrating how context and meaning are integral parts of what is considered information:

The data item 01111101 could be the binary equivalent of the integer 125 or it could be binary for the ASCII code for the symbol ‘}’ . How this number is processed determines how it is displayed, but as well as this there has to be a context.

If we know that 01111101 is the way the computer stores the re-order quantity in a stock file then we know it represents the integer 125. However, if we are told that it is part of a stored word-processed document then we can be confident that it represents the symbol ‘}’.

5.1.3 Knowledge

After repeating the type of activity that the learners undertook for data and information, give them this example:

Data: The number 40 000 is a piece of data, as is the name Iqbal Ahmed. Without anything else to help us, these two items of data are meaningless.

Information: If we now say that 'Iqbal Ahmed is a teacher' and '$40 000 is a teacher's salary', the data is given meaning or context, and makes more sense to us.

Knowledge: builds on the information. Knowledge is 'Iqbal Ahmed is a teacher and he earns $40 000 per year'.

Then ask learners to come up with their own examples.

5.2 Topic consolidation

The following activities are suggested to consolidate your students' learning after they have studied this topic:

5.2.1 Sixty second challenge – sum up knowledge learned in this topic

Give learners an A4 piece of paper and ask them to write down everything they can remember about the topic Data, Information and knowledge in 60 seconds. No outside resources such as textbooks, their lesson notes or computers are allowed.

Learners then work in groups of four to compare their ideas, and using a side of A3 paper, copy out the relevant points for displaying in the classroom.

5.2.2 Write the new words you have learnt in this topic and what they mean in terms of information technology

Again each learner should have a piece of A4 paper to write on, but this activity is not limited by an amount of time. You may need to bring the activity to an end when the majority of the learners have completed the activity.

You could collect and collate these responses and display the better ones on a wall of the classroom to be used by learners as a visual stimulus when revising.

5.2.3 Self-assessment – record what you've learnt, any difficulties you have had and set your personal targets for learning.

This activity is not time limited but you will need to be aware of when your learners have started to run out of ideas.

Learners will need to set their own targets for learning and together with you, will need to devise methods by which they can achieve their targets.

5.2.4 Change of role – student as teacher. What questions would you ask the class and why?

Ask learners to imagine they are the teacher. They write down three questions they would ask the other learners that would fully show that they have understood the topic.

One learner then uses their questions to ask the other learners about the topic. After learners have answered the questions, ask the group to comment on whether the questions were detailed enough. Give them a few minutes to refine their own questions.

Other learners in turn take the role of the teacher, allowing time to refine questions each time a learner finishes asking questions.

Note: The number of learners allowed to ask questions needs to be small unless the group is small.

5.2.5 Consolidation using question and answer cards

This activity is only suitable for medium to large teaching groups (at least eight learners). Create cards (and laminate them if possible) with a question on one card and the answer on another. Mix the cards up, and give each learner two cards – an answer card and a question card, so that learners don't have a matching question and answer. Ask the learners to stand up.

Select a learner to start by asking their question (read from the card). The learner with the correct answer shows their answer card. They then ask their question from their question card and sit down. The activity continues until there are no learners left standing.

5.3 End of topic test

1. Explain the difference between data and information. [2 marks]
2. Describe how data becomes knowledge. [3 marks]
3. 5, 10, 15, 20 are items of data. Explain how these could become information and what knowledge could be gained from them. [4 marks]

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