

Chapter 9. Developing material for learning

The learning aim of this chapter is to be able to design material for different media for supporting learning at the appropriate level of understanding.

9.1. *Development team*

9.2. *Categories of learners*

Background

Gender

Culture

9.3. *Visualising the hidden and abstract*

When using an application, some features and principles are easily recognisable at the interface, for example that the cells in a spread sheet are organised in a grid, and that the text in a document has a specific layout. The sequence of operations, typically whether to choose data before operation or vice versa, may not be displayed, but they are experienced through the users' actions, so we obtain an immediate impression.

Other features are less prominent. Examples of hidden features are that the caption of an illustration in a text document does not belong to the main text flow, and that behind a number in a spreadsheet cell could be a formula which refers to many other cells. In the word processor, there is no intuitive way to see where one text flow starts and another one ends. It might be possible to view the non-printing characters, but these do not necessarily tell us about the text flows or many other properties of the document, like the paragraph and character styles.

When there are no ways to show the hidden features, they remain abstract until made explicit. The written text is a one-dimensional sequence, while structures in the computer often are of other kinds. Since many hidden aspects are structural, a combination of language and graphics would normally be a better option than just one of them.

Creating useful graphical models is partly arts & crafts, but there are also principles to consider. The books by Edward Tufte constitute a comprehensive introduction to the area (Tufte, 1990, 2011). Marti Hearst (2003) has made a tutorial on graphical elements and how people experience them, while Rosling (2006) provides a video of visualisation of numbers and statistics. These authors deal mostly with the information subject matter of IT

competence. In the following, specific considerations for visualising the interior functioning and structure of software are presented.

Recognisable elements

Any explanation of what goes on in the interior of the computer should be based on the current competence of the users, including the users' understanding of concepts, experience with operating the software and their background for understanding the notation used.

In order to aid understanding, and not making it more difficult, graphical representations need to be

- simple, in the sense that they contain a small (7 ± 2) elements
- recognisable, so that each element provides immediate meaning

The model of the file system in Figure 40 is simple, but is made with a notation which is not recognisable by most users. On the other hand, maximum recognisability is sought in Figure 41, while this illustration does aim at providing a general presentation of the structure of the file system. Figure 41 also uses examples instead of the general categories in Figure 40, bringing it closer to user experience but making the illustration larger and less simple. There is often a trade-off between simplicity and recognisability.

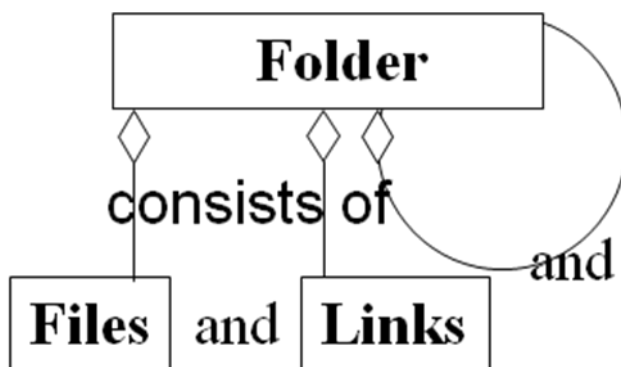


Figure 40. Abstract model of the file system

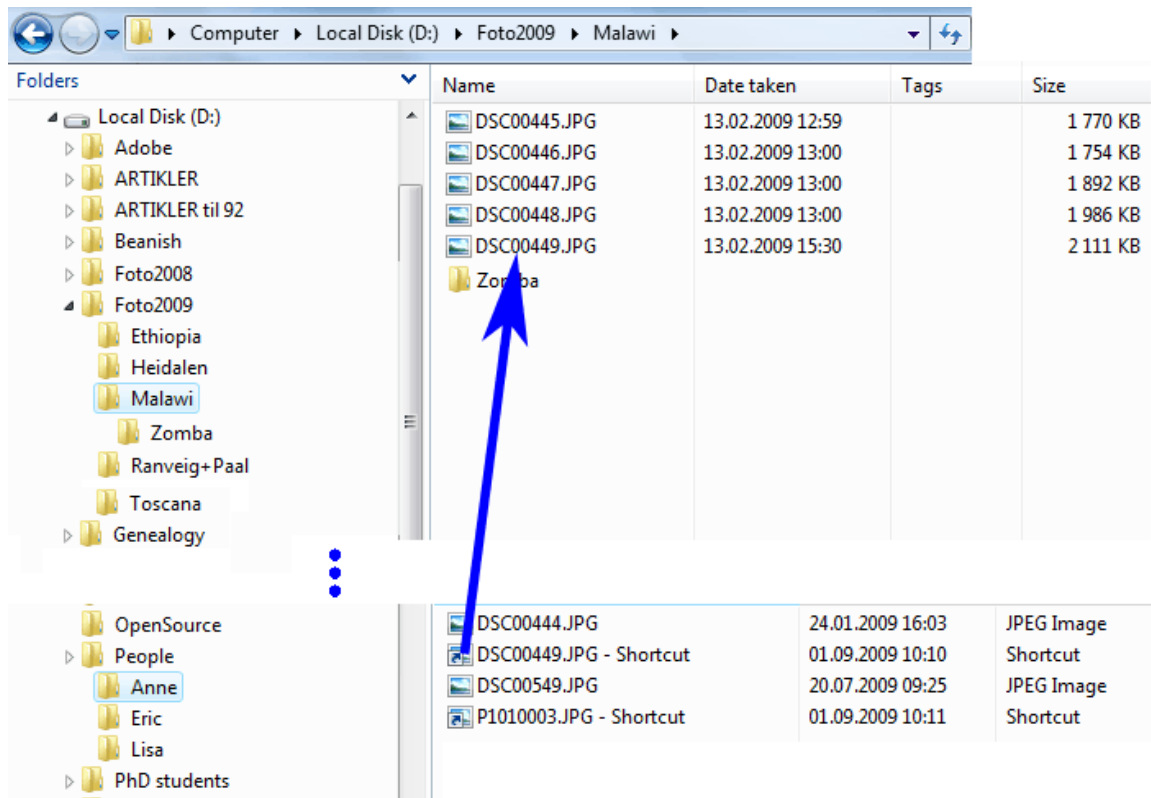


Figure 41. Recognisable model of the file system.

Figure 40 is a model of how the file system can be conceived under the surface, while Figure 41 is mainly a surface model with an additional graphical element for showing the under-the-surface connection. The user interface of the Windows file system provides a reasonably good view of the data structure when viewed in the Explore mode shown here.

Visible impression versus under-the-surface structures

For applications which aim at the What You See Is What You Get (WYSIWYG) principle, the data shown at the interface is supposed to mimic the printed copy, and then there is little room for also showing the underlying structures at the interface. A word processor file can include a spread sheet table, and such imports of other data types into a text file can be done either by making a copy of the spreadsheet or by setting up a reference to the spreadsheet file. The visual result in the text file will be the same, but the underlying data structure will differ. In such situations, the illustration should depict the two data structures in the hard disk of the computer, and that they appear in the same way at the interface, see Figure 3 (p.13) and Figure 4.

The elements of Figure 3 and Figure 4 exploit the everyday experience of the layered architecture of the computer. The hardware, the data within the computer, and the visible copy of these data in way which the screen allows.

Several relationship types

In the previous illustrations, blue arrows are used for denoting reference, link, pointer, shortcut, or whatever particular name is used for the mechanism for achieving functional dependency. Often, there is more than one type of entity and relationship to illustrate, and then the corresponding symbols have to be differentiated. Figure 16 (p.40) shows how the character fonts are used for separating the two kinds of entities in the model. Also, the two kinds of relationships are differentiated, and since the arrow and the diamond could mean anything for users, the relationships are also labelled. Even with these labels, the model is at a high abstraction level which might be better suited for teachers of computing than for learners.

Exploiting the more easily recognisable interface and adding the type-instance relations at an example may produce a visualisation like Figure 42. Adding the consists-of relationships here would have made the illustration far from simple.

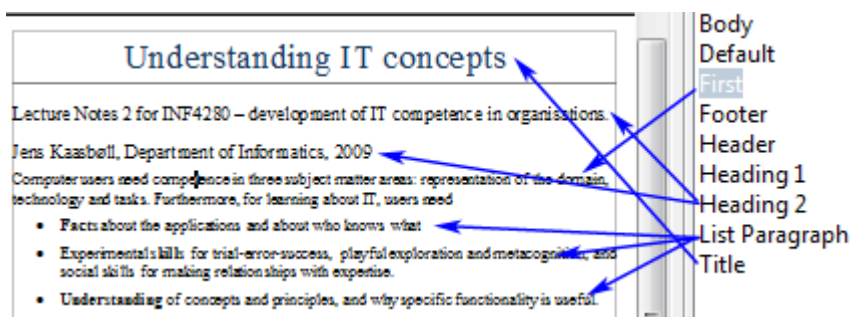


Figure 42. Style-paragraph relations.

Levels of mastery of externalisation of IT concepts

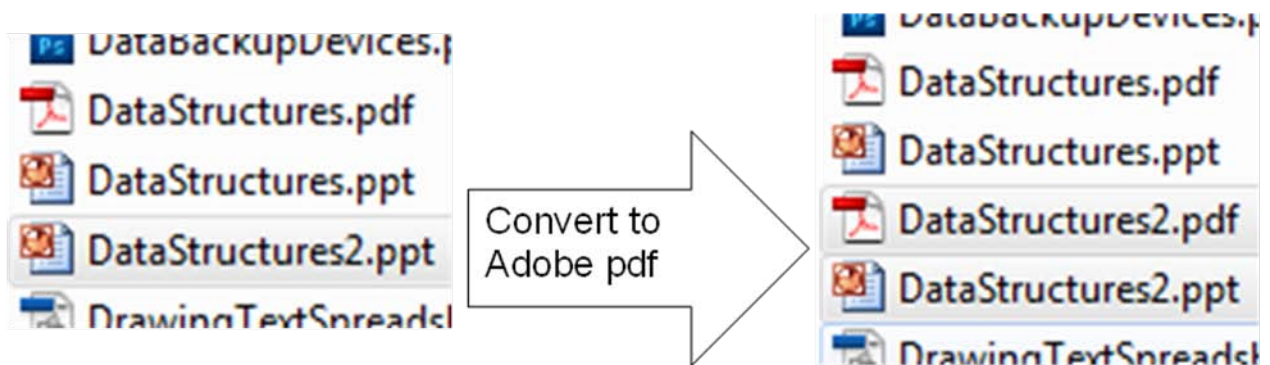
The externalisation of concepts model divided the stages of competence into

- IT skills, where the user carried out operation
- IT functional understanding, where users tell about the effect of the action, that is transforming input to output.
- IT conceptual understanding, where the users talk about the principles or concept as an object of its own, and relate it to other topics.

The skills stage would entail carrying out a sequence of operations, and having documentation on which buttons to push will ease this task. Instruction sheets as shown in Figure 6 (p.16) and Figure 7 (p.17) target the IT skills level. These illustrations use the visible clues at the interface without trying to visualise hidden data or structures.

In the functional understanding stage, however, there is a need to understand the status before and after, and this could require some models of the hidden. Figure 41 and Figure 42 depict status before or after an operation. For example, users may be unsure of the result of Save As,

Export or convert operations, by not knowing whether the original file also will remain.
 Illustration 7 Shows an example of how to depict the pre and post status of an operation.



The original is kept untouched during conversion

Figure 43. The input and output of a conversion.

For supporting conceptual understanding, we can illustrate its structure, how it resembles other concepts and how it is distinct from other concepts. Figure 40 to Figure 42 all illustrate the structure of the concepts.

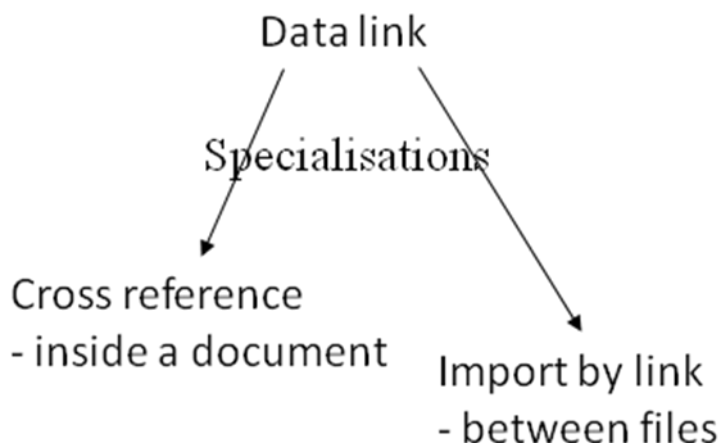


Figure 44. How Reference and Import by link resemble by being specialisations of Data link

Figure 44 shows that two concepts are similar by being specialisations of a more general concept and how they differ. A more comprehensive illustration of relations between concepts is found in Figure 19.

9.4. Sequences and observable states

9.5. Videos for imitation and analogical reasoning

Se

9.6. Software learnability

9.7. Producing material for different media

DocBook

6. Provide a variety of learning material.

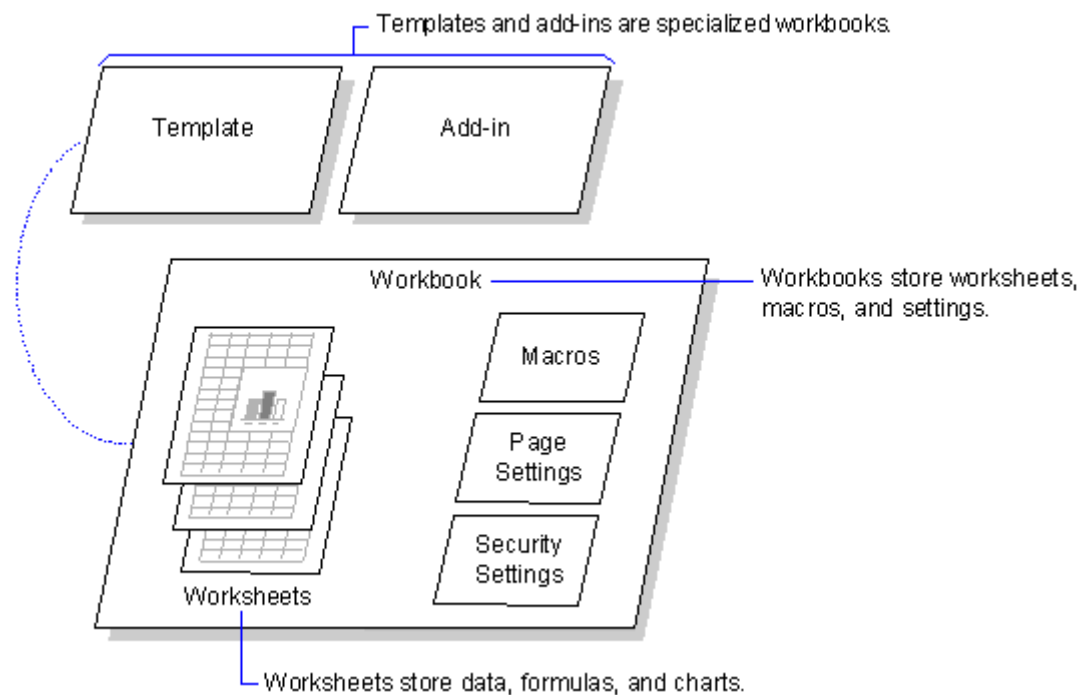
Exercises

1. Open a spreadsheet file with Google Spreadsheet, Microsoft Excel and OpenOffice Calc. Can the software display the precedents and descendants of formulas? This function is often called 'trace.'
2. Consider Figure 17 (p.44) and Table 4 (p.44). Which levels in the Externalisation of IT concepts model do they target?
3. Which level of

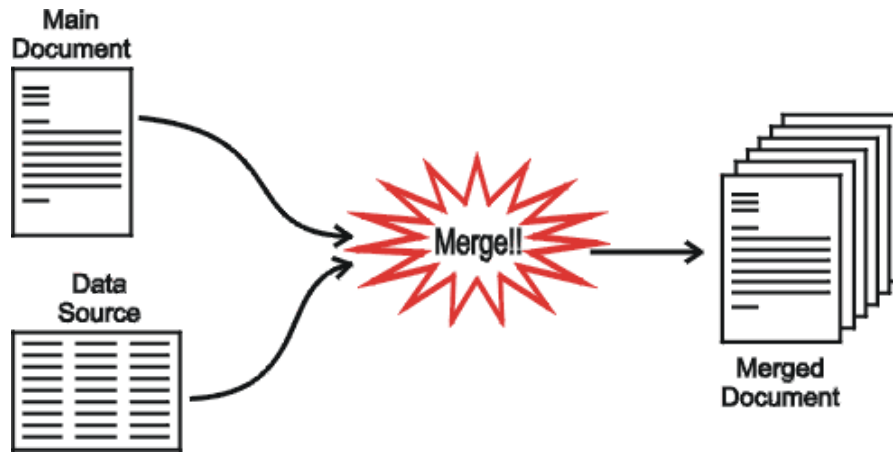
Externalisation of IT concepts and

Externalisation of IT use

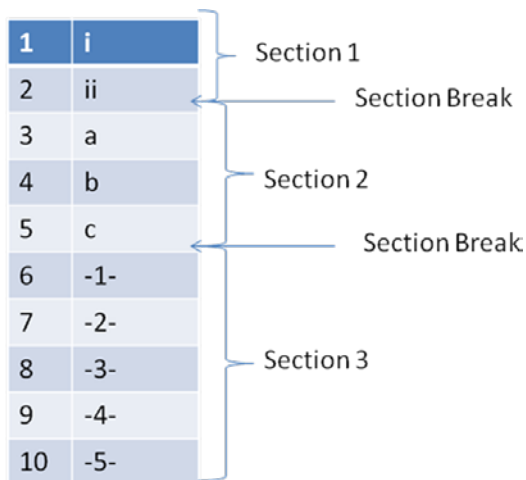
do the following illustrations aim at?



- a. How MS Excel Is Structured by Microsoft TechNet



b. Mail Merge by Clement Khalika and Eddons Munthari

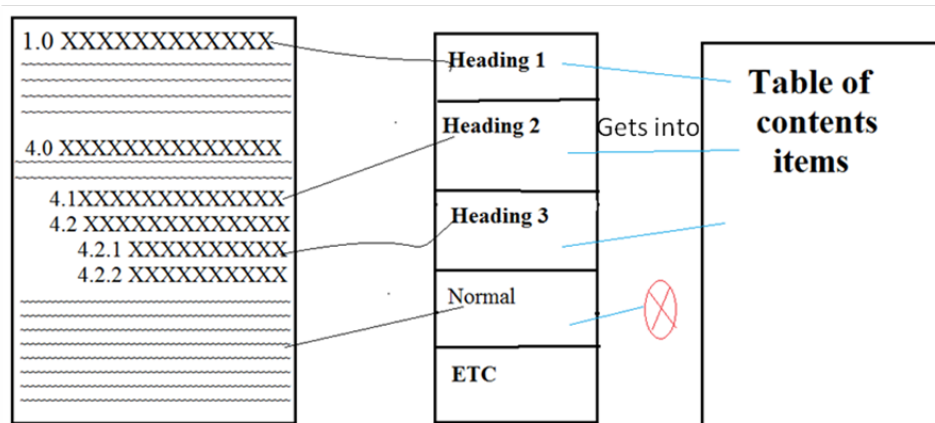


c. Page numbering by Chipiliro Awali and Muhabi Chisi

Document e.g. Thesis

Apply Styles

Insert Table of Contents



d. Table of Contents by Christina Ussein and Edward Kambwiri

4. Which level of

Externalisation of IT concepts and

Externalisation of IT use

do the following tutorials aim at? Consider both the various elements in the tutorials and the totals:

- a. Style basics in Word by Microsoft

<http://office.microsoft.com/en-us/word-help/style-basics-in-word-HA010230882.aspx>

- b. Applying Styles in Word 2007 by About.com

<http://wordprocessing.about.com/od/microsoftword2007/a/2007styles.htm>

- c. The Essentials of Creating and Using Styles in Word 2007 by Dummies.com

<http://www.dummies.com/how-to/content/the-essentials-of-creating-and-using-styles-in-wor.html>

- d. Anatomy Of Word: Use Word Styles To Create Consistent And Usable Documents by TechRepublic

<http://www.techrepublic.com/article/anatomy-of-word-use-word-styles-to-create-consistent-and-usable-documents/6080974> (requires registration) or <http://www.uio.no/studier/emner/matnat/ifi/INF3280/v11/StylesTechRepublic.pdf>

Project

Make a graphical illustration for your teaching project for one of the understanding levels for each of the three areas of IT competence:

- Information
- IT
- Tasks

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