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Opinion: Writing to be published or writing to be read?

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OPINION*

Writing to be published or writing to be read?

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The purpose of a scientific paper

The purpose of a scientific paper is to convey ideas to an audience who may be differentiated into experts (professional scientists) and novices (students). The latter require more support from the paper's author(s) to help them to understand the intended meaning of the paper and to place it in the context of the discipline. This help can be offered by providing an explicit structure to the paper by using a concept map to highlight key points and the links between them. Consideration of the audience when writing a paper may increase its readability and increase the likelihood of the paper being used at university as a tool to help students to engage in the discourse of the discipline (Northedge 2003b). Within Higher Education, it is normal for courses to be accompanied by, or even based on, the reading of research literature (e.g. Janick-Buckner 1997; Muench 2000). It is therefore important to have the student in mind when constructing a paper.

When Janzen (1996) wrote, "I write papers to be published rather than to be read", he was probably representing the unspoken intentions of many authors. Writing with this aim in mind can result in papers that are crafted to satisfy only the requirements of a small community of experts (including editors and reviewers) or to fulfil requirements to grant-awarding bodies or for the Research Assessment Exercise, while ignoring the needs of a wider readership. The result can be impenetrable text, laced with technical jargon that is only appreciated by "those in the know" (e.g. Andreadis 2003). Experts in the field will cope with papers of this type and will be able to place the paper within the context of related research. However, students of Biology typically do not have such a sophisticated knowledge structure to activate and, therefore, "fail to put the details of a paper together to create a coherent understanding of the text" (Brill et al. 2004).

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Students, therefore, need to acquire techniques that can help them to develop the skills required to make the most from their reading.

Students' reading of scientific papers

Marton and Saljo (1976) showed that some students will adopt a strategic surface approach to reading by skimming through and trying to pick out key points. This results in the student missing the overall message of the paper (Entwistle et al. 1982). One of the aims of summarizing a paper as a concept map is to encourage all students to use the higher cognitive-level processes that the more academic students use spontaneously: what Biggs (2003) calls, "narrowing the gap".

For the text of a scientific paper to encourage meaningful learning by the student/reader, it must enable the student/reader to link the ideas presented with existing knowledge frameworks and support the construction of understanding. With Higher Education currently expanding from a system of elite education to a system of mass education, the diversity of students is set to increase (e.g. Northedge 2003a) with the result that more students will need support in their learning. For this, I am not advocating a "dumbing down" of the research literature into a "Janet and John" level of text that can be grasped by all. Quite the opposite, I am saying that writers of academic papers need to work harder to make their message clear and unambiguous.

Concept mapping

Concept mapping is a graphical tool that can be used to summarize complex ideas. Its value lies in the way in which the links between ideas are depicted explicitly to show the author's beliefs and assumptions about the nature of knowledge integration in a particular context. Numerous applications have been described for concept-mapping activities with the aim of promoting meaningful learning in the biological sciences (e.g. Kinchin 2000). One aspect of the use of this tool that has not been considered explicitly in the literature is the way in which concept mapping may be used by authors to clarify the dense text that is often characteristic of detailed arguments presented in scientific papers.

Concept maps may be helpful at various stages of the writing process as they can be used to:

- Structure a paper in the making and so help the author to clarify the sequencing of an argument.
- Clarify/summarize a section of text and highlight connections with other aspects presented within the paper.
- Provide a pictorial abstract/an advance organizer to guide the reader. Experts may utilize the abstract of an article as an advance organizer which activates appropriate cognitive structures and puts the whole paper within a context. However, students (novice readers) typically do not have such a sophisticated structure to activate and, therefore, fail to put the details together to create a coherent understanding of the text (e.g. Brill et al. 2004).
- Compare the perspectives of the novice and the expert and so guide the novice towards the development of expertise.
- Help readers with different "cognitive skills" or "learning styles" (text favours the "serialist", whilst the concept map may help the "holist"). A combination of

representations has been shown to help promote deep understanding in the sciences (e.g. Kozma 2003).

Concept mapping may also help by:

- Reducing the amount of text needed to summarize an argument. The nuances of the language used may not be appreciated by members of an international readership whose first language is not that used in the paper.
- Separating differences in preferences of expression from substantive differences in understanding/interpretation of the ideas presented.

The paper chosen to illustrate this here (Kinchin 1995) was selected as it is a paper that I authored, therefore I feel free to be critical of it. The work presented is seen as controversial by some members of the international research community, indicating that the paper may be in need of some clarification. It is a short paper aiming at a general readership who may benefit most from a graphical simplification of the ideas presented within the text (see Figure 1).

Resistance to the concept-mapping approach by some authors is to be anticipated as its adoption requires a different way of thinking about the construction of a paper. It has been suggested that one reason why biologists may find it difficult to adopt concept mapping is that the underlying philosophy (Constructivism) can be seen to be at odds with the dominant scientific paradigm (Objectivism) (Kinchin 2001). It has been shown, however, that biological researchers often adopt a “biphilosophical” view of knowledge in which they oscillate between constructivist and objectivist views as part of the normal process of research (Abrams and Wandersee 1995). Taylor and Willison (2002) have described an “emerging agenda for epistemological pluralism”. This is seen as a positive force to help researchers gain valuable insight into complex phenomena by promoting the consideration

Figure 1. Summary of the main ideas presented within a paper on tardigrade evolution (Kinchin 1995), given as an example of how dense text may be simplified as a concept map. Annotations to the map highlight key questions for the reader to consider that will clarify the ideas presented and help place the paper in the wider context of the literature.

of multiple perspectives on a given problem (Morgan and Drury 2003). Ethnographers of science, studying the daily life of the laboratory, have found that scientific discoveries are made in a concrete, ad hoc fashion, and only later recast into canonically acceptable formalisms. The validity of some of these traditions (e.g. writing in the passive voice) are now being questioned openly (e.g. Sheldrake 2004). Breaking away from such traditions may influence the impact that some papers may have beyond the specialist readership of technical journals (Moore 2000).

In conclusion

Text inevitably forms a linear sequence of ideas, leaving the reader to make links that form a more integrated framework of understanding. Help to construct this framework can enhance the paper, making it more useful to a wider audience. Increasing accessibility to published work is not about compromising quality or “dumbing down”, it is about increasing clarity and respecting the needs of the readership. Concept mapping may provide a tool to help achieve this aim. Students can be encouraged to use concept mapping to support their reading (e.g. Kinchin 2005), but the effectiveness of this would be enhanced if authors also paid some attention to the knowledge structures they are transmitting through their papers at the time of writing. I would, therefore, issue the following challenges to authors:

- Try to draw a concept map to summarize the paper you are currently writing.
- Make sure that all the major concepts are linked explicitly and that the major ideas can be found above the subordinate concepts.
- Consider how the structure of the paper reflects the structure of your concept map (possibly using headings to flag up important features within the map).
- Consider including your concept map within the introduction to your paper.

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