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RESEARCH ARTICLE

MIND MAPPING FOR READING AND UNDERSTANDING SCIENTIFIC LITERATURE

Jose M Guerrero¹ and Pilar Ramos²

¹Infoseg, S.A, Capitan Arenas 30 bajos 08034 – Barcelona Spain
²Hospital Clínic de Barcelona Villarroel, 170 08036 Barcelona Spain

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ABSTRACT

Reading scientific literature requires a great commitment of time and effort. However, the advantages of reading original research and review articles make this commitment worthwhile.

The article has to be read and it has to be understood. This paper is an introduction to the experiment that we are going to run in a few months. It will attempt to prove that the mind mapping technique is an effective way of increasing the productivity of both research and clinical teams when reading and understanding scientific literature.

Mind mapping helps the reader to identify the problems that the article is trying to solve and the solutions proposed by the authors.

In the future, mind mapping automation will help digital indexing and navigation systems like Scopus, PubMed or CiteSeer to increase the efficiency of scientific literature reading and understanding.

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INTRODUCTION

Reading scientific literature requires a great commitment of time and effort. However, the advantages of reading original research and review articles make this commitment worthwhile. Scientific articles contain new discoveries and questions that are still unanswered. These questions give clues which inspire new research methods that can save more time than has been spent reading and analyzing the scientific literature. The problem is twofold: The article has to be read and it has to be understood. Sometimes it is necessary to highlight important parts of the text, take notes and draw diagrams in order to achieve a clear understanding of the content. When experiments are described in the article, a diagram of each experiment is required. This complex process is usually iterative, with every step being repeated meticulously a number of times until the content of the article has been completely understood. This process usually includes the task of checking other articles referenced in the article in question. In some cases the reader will need to write down every word that she does not understand and look them up.

This paper is an introduction to the experiment that we are going to run in a few months. It will attempt to prove that the mind mapping technique is an effective way of increasing the productivity of both research and clinical teams when reading and understanding scientific literature. The fact that diagrams are frequently used in scientific literature is an indication that mind mapping has an important role to play in its reading and understanding.

Mind mapping helps the reader to identify the problems that the article is trying to solve and the solutions proposed by the authors. Exclusive use of linear text makes it very difficult to make the message clear, as is the interpretation of complex statistics. In the future, mind mapping automation will help digital indexing and navigation systems like Scopus, PubMed or CiteSeer to increase the efficiency of scientific literature reading and understanding. Articles in the mind mapping format are more easily managed and navigated than their PDF counterparts. At present, even manual digital mind mapping offers many benefits over traditional techniques.

MATERIALS & METHODS

In order to make an initial evaluation of the possible benefits of mind mapping in reading and understanding, we selected a relatively complex article that needs to be read and understood by nurses and physicians in gastroenterology: “The controlled attenuation parameter (CAP): A novel tool for the non-invasive evaluation of steatosis using Fibroscan®” [1] The experiment was very simple. A person read the article and created a detailed digital mind map using the software MindManager from Mindjet. A second person read and studied only the mind map. A poster was created [2] and presented at the XXII Congreso Nacional Asociación Española de Enfermería de Patología Digestiva in June 2015 in Madrid, Spain. Parts of the mind map created are illustrated below (Figures 1-4). In the experiment, the mind map was created in the Spanish language. This is helpful when nurses or physicians are not fluent in the original language of the article, as the mind map can be created in any tongue of the readers. This is another important element in the process of

increasing productivity, i.e. when the language of the original article is unknown to the readers.

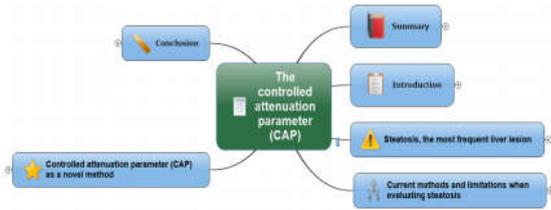


Figure 1 Collapsed view of the sample mind map

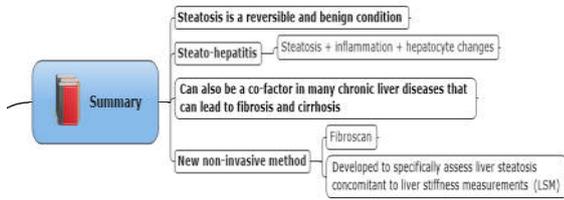


Figure 2 Summary of the sample mind map

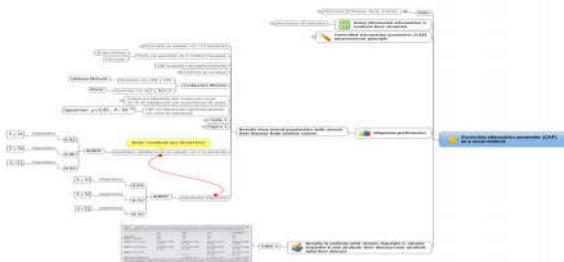


Figure 3 Controlled attenuation parameter (CAP) as a novel method

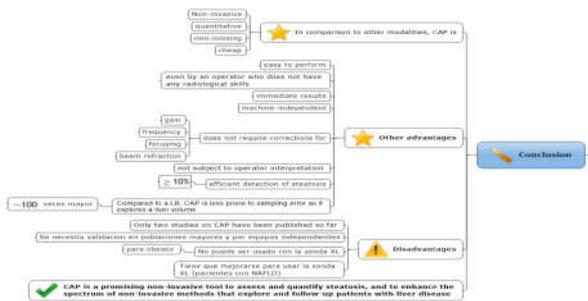


Figure 4 Conclusion of the article

RESULTS

In this initial study, we found that nurses and physicians who use mind mapping when reading scientific literature could increase their productivity by up to 50% [2]. This initial study was extremely simple but provided the basic information needed for the design of a more detailed experiment that we are going to run in a few months.

DISCUSSION

The multiple advantages of mind mapping over linear text in both recall and productivity have been already described elsewhere [3,4]. This is a summary of the reasons why mind mapping is probably the best way to organize, create, visualize and analyze complex information:

- Its visual nature, using icons, images, relationships and direct links between topics, attachments, multimedia, hyperlinks to web sites, spreadsheets and charts [5]. Visual information is processed by the human brain significantly faster than information delivered by linear text.

- The relationships between the parts are visible and clear.
- The collapse/expand feature of the branches of digital mind maps.
- The capability of simultaneous whole-view and detail-view.
- All the information appears on a single page or screen.
- Its hierarchical structure [6, 7].
- It helps to overcome the limitations of the human working-memory [8].
- It shows clearly the relationship between the parts of the article.
- All elements of information are in a single compressed file. This makes the file suitable for sending as an attachment to an e-mail message or uploading to a web site using FTP.
- The information contained in the mind map is machine readable.
- Both paper and digital mind maps are suitable for collaborative work.

It is also important to highlight the differences between outlines and mind maps. Outlines share many of the problems of linear text. The more information delivered or the more complex it is, the more useful mind mapping is. Outlines do not have the visual quality of mind maps and they have a linear nature. In very simple cases, outlines can compete with mind maps. However, when one is managing large amounts of information or the information is complex, mind maps perform significantly better than outlines. When the outline is very long, its linear character dominates and it becomes difficult to see the forest for the trees. It is very important to see the whole-view and the detail-view on a single screen, this facility makes a significant difference at the time of visualizing complex information. It is also usually easier to add or re-arrange nodes in a mind map than in an outline. Mind maps are easier to edit than outlines.

Team reading and understanding

Information overload is a notable problem in the work of research and clinical teams of physicians and nurses [9, 10]. The reading and understanding of scientific literature contributes significantly to the information overload of team members. In many cases these teams are required to read between 100 and 200 articles per year. In 2001 the Institute of Medicine published "Crossing the Quality Chasm: A New Health System for the 21st Century" [11]. This report was written by the Committee on the Quality of Health Care in America, which was appointed in 1998 to identify strategies for achieving a substantial improvement in the quality of health care delivered to Americans. One of the most disturbing findings of this report is the absence of real progress toward applying advances in information technology to administrative and clinical processes in order to improve them.

One of the reasons for this absence of progress is the information overload suffered by physicians and nurses. Despite the progress in information technology the way in which teams of physicians and nurses have been reading and understanding scientific literature has remained constant: each

member of a team reads each article individually; in this respect, each member of the team works as a silo. This has a negative effect on the productivity of nurses and physicians and consequently on the quality of health care. This traditional system of reading and understanding scientific literature is outmoded. Reading scientific literature is one of the most common tasks of physicians and nurses in research and clinical teams. If the new mind mapping based system really offers a 50% increase in productivity then adopting this new system would result in a significant improvement in the efficiency and timeliness of those teams. In "Crossing the Quality Chasm", one of the major challenges that needs to be met successfully by organizations is to continually advance the effectiveness of teams. This simple improvement in the productivity of teams that are reading and understanding scientific literature has important consequences for the quality of Health care.

A mind mapping framework for reading and understanding scientific literature

In order to facilitate the integration of mind mapping into the reading and understanding of scientific literature we propose a simple framework that can be used as a model by teams (Figure 5).



Figure 5 Mind mapping framework

The main topic "I. Content" describes the content of the article in detail. The rest of the main topics are dedicated to the critical appraisal of the article. This appraisal must be created from topic I of the mind map. Once we have determined to analyze an article using the mind mapping framework, we have three options of implementing it:

1. To use a detailed paper version of the mind map.
2. To use a detailed digital version of the mind map.
3. To use a summary digital version of the mind map and the PDF version of the article.

In the three cases, the original mind map is digital, created using one of the standard mind mapping software products. The main advantage of the paper version is that it can be created on a large scale using DIN A2 or DIN A1 paper. The main advantage of the digital version is that it can be navigated using the tools provided by the mind mapping software. The third option is using a simple summary digital mind map to provide an overview of the article and then reading the article in detail.

The options available for the creation of the mind map are:

1. One member of the team specializes in mind mapping and is assigned the task of creating all mind maps.
2. The members of the team take turns creating the mind maps.
3. The task of creating the mind maps is assigned to some

individual or company external to the team or hospital.

We will conduct several experiments in order to discover the best option for each type of article. The results do not necessarily need to be the same for research articles, review articles or technical reports.

CONCLUSIONS

The initial results are promising, but a proper randomized controlled trial needs to be designed and run with a reasonable number of subjects reading and understanding an article. We are now in the process of designing such a trial that will be run before the end of this year. If the results are similar to the initial test, there will be good reason for research and clinical teams to start using the mind mapping technique in order to increase their productivity. This application of the mind mapping technique is not expensive and can be implemented in a relatively short time. In the future, automatic content parsing of the scientific articles will help to increase productivity by eliminating - at least partially - human involvement in the creation of the detailed or summary mind map.

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