Using Mind Mapping in Technical Education

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Abstract

The main objective of this paper is to introduce the concept of "Mind Mapping" and explore its application in technical education. The author has used the concept in his course, Introduction to Electricity and Electronics, and the preliminary results are reported here. The on going study will reveal additional results of which further analysis will be performed and reported in the future. The objective of the study is to verify the conviction of Mind Mapping proponents who say that: "this concept will improve learning and enhance performance."

Introduction

The Mind Map is an expression of "Radiant Thinking" and is therefore, a natural function of the human mind. It is claimed to be "a powerful graphic technique, which provides a universal key to unlocking the potential of the brain" [1, 2, 3]. According to Tony Busan who originated the concept of Mind Maps in the late 1960's: "A Mind Map is a powerful graphic technique, which provides a universal key to unlock the potential of the brain. It harnesses the full range of cortical skills – word, image, number, logic, rhythm, color and spatial awareness – in a single, uniquely powerful manner. In so doing, it gives you the freedom to roam the infinite expanses of your brain. The Mind Map can be applied to every aspect of life where improved learning and clearer thinking will enhance human performance [4]." Mind Maps can be applied to every aspect of life in which improved learning and clearer thinking may enhance human performance [3]. An example of Mind Maps is shown in Figure 1 below. The example is generic in nature and outlines ways to solve problems. Other examples can be also found in [4].

The Mind Map has four essential characteristics:

1. The subject of attention is displayed in a central image.
2. The main themes of the subject radiate from the central image on branches.
3. Branches hold a key image/word printed on the associated line so that details radiate out.
4. The branches form a connected nodal structure.

The author was introduced to the concept of Mind Mapping during a recent full day workshop that was sponsored by the Learning, Teaching, and Innovative Technology Center at MTSU. During this workshop participants learned how to:

- Use whole-brain stimulation techniques to increase the ability to think multi-dimensionally.
- Use color, fun, planned breaks, images, and multi-sensory approaches.
- Enhance personal learning, memory, and creativity.

- Develop and exercise long term memory through staged review periods.
- Apply learning process theory to overcome mental blocks that inhibit learning.

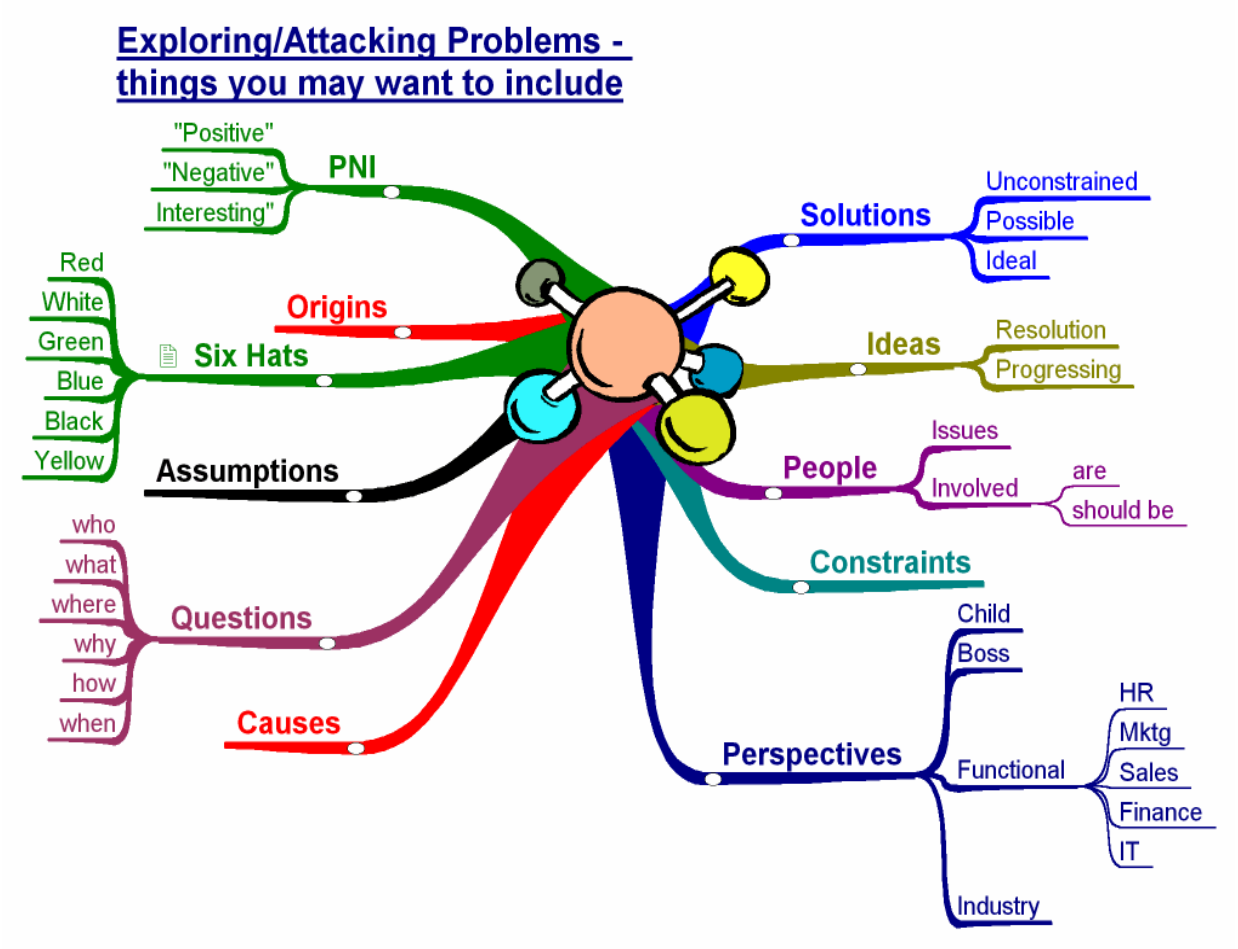

Figure 1: Example of a Mind Map [4].

The Buzan-certified workshop facilitator as well as users of Mind Maps claim that the technique will:

- Increase productivity, communication, and problem solving abilities.
- Increase creativity, concentration, and memory usage.
- Assimilate and present large volumes of information quickly.
- Improve organization, planning, and the ability to see and present the "big picture."
- Enhance/evoke strategic thinking.
- Improve individual and group brainstorming sessions.
- Develop and deliver more effective presentations.
- And, save time.

The author has found the concept to be interesting and intriguing. He learned that the use of mind mapping is widely spread across the globe but more internationally so than in the USA. It is

widely used in Europe and in almost all stages of education as well as it is a standard industrial practice [5, 6].

In the USA, on the other hand, it is a commonly known practice by the industry and sample examples have shown that the technique has saved Boeing, NASA, and other major companies millions of dollars in employee training. However, mind mapping is not widely used here in education, and in particular, post secondary education. When the author asked his students who were enrolled in the Introduction to Electricity and Electronics course (a class of 45 students) about mind mapping, only one student was familiar with it. The student indicated that he learned the concept in elementary school and it was fascinating to see that he is still using it. He actually showed his classmates promptly a mind map that he made for a chapter in the book and is using it as a summary and to aid him recalling the chapter concept.

The author felt that it is worthwhile to use this concept in his classroom and to test its advantages. The course of choice for this study was ET 3610, Introduction to Electricity and Electronics. The reasons for choosing this course are:

- The course is intended for "non-major" students who generally find the course very challenging and any tool to aid students during their learning experience is usually welcomed by both students and faculty.
- These students come from a wide range of cross-disciplinary majors including many non-science majors such as the Recording Industry. The cross-disciplinary nature of students will add another dimension to the study and will give a better picture on how students will perceive the new concept.
- Since the course is introductory in nature, it emphasizes concepts over theories and their mathematical derivations. The author felt that mind mapping can be integrated easily within the course.
- It is hoped that students will find the concept useful and will use it in their advanced classes and future careers.

Early results have indicated that students found mind mapping to be useful and exciting, but the more important question is: will it improve students' learning and add to their abilities? This is the goal of this on going research.

How to Make a Mind Map

Since most students who were enrolled in the Introduction to Electricity and Electronics course were not familiar with mind maps, the author had to introduce the concept and to explain to his students how to make a simple mind map. He also encouraged the students to be creative and use all sorts of graphics. Several books and online sources that explain how to make Mind Maps are available to the reader [1, 4, 6, 7]. Students found it strange yet to be "tons of fun" when they were engaged in drawing facial expressions, various shapes, as well as technical symbols. The students were provided with Table 1 (Appendix-A) that explains how to make a mind map [1].

Research Methodology

This research focuses on the use of Mind Mapping in technical education and the assessment of its effectiveness. The author has extensive experience in innovative teaching methods and assessments due to his work during the last ten years while participating in three major ATE NSF-funded projects, the main goal of which has been improving technological education. The author has worked (and still working) extensively with learning scientists who are leaders in the field of "How People Learn." One of the tools that can be used to assess learning is called "Transfer Knowledge." Transfer is defined as the application of old or gained information in new settings. For example, asking the students to estimate the area of a circle or a triangle after the students has practiced and mastered the task of estimating the area of a rectangle.

According to De Corte (1999) [8]: "The field of industrial and corporate training is strongly interested in the transfer of learning. This is not at all surprising when one takes into account that business and industry must invest enormous amounts of money in in-service training and retraining of personnel. From that prospective, acquiring of transferable knowledge and skills by workers, employers, and managers is seen as an important component of a "Learning Economy" resulting in a reduction of spending."

The author normally teaches two sections of ET 3610, Introduction to Electricity and Electronics, every semester. The course is four credit/six contact hours, three hours lecture and three hours laboratory. In the first semester of applying this concept, the author asked his students in both sections to produce mind maps for every other chapter. The author usually gives a quiz every week that covers one chapter. He then compared students' performance with and without mind mapping. Early maps were produced manually but later maps were produced using the MindManager software (www.mindject.com). The software license for 15 seats costs approximately $1800 after educational and volume discounts. A student sample Mind Map representing Chapter 2 from the required textbook [9] is shown in Figure 2. The chapter covers voltage, current, and resistance including resistor color code. The chapter consists of the following sections: Atoms and Atomic Structure, Electrical Charge, Voltage, Current, Resistance, The Electric Circuit, Basic Circuit Measurements, and Electrical Safety. The map was designed for 11x17" size paper and small details may not be legible at the size shown and is included for the demonstration purpose only.

In the Spring 2005 semester, the author required his students enrolled in one section to produce a Mind Map for each chapter, a larger map for each section of the book, and a map that represents the whole semester or "the big picture." The second section was used as a "control section." The students can make their maps during the extra lab time or outside class time. Transfer Knowledge questions have been designed and embedded in various quizzes and tests throughout the semester. The students in the control section will be given traditional homework to offset the difference in coursework. The results of this research will be analyzed and studied. Depending on the success of this experience, the method might be modified and repeated in future semesters for further studies.

To be effective, chapter and book-section maps will require the use of an 11X17" format color printer. Such printers are inexpensive and readily available in most labs.

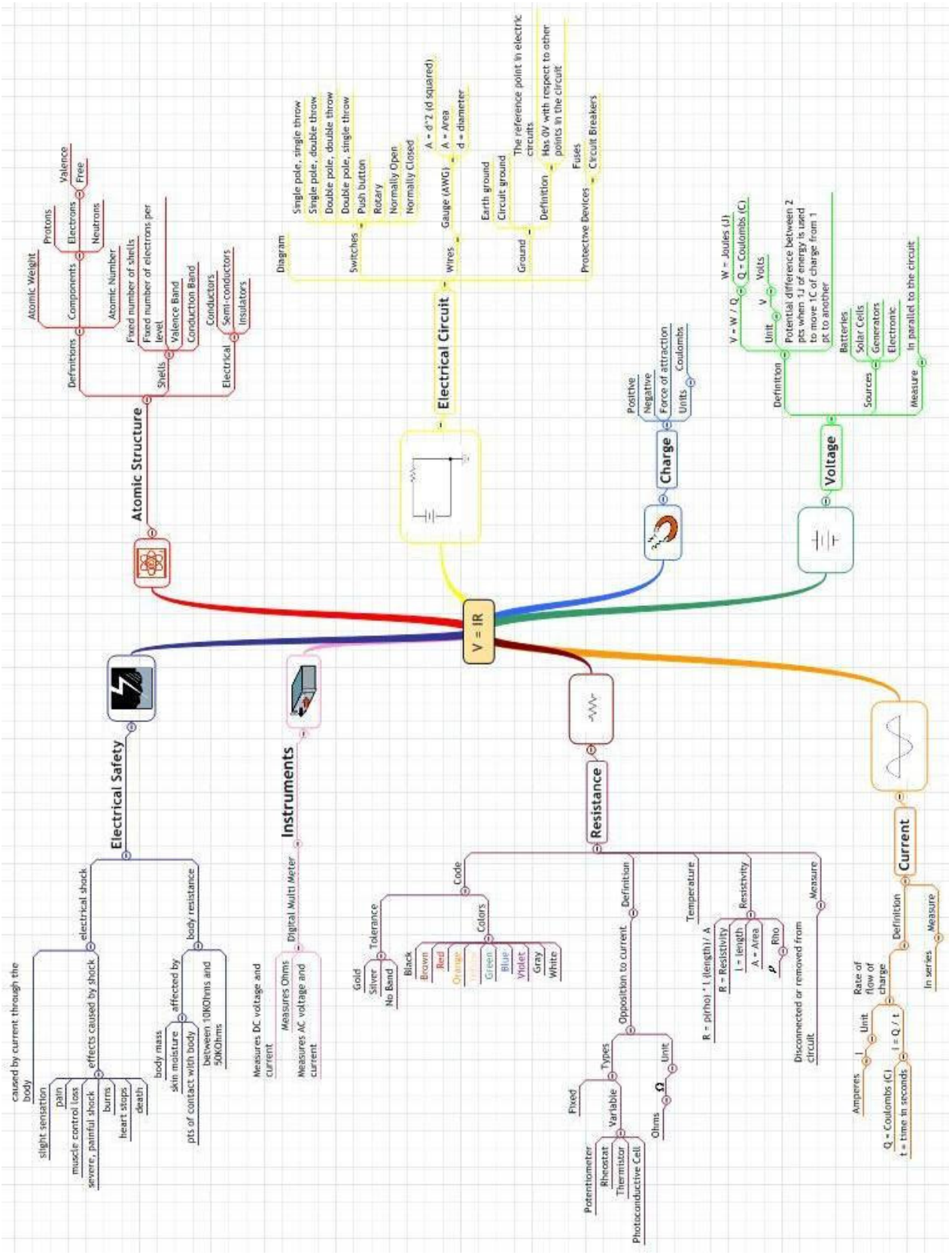

Figure 2: A Sample of a Student Mind Map.

Importance

The research will be essential for implementing innovative teaching techniques in technical education. The research will demonstrate the advantages and disadvantages of Mind Mapping in technical education. If proved effective, it will be another tool that helps students during the course of their studies and beyond.

Early Results

Analysis of the results is still an on-going process; however, early results indicate that student performance has been improved slightly when mind maps were used. The student also retained knowledge for a longer period of time since the visual representation of materials helped the student recalling certain knowledge and concepts. Test scores, transfer task questions, and student feedbacks have indicated positive outcome in most cases. Some students resist the use of Mind Maps at the beginning but later found them to be useful. Only very few students, however, indicated that the method did not help them at all but it was rather "wasted time." A more comprehensive analysis of the results will follow and another study is being planned for subsequent semesters. The transfer knowledge study in particular will reveal for certain weather this concept is also effective in technical education.

Acknowledgment

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Dr. Saleh M. Sbenaty is currently a Professor of Engineering Technology at Middle Tennessee State University. He received the BS degree in EE from Damascus University and the MS and Ph.D. degrees in EE from Tennessee Technological University. He is actively engaged in curriculum development for technology education. He has written and co-authored several industry-based case studies. He is also conducting research in the area of mass spectrometry, power electronics, lasers, and instrumentation.

Appendix — A

Table 1: How to Make a Mind Map [1]

1. Take a blank piece of paper, A4 or larger	Blank paper allows 360º of freedom to express the full range of your cortical skills, whereas pre-drawn lines restrict the natural flow of your thoughts
2. Use the paper in landscape orientation	Words and images have more space in the direction we write, so they don't bump into margins as quickly
3. Start in the centre	Thoughts start in the centre of our mental world. The Mind Map page reflects this
4. Make a central image that represents the topic about which you are writing /thinking • use at least three colors • keep the height and width of the central image to approx. 2'' or 5 cm (proportionately larger for bigger paper) • allow the image to create its own shape (do not use a frame)	A picture is worth a thousand words. It opens up associations, focuses the thoughts, is fun and results in better recall: • colors stimulate the right cortical activity of imagination as well as capturing and holding attention • this size gives plenty of space for the rest of your Mind Map, while making it large enough to be the clear focus of the topic • the unique shape makes it more memorable and enjoyable. A frame makes the centre a monotony of shape and disconnects the branches
5. The main themes around the central image are like the chapter headings of a book • print this word in CAPITALS or draw an image • place on a line of the same length • the central lines are thick, curved and organic i.e. like your arm joining your body, or the branch of a tree to the trunk  • connect directly to the central image	The main themes, connected to the central image on the main branches, allow their relative importance to be seen. These are the Basic Ordering Ideas (BOIs) and aggregate and focus the rest of the Mind Map • printing (versus cursive) allows the brain to photograph the image thus giving easier reading and more immediate recall • word length equals line length. An extra line disconnects thoughts, length accentuates the connection • curved lines give visual rhythm and variety and so are easier to remember, more pleasant to draw and less boring to look at. Thicker central lines show relative importance • Connected to the image because the brain works by association not separated, disconnected lines
6. Add other main theme branches by thinking of other 'chapter headings'. Remember to print the word or draw an image and make it fit the line	Then your main themes will stand out clearly, and trigger your subsequent connecting thoughts
7. Start to add a second level of thought. These words or images are linked to the main branch that triggered them. Remember:	Your initial words and images stimulate associations. Attach whatever word or image is triggered. Allow the 'random movement of your thought; you do not have to

• lines connect are thinner • words are still printed but may be lower case	'finish' one branch before moving on • connected lines create relationships and a structure. They also demonstrate the level of importance, as from a branch to a twig • the size and style of the letters provide additional data about the importance and meaning of the word/image
Add a third or fourth level of data as thoughts come to you • Use images as much as you can, instead of, or in addition to the words • Allow your thoughts to come freely, meaning you 'jump about' the Mind Map as the links and associations occur to you	Your brain is like a multi-handed thought-ball catcher. The Mind Map allows you to catch and keep whatever 'thought ball' is thrown by your brain
9. Add a new dimension to your Mind Map. Boxes add depth around the word or image	To make some important points stand out
10. Sometimes enclose branches of a Mind Map with outlines in colour • enclose the shape of the branch. Hug the shape tightly • use different colours and styles	The outlines will create unique shapes as you find in clouds and will aid your memory • these provide immediate visual linking. They can also encourage follow-up and remind you of action you need to take • they can also show connection between branches by using the same colour outline
11. Make each Mind Map a little more: • BEAUTIFUL • ARTISTIC • COLOURFUL • IMAGINATIVE and • DIMENSIONAL	Your eyes and brain will be attracted to your Mind Map It will be easier to remember It will be more attractive to you (and to others as well)
12. Have fun! Add a little humour, exaggeration or absurdity wherever you can	Your brain will delight in getting the maximum use and enjoyment from this process and will therefore learn faster, recall more effectively and think more clearly