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Use of Mind Mapping (MM) as an Unconventional Powerful Study Technique in Medical Education

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Introduction and Objectives

An Overview of the Problem

Medical students everywhere are overloaded with an excessive quantity of information, with a restricted amount of time to learn and remember all the information and to utilise it immediately. Consequently, many medical students struggle with their individual capability to meet the demands of medical programmes, courses and syllabuses and thus are not successful at examination time (Yussof and Baba 2013; Anderson and Graham 1980).

Many medical educators throughout the world use the traditional method—PowerPoint slides—as the chief information distribution

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platform in their lectures. PowerPoint is described by Garber (2001) as the use of slides, disordered with text, often with unconnected additions, leading to little expressive learning and student dullness. As a traditional method, PowerPoint presentations can be developed, but there is a drawback to this educational method. Lectures and text slides are linear representations that cannot express the rich interrelations among medical ideas and concepts. This results in linearity more than connectivity, less critical thinking and less expressive learning, which are important in the education and development of future medical practitioners.

The quick, sustained transformations in medical science, and the need for future medical practitioners to remain capable, requires an alteration in the educational techniques by which medical students are trained. Lately, the number of studies on learning methodologies used in medical education that might help students study and ultimately integrate information has increased (Dolmans et al. 2005; Kim et al. 2006; Zajaczek et al. 2006). Different authors have documented the need for alternate methods of teaching and learning that will empower medical students to recall enormous amounts of information, develop critical thinking skills and resolve a range of complicated clinical problems.

Pudelko (2012) reported that mind mapping (MM) is a multisensory, non-linear teaching and learning approach that has recently surfaced in higher education as a means to support students' critical thinking and encourage a deeper level of integrated information.

While the MM teaching and learning strategy has appeared in the literature, its usage by medical educators in Sudan is unknown. As Sudanese medical educators, fostering an environment that improves students' critical thinking and their ability to master the quantity of information required to succeed in medical institutions in Sudan is one of our principal roles.

Definition and Tools of MM

Tony Buzan, the inventor of mind mapping, defines MM as a powerful graphic technique that acts as a master key to unlock the brain's potential by creating a visual display of a concept using mind mapping tools

that include images, keywords, lines and colours in a distinct, uniquely powerful, structured manner. MM can be used in all aspects of life where critical thinking and enhanced learning will boost human performance.

The Key Elements of Mind Maps and Evidence Supporting MM

Many studies emphasise the usefulness of MM in many kinds of occupations including research, teaching, learning, unifying, problem-solving and so forth. Mind maps are built on several key elements, which have been verified to play an important function in liberating thinking capacity.

Radiant Structure

Anokhin (1973) reported that the brain works on the basis of association and is capable of connecting thousands of ideas. Mind mapping is a pattern of radiant thinking application, which stimulates all parts of the brain that work in communication, starting with a central thought that radiates to infinite space, as opposed to the normal linear method of thinking, which restricts thinking and information retention and recall (Buzan and Buzan 1994). The radiant structure of the mind map encourages longer continuous thinking as it is much simpler to find new connections between the branches of the mind map, resulting in a natural flow of thinking that tries to fill in the blank spaces.

Basic Ordering Ideas (BOIs)

Basic Ordering Ideas (BOIs) is well defined as the initial - level topics that come out from the mind map central idea like headings of chapter in a written book on certain subject. BOIs consider as the main concepts that assist to create the utmost number of associations as putting and arranging thoughts. Ideally, the initial - level topics should be wide-ranging to provide for a greater range of associations. The author of the Mind Mapping Software Blog (2008) Chuck Frey considers good BOIs for adjustment of the MM quality.

Single Keywords

A keyword is generally a word that will produce as much correlated meaning as possible. In MM keywords open up thinking and stimulate the mind to see more details that were previously unseen. By trying to choose a word that most suitably conveys a subject, the brain is forced to think more actively rather than only gathering or repeating information. A study done by Howe (1970) on note-making and note-taking reported that keyword notes given to students were more efficient in terms of understanding and recall than complete sentence summaries or text notes. Keywords generate many associations.

Interesting Colour

Colour is one of the most forceful and entertaining parts of MM. It recovers memory, excites creativity and influences how one communicates with others. Psychologists have discovered that colour helps one process and store images more competently than colourless (black and white) scenes, and to better memorise them as a result (Journal of Experimental Psychology 2002).

Influence of Images and Icons

Images are an excellent memory aid. Our ability to remember images is far better than our memory for words. A study by Anglin et al. (2004) confirmed the power of pictures, while one by Haber (1970) also supports the value of imagery. McArdle (1993) found that adding visuals such as photos or maps to a presentation increases the amount of information recalled by as much as 55 %. Mind mapping stresses pictures, visual imagery, drawings, doodles and symbols. Using imagery arouses the brain's imagining and visualisation capacity, which produces huge creativity benefits and improves the memory's storing and recalling abilities.

Icons impart clearness and appropriate meaning to topics and are promptly understood by the brain. Small visual symbols such as triangles,

circles, ticks and crosses strengthen the benefits of using imagery in mind maps, for example denoting category, hierarchy, priority, status and so on.

Relationship Arrows

Association arrows explicitly link different topics together throughout the map and present multidimensional direction to thoughts, thus promoting different and extremely creative thinking (White and Gunstone 1992).

Emphasising (Chunking)

Emphasising, or chunking, is a technique used in mind mapping to gather and emphasise the main branches within a boundary to make specific topics or ideas in the mind map visually noticeable alongside the rest of its content, thus making these ideas simpler to memorise and connect to others. According to Frey (2008), short-term memory is usually only effective in storing seven items of information, and chunking can aid in using this storage space more competently.

Whole Brain Thinking

Using all of the above mind mapping elements produces a functional arrangement of a range of cognitive purposes and processes in a way that uses both the right and the left sides of the brain. The two brain sides cognitive function is primarily discover by Sperry (1968), who set that the thinking cap of the brain (Cerebral Cortex) is separated into two main hemispheres that perform a range of intellectual tasks (cortical skills). The right brain works using images in a non-verbal way and takes over in dealing with emotion, colour, form and shape, rhythm, and perceptive information. The right brain processes information rapidly, in a non-linear and non-sequential style. The left brain is found to work in a linear way, recording things in a consequential order. It is related to analytical thinking and logic, dealing with naming and classifying language, things, reading, writing, mathematics and representative inference together with

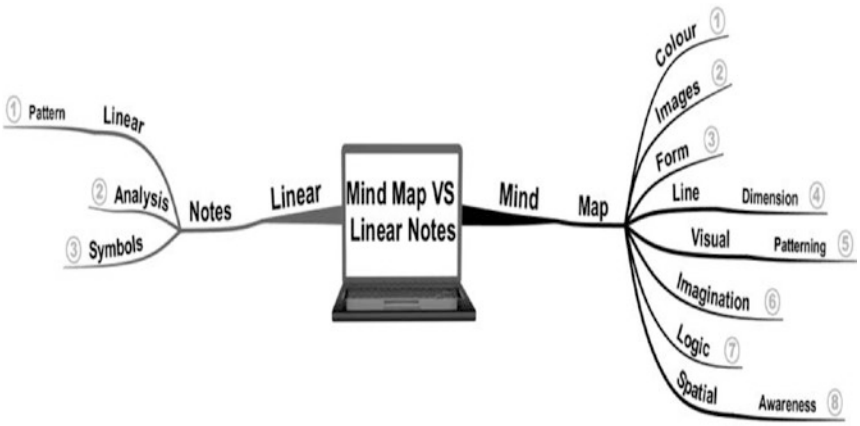

Fig. 7.1 Mind map vs linear note (devised by author)

seeing things in black and white. An individual's mental ability is based on how they use their brain. Mind mapping is one approach to using both sides of the brain (ambidextrous). When using MM, thoughts are diffused and stream between lines and relations, which is linked with imagination and creative thinking as opposed to the linear approach (Fig. 7.1).

Research Studies on MM in Education

Mind maps have been shown to be a simple but powerful technique for learning and have had surprising success in education all over the world in the 40 years since Tony Buzan first invented the method. The techniques of MM have been embraced by students of all ages to help them understand, generate ideas, revise and recall information related to their subjects. Important studies have shown the potential of MM as a powerful tool for learning and teaching.

Promote Creativity

A study by Al-Jarf (2009) showed that the spatial layout of a mind map provides a better overview that makes new associations more noticeable and generates an unlimited number of ideas, thoughts and associations related to any subject. Mind mapping software offers prominent advance for enhancing the aptitude of anyone to MM yield ideas as it is built over

several key parts, which have been verified to play an essential function in releasing thinking capacity. Mind Map unify ideas by thinking with greater clarity to learn associations between ideas and put an innovative viewpoint on things and seeing all the correlated issues and study alternatives in bright of the large image Visualize ideas' by creating a visual display of a concept through using MM tools, which include images, key words, Lines, and colors, in a powerful structured manner. The subjects in the study confirmed that the MM tools stimulated creative thinking and enabled them to more rapidly conceive and shape ideas for their writing.

Augment Memory

Compared to conventional learning methods and note-taking, the cortical skills of mind mapping have been shown to significantly increase information recall. A study by Wickramisinghe et al. (2007) revealed that a majority of medical students using MM found it more useful for memorising information in a structured way compared to their former study methods.

Toi (2009) confirmed that MM can help children remember words more easily than using lists, with up to 32 % improvement in memory. Additionally Farrand et al. (2002) found that mind mapping improved medical students' long-term memory of precise information by 10 %.

Boost Teaching Confidence

Boyson (2009) found that using MM for lesson preparation helped teachers develop lessons plans and teaching methods, and improved their recall of the subject material. This can enhance teaching confidence and help smooth management of classes and boost teaching confidence.

Mind Mapping was found to be a valuable approach for presenting novel concepts, attract a whole-class concentration, and assist in people in planning and build up projects and assignments more efficiently (Goodnough and Long 2002).

Learning Process Empowering Medical Education

The first study regarding the potential utility of MM in medical education was conducted by Farrand et al. (2002). They examined the advantages of the mind map learning technique compared to traditional note-taking

for medical students' long- and short-term recall of written information. The investigators found that the mind map technique significantly improved long-term memory of information.

D'Antoni and Pinto Zipp (2005) reported that of 14 physical therapy students studied, ten found that MM helped them arrange and assimilate the material presented in their course. Many of the study participants enjoyed being creative when making mind maps, employing a variety of designs, symbols, colours and keywords.

A study of undergraduate medical students to determine the efficiency of using MM to improve reliable recall from written information concluded that MM was a competent study technique when applied to written material and improved recall of information and memory (Farrand et al. 2002).

Willingham (2007) reported that; critical thinking happens when students enters behind the surface structure of a problem and knowhow the problem can be explained, and possesses the content knowledge important to solving the problem.

The extra capacities of pictures and colors that are uniquely to mind maps does not enable just memory but also deliver a wide range of medical students to distinguish the intra and inter relationships between thoughts, which exposes the way of real-world thinking prevalent in the clinical location. Srinivasan M et al. (2008).

Spencer et al. (2013) published a study entitled 'Radiant Thinking and the Use of the Mind Map in Nurse Practitioner Education', which stated that the MM graphical method increases the visualisation of relationships and connections between thoughts, which helps in information attainment, data holding and inclusive comprehension.

Descriptive unpublished data on the use of MM in note-making (teaching) and note-taking (learning) in a general pathology course for students in a clinical nutrition department shows that using MM resulted in high grades among student (23.8 % received A+, 19 % A, and 21 % B+) (Fig. 7.2)

Presentation Effectiveness

A study done by Mento et al. (1999) on a number of managers using mind mapping, showed a successful way in remembering and managing

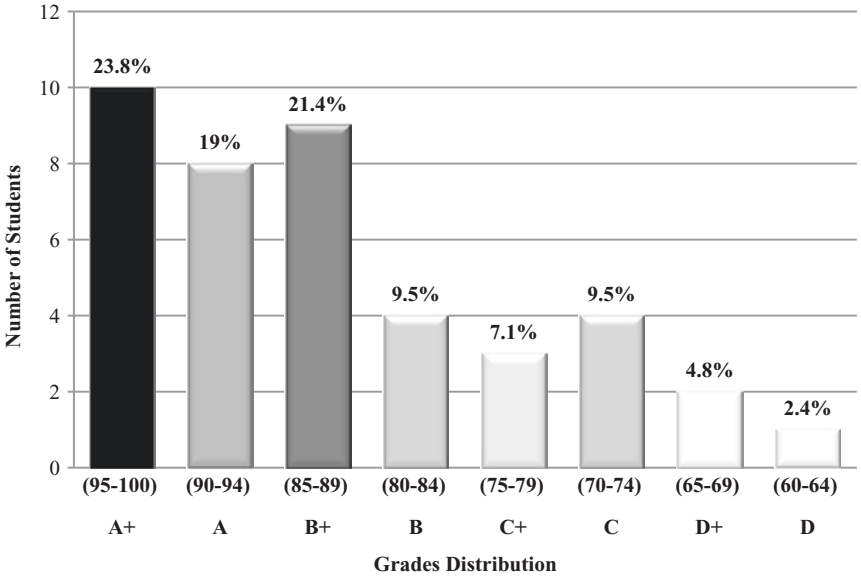

Fig. 7.2 Pathology final exam result for second-year clinical nutrition students who used mind mapping in education (devised by author)

information, which are held and kept in connected and organized manner rather than linear.

Project Preparation

Holland et al. (2003/2004) reported that Mind Mapping is consider as forceful approach that help in designing and planning projects and improve the written skills of assignments. Contributors will be capable to of planning and organizing their thinking for any type of project.

Writing Improvement

Written work based on the use of MM was well schematised and linked ideas with more associated detail. It improved the work of students at all stages as they became more imaginative in creating and combining ideas for their writing (Al-Jarf 2009).

Thoughts Organisation

A Mind Map is considered as brain storming showed in one picture therefore it assist in thinking with greater clarity to discover connections between ideas and characters and find keys to problems by places a innovative viewpoint on things and seeing all the correlated issues and study alternatives in bright of the large image. This had been approving by results of Mueller et al. (2002) study which expressive how the use of Mind Maps to suggest patient care at Front Range Community College settled an increased critical and inclusive thinking.

Although the MM teaching and learning technique has appeared in the literature, its use in Sudanese medical education is unknown. While computerised databases are ingenious and useful, **NO** data was found in a search for the current literature review (Use of mind mapping in medical education in Sudan).

Specific Purpose of the Literature Review

The purpose of this literature review is to present evidence of MM's effectiveness in improving research and education (teaching and learning), and to progress understanding about using MM to improve students' critical thinking and their ability to handle the quantity of information necessary to succeed in Sudanese medical institutions.

Methodology

Literature Searching

- **Targeted Search**
  The literature was obtained through library databases (PsychINFO, PubMed, MEDLINE PsychINFO and EMBASE). It includes both empirical and conceptual published literature on the definition, characteristics and uses of MM in medical education up to April 2016.

- **Search Strategy**
  The search strategy primarily involved looking for the following keywords and phrases: mind mapping, medical education, critical thinking, visual education, and Sudan. The reference lists from reports and published studies were searched for more sources. A number of electronic journals specialising in medical education, Tony Buzan's website (ThinkBuzan.Com), and scientific studies and research on MM were examined. The general search mechanism revealed information from consultation papers, discussion papers and opinions of medical educators, and all which were examined for evidence related to the present integrative literature review objectives.

Selecting the Articles and Review Resources

Inclusion Criteria: the inclusion criteria include articles (reviews, use of mind mapping in learning, teaching, critical thinking and outcomes required), chiefly in Sudan.
Topics of Interest: topics of interest are: mind mapping learning and teaching types, Sudanese medical education system.
Evaluating the Evidence: final selection of articles was done by thorough review of each studied article by two persons to minimise omissions and errors.

Discussion

Medical educators face many challenges in preparing students to recall huge amounts of content and to develop associations between concepts, especially with the rapid growth and transformation of clinical practice and medical education. Medical educators are responsible for preparing graduates who are skilled in analytical reasoning and problem-solving in a variety of clinical practice locations, which requires them to use teaching strategies that improve communicative learning instead of depending on traditional methods involving rote memorisation.

The medical educator must generate magnificent learning experiences for the enhancement of critical thinking in order to improve students' effectiveness as evidence-based independent clinicians.

The evaluation in this study focuses on the usefulness and creativeness of one teaching approach, mind mapping, compared to more traditional methods. A study by D'Antoni et al. (2005) identified MM as a credible teaching and learning approach that actively engages the mapper (learner) in assimilating material in a non-linear, meaningful way, which boosts critical thinking.

The combination of images and words makes mind maps a rich optical channel for pioneering and imaginative vision. Visual presentations are more effective than verbal presentations. The presenters who used visual language were stronger, more exciting, brief, specialised, reliable and better prepared. These findings agree with the results of Howe (1970), which showed that keywords were more efficient by far than sentence summary notes or whole text notes in terms of recall.

Farrand et al. (2002) stated that MM is a successful study method when applied to written material and is likely to motivate a greater level of managing for memory creation.

Mind Mapping increases the mind's potential for entire brain thinking by using both cortical sides together—the left brain (numbers, linearity, logic, words) and the right brain (creativity, images, colour, curves, space)—which increases the brain's power. This is confirmed by the findings of Sperry (1968), who reported that the more assimilation there was between the left and right brain actions, the more the brain's performing turned out to be synergetic, which means that every cortical skill encourages the actions of other parts so that the brain is operating at its peak.

Medical educators should encourage the use of MM techniques for learning collaboratively, taking notes, brainstorming, presenting and organising ideas, and studying. Moreover MM can be used in problem-based learning, medical care process; identify disease causes, diagnoses and planning treatment.

Conclusions, Recommendations and Implications

Many studies have verified the effectiveness of MM in education. Mind maps can be used as a teaching method to improve critical thinking in medical education by inspiring students to link information across disciplines and recognise relationships among the clinical and basic sciences. The use of mind maps in medical education may benefit more students with diverse learning types. Mind mapping was found to be a useful tool for creative thinking and collaborating with others.

The literature review showed that Sudanese medical educators are not at present using Tony Buzan's mind maps as a method for conveying and assimilating information in medical education programmes. This primary data is the first of its kind on the potential usefulness of mind mapping in medical colleges in Sudan and can be used to explore plans to address the assumed obstacles.

Considerable work will be required to promote mind mapping as a tool that can promote critical thinking skills. Informing higher education officials about the MM approach and what it can achieve may lead to their support for the use of MM as a learning and teaching approach within medical education and health care programmes in Sudan

Nevertheless, before mind maps become generally accepted as a study technique, attention has to be given to ways of improving inspiration amongst users. Mind mapping is a stimulated technique for students to employ that can improve memory and help create a unique environment for managing information.

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