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Review Article

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A Perspective on Utilizing Mind Map as an Educational Tool for Teaching Physiology to Health Professionals Students

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ABSTRACT

Current ongoing changes in the landscape of medical education demands for a more authentic learning experience for learners. A deeper understanding of learners and their needs has led educators to continually seek innovative ways to enhance their learning. Increasing availability of information and increased expectations of educators also contribute to this pursuit. Tony Buzan, an English psychologist influenced by Leonardo da Vinci's notebooks, introduced the concept of mind maps in his journey to improve learning experiences of learners. A mind map simplifies complex concepts and highlights relationships by offering a visual representation of information. As students learning physiology encounter a variety of challenges because of complex contents, mind mapping can be an invaluable tool for educators. The effectiveness of mind maps is not well established empirically, but there are anecdotal reports indicating that students who employ them reported enhanced recall and active learning. In this article, we present our perspective as educators on integrating mind maps into physiology education. A narrative literature review, theoretical basis and practical implementation of mind mapping are discussed in this article.

Keywords: Active learning, health professionals students, medical arts, mind map

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INTRODUCTION

Developing health professional students' competency in physiology can be challenging for many educators.[1] The existing teaching learning methods might not engage students. This might result in surface-level learning and the dissemination of knowledge rather than the active construction of knowledge by students. One of the effective approaches to improving students' comprehension of complex physiological concepts can be mind mapping. Mind mapping is a method of visually mapping information in simple concepts and finding relationships between them. However, its integration into physiology education remains relatively unexplored and lacks empirical study regarding its effectiveness. A significant increase in performance was observed in syllabus that comprised Vector-borne Diseases as reported by Choudhari et al.[2] among students using mind maps compared to controls. Although there was no statistically significant difference in mean scores for the Physiology concept " glucose homeostasis " between the groups that used mind maps (MM), Shete et al.[3] revealed that students reported MM enhanced their ability to recall information and promoted more active learning. Although the mind maps group had lower mean scores, they exhibited qualitative factors such as engagement and memory retention. There is limited research in Nepal that has explored the use of mind maps to teach physiology. So, Nepalese students may have been hindered from achieving enhanced and engaged learning because of the absence of these techniques. Therefore, the main objective of this article is to present my perspectives on mind maps as a pedagogical tool for teaching physiology to students of Health Professionals Education (HPE).

Mindmapping

The concept of mind mapping, also called idea mapping, is defined as a visual, non-linear representation of ideas and their relationships. By simplifying long texts, information becomes comprehensible and captivating for the brain. A central theme is used to organize ideas so a person can see how they flow from one level to another. Texts are reduced to lines, symbols, key words, color and images to create simple, mind-friendly concepts.[4]

In this type of concept, information is organized systematically, illustrating connections between different aspects of a concept, which often springs from a central idea. In a blank canvas, a central concept is surrounded by mind-friendly elements such as images or word segments that represent subtopics or categories. 2 Using mind maps allows students to understand why concepts are related and how they are interconnected, reflecting the kind of thinking that occurs in a clinical setting. Concepts are organized in mind maps either radially, hierarchically, linearly, or nonlinearly. In most cases, individuals create hand drawn mind maps, which are often used as notes in lectures and meetings, but if time permits, a more refined visual format can be adopted.[5] There have been centuries-old uses of mind maps (or similar concepts) to teach, brainstorm, visual think, and solve problems. Burzan et al[6] argues a mind mapping exercise utilizes the full range of left and right brain skills. Mind maps can help students brainstorm a topic and are a great tool to use.

Significance of Mind Mapping

The landscape of medical education has transformed dramatically, adopting the concept of student-centered learning. With this pedagogical shift, educators have switched from being the traditional "sage on the stage" to being the "guide on the side," encouraging active learning of students. A hallmark of this transition has been the recognition that learning should be centered around learners and that learning outcomes should be the focus of education. This has given rise to outcome-based learning. In outcome-based learning, the focus is on what students learn and what they can do with the knowledge, rather than mere content delivery.

Through this, learners' needs and preferences have been better understood, and multiple intelligences have been recognized. Educators and researchers have been striving to identify effective learning strategies that cater to these diverse intelligences. It has resulted in the adoption of active learning methodologies such as Problem-Based Learning (PBL), Community-Based Learning (CBL), Team Based Learning (TBL) and Mind Mapping (MM). Mind mapping caters to diverse learning styles such as visual learners, kinesthetic learners and logical learners. Moreover, it encourages students to think critically, present their ideas visually, and collaborate with others. By engaging in brainstorming during mind mapping, learners develop a mental framework. The purpose of this is not only to help students retain information,

but also to develop essential modern skills such as problem-solving and information synthesis. Hence, in a time when information is readily available, mind mapping gains even greater value.

History

Tony Buzan, British psychologist pioneered the development of Mind mapping, perusing the notebooks maintained by Leonardo da Vinci. Words played a secondary role for Leonardo compared to the language of images, which probably helped Leonardo explore ideas across diverse fields.[7] Seminal works in use of mind map in medical students was done by Farrand et al.[8] In their study, they compared the retention of knowledge among self-study group and mind map groups. After a week it was noted that mind map groups had 10 % better retention.

Literature Review on use of Mind mapping on Medical Education

The mind maps group of Iranian nursing students scored significantly higher in assessment compared to the control groups, according to Rezapour Nasrabad. Feedback on the new teaching techniques was also collected from intervention groups, and it was rated positively by all students.[9] After provision with reading assignments, students of doctor of physical therapy were facilitated in conceding the findings in a form of mind map. Post course, a survey was conducted to evaluate students' perception regarding the course. Based on a post-course survey, 10 out of 14 students agreed that mind maps were a helpful tool for organizing and integrating course material, while only two disagreed. In their opinion, the technique did not impact organization or integration, but it did help them identify areas requiring further research.[10] A pilot study was conducted by Kalyanasundaram et al.[11] among Indian sixth semester medical students in community medicine. On day zero after intervention, students in mind map groups did not score significantly higher than control group students. However, there was a significant difference between the intervention and control groups on the seventh day. Considering this author argues, the mind map technique does not provide an advantage over routine learning strategies for retrieving short-term recall. Mind maps may be effective after extensive practice. Palaniappan V et al.[12] revealed that students who were recruited in mind maps groups performed significantly better in post-tests compared to control groups. The authors used Freemind software among intervention groups for mind mapping. Compared to assessment of the content as in other studies, Wu et al.[13] assessed critical thinking skills among their nursing students in China. A Chinese version of the Critical Thinking Disposition Inventory was administered by the authors.

The scale comprised seven domains namely: analytical, open-mindedness, inquisitiveness, systematicity, truth-seeking and judgemental maturity. A significant improvement in critical thinking was observed in students after intervention. Before intervention, students had neutral inclinations, but after intervention, they had positive inclinations. Significant improvement was observed in four domains: open mindedness, inquisitiveness, systematicity and judgemental maturity. The use of mind maps by high-achieving students in undergraduate medical education was identified as one of learning strategies.[14]

Theoretical basis of Mind Mapping

A central principle of mind mapping is constructivism, which recognizes that meaningful learning occurs as learners integrate new knowledge into existing cognitive frameworks. Consequently, the sense-making process of a learner may differ considerably from the facilitator. Therefore, mind mapping allows learners to actively build knowledge within their own contextual understanding instead of passively absorbing information. This illustrates how learners and their environment interact dynamically, highlighting their inherent relationship.[5]

Steps to draw mind map

Step 1: Take a large piece of paper that allows them to break out of the boundaries, preferably in landscape. In theory, lined paper restricts thoughts, so use blank paper instead. You can scribble more easily if the paper is landscape oriented. In the center of the paper, write down or draw that reflects the central theme. Central theme controls the context of the mind map. Placing text or image in the center allows the learner to 360 degree freedom.

Step 2: Radiate out branches from the central theme. Branches symbolize different categories related to the key concept based on the student's perception. The main branches are subdivided into sub branches. Make branches quickly without pausing

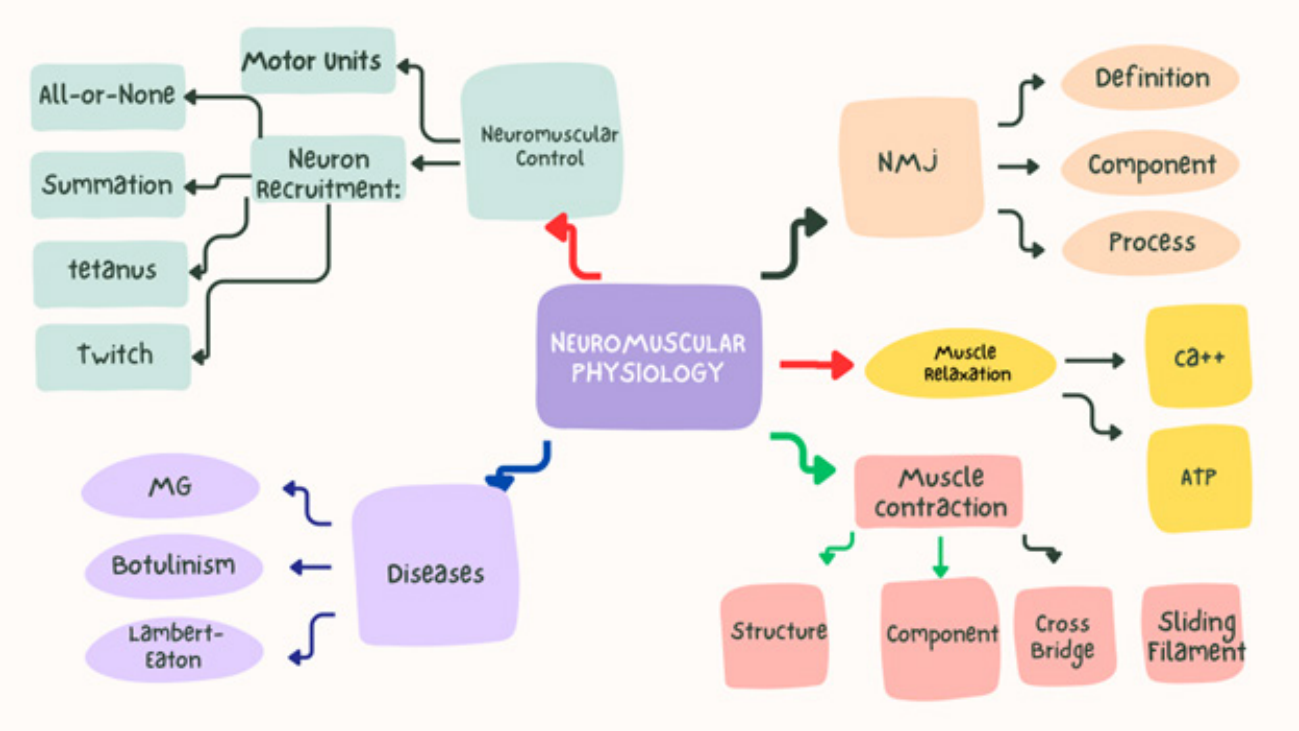

Figure 1 : Mind Map of Neuromuscular Physiology

or editing. Use speech bubbles as subthemes. Use curved branches rather than straight ones as they are more riveting to the eyes.

Step 3: You can use colors to create branches. Colors stimulate the brain just as much as images do. It is important to use colors that represent different things. In order to better reflect on the mind map later, remain consistent throughout. For example, use red for things that require more research and blue for things you are confident about.

Step 4: Connect major branches to the sub-branches as the brain works better through associations. Thoughts are based on a basic structure or architecture that is formed by connecting main branches.

Step 5: Keep each line to one key word; this gives Mind Map more freedom and flexibility. Using key words is like using all the fingers in your hand, but using phrases or sentences is like holding all of your fingers in splints.

Step 6: For longitudinal work on the content, always leave a space. [4,6]

We have drawn a simple mind map of neuromuscular physiology in Figure 1. Learners may get creative and draw their own mind map for engaged and effective learning. For creating this mind map, we jotted down the main idea i.e. neuromuscular physiology. Then in the middle of the template in Canva, we placed the topic of learning, then themes were slowly introduced in the template, followed by subthemes

How can educators integrate mind mapping in the educational process?

It is recommended that educators implement mind maps in their classrooms pro-actively. They can give a presentation on how mind mapping works and its benefits. During didactic sessions, they may encourage students to create their own mind mapping aligning with their understanding of the topic. This may help educators identify the deficiencies amongst learners. The mindmapping tools can be used in brainstorming sessions in the classroom or during problem based learning. To guide students through examples, educators may provide them with the mind map they have created. Digital tools can be used during mapping and students may be encouraged to use them. Each lesson may be summarized through a mind map or students may be asked to create a mind map on their own. Educators from different departments may create a mind map system together in integrated basic sciences. The use of mind mapping as a formative assessment tool is also possible.

Role of Learners in Mind mapping:

Learning may be enhanced when learners create their own mind maps, visually describing their understanding of a subject. Furthermore, students can participate actively in brainstorming sessions and problem-solving activities, using mind maps as tools for synthesis and exploration of ideas. Study strategies and note-taking can be enhanced with the use of mind maps for personal study and organization. Learners must understand, however, that one size doesn't fit all. For some people, mind mapping may be highly effective, but for others it may not. In the event that learners have difficulty making sense of mind maps or feel frustrated because they cannot achieve the desired outcomes, it is recommended that they explore other possible learning strategies. The learning style and preferences of each individual are unique, meaning what is effective for one person may not work for another. Learners should experiment with different approaches rather than sticking with a technique that doesn't work for them. Alternative methods can be explored until the students discover the ones that best help them comprehend and retain information, such as traditional note-taking, flashcards, mnemonic devices, or interactive discussions. It is ultimately important for learners to identify a learning strategy that is meaningful to them and will support their academic success. However, learners must also keep in mind that passive knowledge acquisition through mere listening, while easier and more straightforward, is not the most effective method. They must always seek ways of finding learning strategies that promote active and deep learning. As a result, learners can develop an internal motivation for lifelong learning. Having an intrinsic motivation for learning not only makes the learning process more meaningful, but it also makes them lifelong learners.

An enhanced use of mind maps through technology

The learners may use hand drawn format for mind map or may resort to technology to learn through mind map. There are various online free tools available for mind mapping. Few of the online available tools are mind the graph, edrawmind, mindmeister and miro. There are some that are free and some that have a basic plan. Based on our personal experience, we would recommend the use of Canva. First of all, it is free to use, and a variety of templates allow creative and technical learning to go hand in hand. In addition, the platform offers a variety of elements that make it engaging for learners. Figure 1 was generated using Canva.

Mind mapping as an assessment tool:

Mind maps can also be employed for assessment purposes. Maps and its contents can be graded based on rubrics created. Mind map assessment rubric was used by D'Antoni et al.[15] by based upon cross linking, linking of concepts, hierarchical, associated examples, images, and colors. Mind mapping can be employed in problem based learning as well during brainstorming sessions.

Mind Mapping in Teaching Physiology

Gonzales et al. conducted a study using concept mapping among the intervention group and traditional methods among the controls on cardiovascular physiology. The participants were evaluated by problem based and multiple questions. The evaluation based on problem based questions showed statistically higher grades among the intervention group which shows a more meaningful learning. However, multiple choice questions did not observe a significant difference which may be due to the memory based design of multiple choice questions.[16]

Using mind maps in teaching physiology is significant because it simplifies texts into small keywords or concepts, enhancing students' comprehension and retention. Similar to concept mapping, it is based on the same principles. Students are already familiar with concept maps, which are constructed in a top-to-bottom hierarchy, and are devoid of color or pictures. The benefits of mind mapping include facilitating more extensive connections and associations, adhered to a truly non-linear process. It is even more valuable to use mind maps in an integrated basic science curriculum as they allow students to establish connections not only within physiology, but also with other basic science subjects such as anatomy, pathology and pharmacology. As a result, student learning becomes more engaging.

Difference between concept map and mind mapping

Using a mind map, you can visualize how ideas and perceptions are related to a central topic or subject. A concept map, on the other hand, illustrates

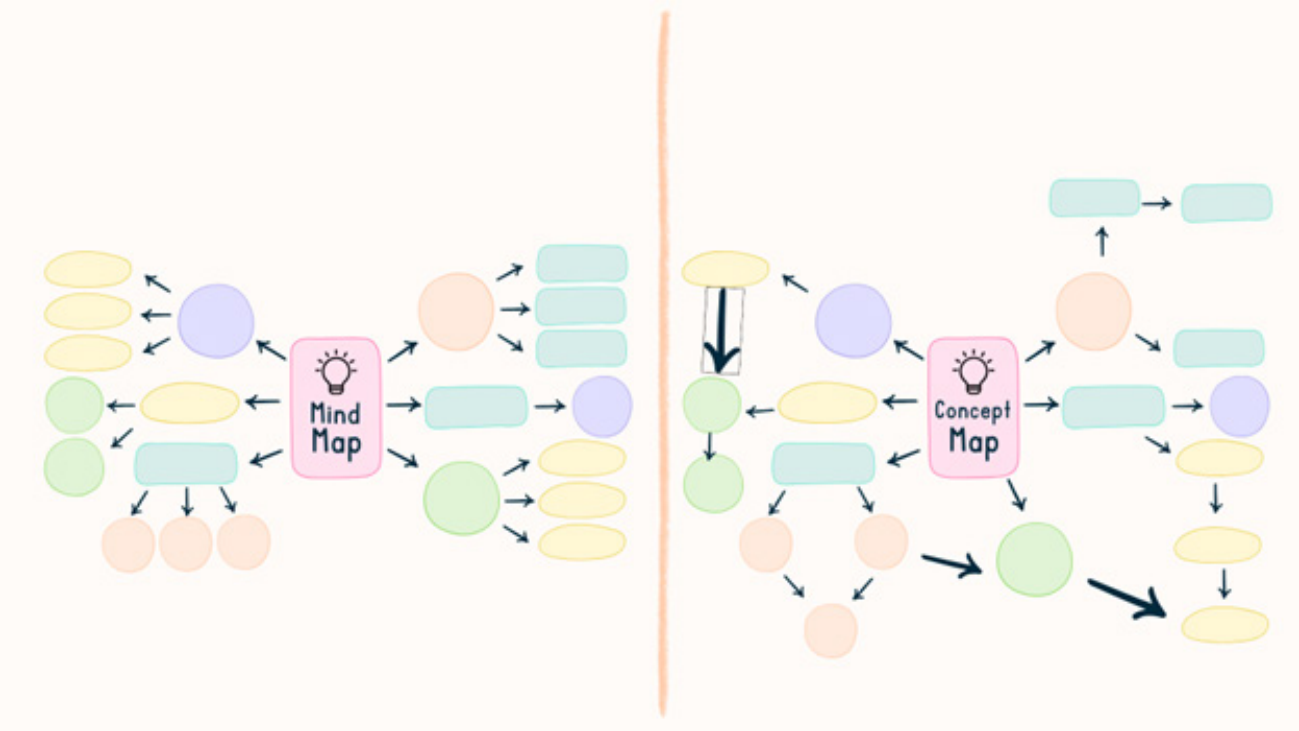

Figure 2 : Visual difference between mind maps and concept maps

relationships between concepts. An idea or concept map connects many ideas, whereas a mind map focuses on one idea at a time. A mind map is a visual representation of one concept, drawn in the middle of a blank page, and filled with words, images, and parts of words. Major ideas are branched out from a central concept. In conceptual maps, there are many branches and clusters, while in mind maps, there are many radial structures. Concept maps label links according to the type of relationship they have with ancestors. The similarity between a mind map and a human brain makes it easy to adapt. A central topic grows into a radiant core in the same way our brains do. Using concept maps makes it easier to understand why individual hubs are related. Alternatively, the mind map is more effective when you need to collect a large amount of information. There can be no changes made to topics on a mind map.[17]

Recommendations for Educators to Conduct a Research on Mind Mapping in Physiology

- A qualitative study to explore perceptions of students regarding mind mapping
- An experimental study to compare effect of mind mapping on retention of physiology content
- A questionnaire based study to assess the feedback of students regarding mind mapping.
- Studies to anaylze critical thinking based on questionnaire such as Critical Thinking Disposition Inventory post intervention
- A longitudinal study to evaluate the effectiveness of mind mapping on learning physiology content
- Role of mind mapping in retention of physiology contents in students with visual, kinesthetic, combined and logical learning styles
- Role of mind mapping in teaching integrated basic sciences among health sciences students
- Above mentioned studies can be done in undergraduate and postgraduate students respectively.

CONCLUSION

Mind mapping as a pedagogical tool in the teaching of physiology holds immense promise. Mind maps facilitate visual interconnectedness of complex physiological concepts in a simpler manner. Mind maps can serve as an invaluable tool that bridges the gap between student-centered, outcome-based, integrated, interdisciplinary, collaborative learning experiences and the changing role of educators as facilitators of active and constructive learning.

Teachers can help students visualize the teaching content by creating mind maps that help them visualize the entire system as a picture in their minds.

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