



CASE REPORT

Concept Maps for Teaching, Training, Testing and Thinking

[version 1]

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Abstract

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Concept maps are evidence based pedagogical tools to fathom how meaningfully students have accomplished their learning objectives. They also give intuitive insights to improvise instruction to enable better and deeper understanding the foundations of learning. In this paper we provide an overview of concept maps and share our experiences of using concept maps for the 4 t's of education - teaching, training, testing and thinking.

Keywords

Concept maps, Teaching and learning strategies, Critical thinking, Assessment, Training, Meaningful learning

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Concept Maps for Teaching, Training, Testing and Thinking

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Abstract

Concept maps are evidence based pedagogical tools to fathom how meaningfully students have accomplished their learning objectives. They also give intuitive insights to improvise instruction to enable better and deeper understanding the foundations of learning. In this paper we provide an overview of concept maps and share our experiences of using concept maps for the 4 t's of education - teaching, training, testing and thinking.

Keywords: Concept maps; Teaching and learning strategies; Critical thinking; Assessment; Training; Meaningful learning

Introduction

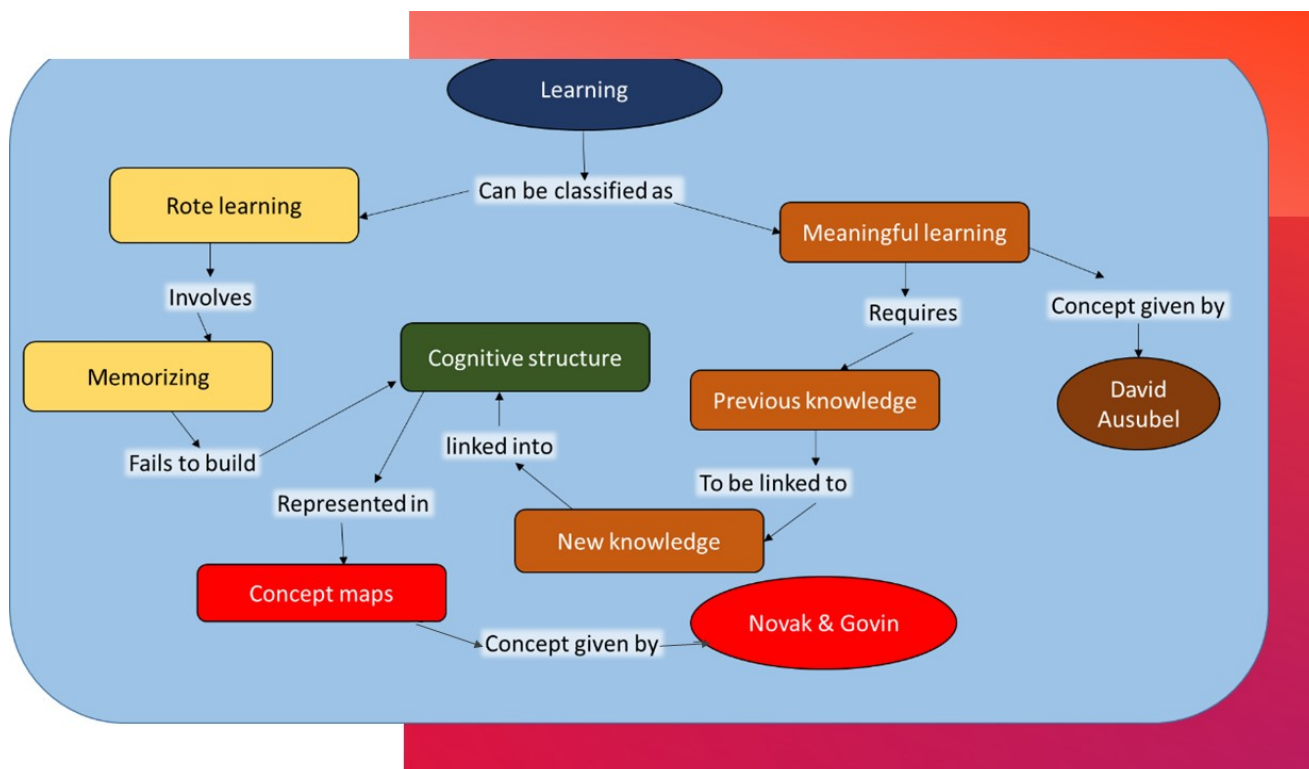
The cognitive processes undergirding teaching- learning are so distinctly dissimilar that it is important to use variegated tools to enhance knowledge construction in the learners. Pedagogical changes have been propounded, with an aim to transform the student into a critical, reflective individual who, in his practice, is able to 'fully learn how to learn' (Gomes *et al.*, 2011). This article on concept maps explores one such pedagogical intervention.

As defined by Torre, Durning and Daley (2013) "*Concept mapping is an instructional strategy for individual and group learning that involves integration of knowledge and creation of meaning by relating concepts.*" Moreover, concept maps help learners to organize and represent ideas so that they can reflect on their learning, leading to a deeper understanding. Concept maps can be used not just for teaching and testing but also for training and thinking – all of which represent a learning continuum.

Initiation of Concept Maps

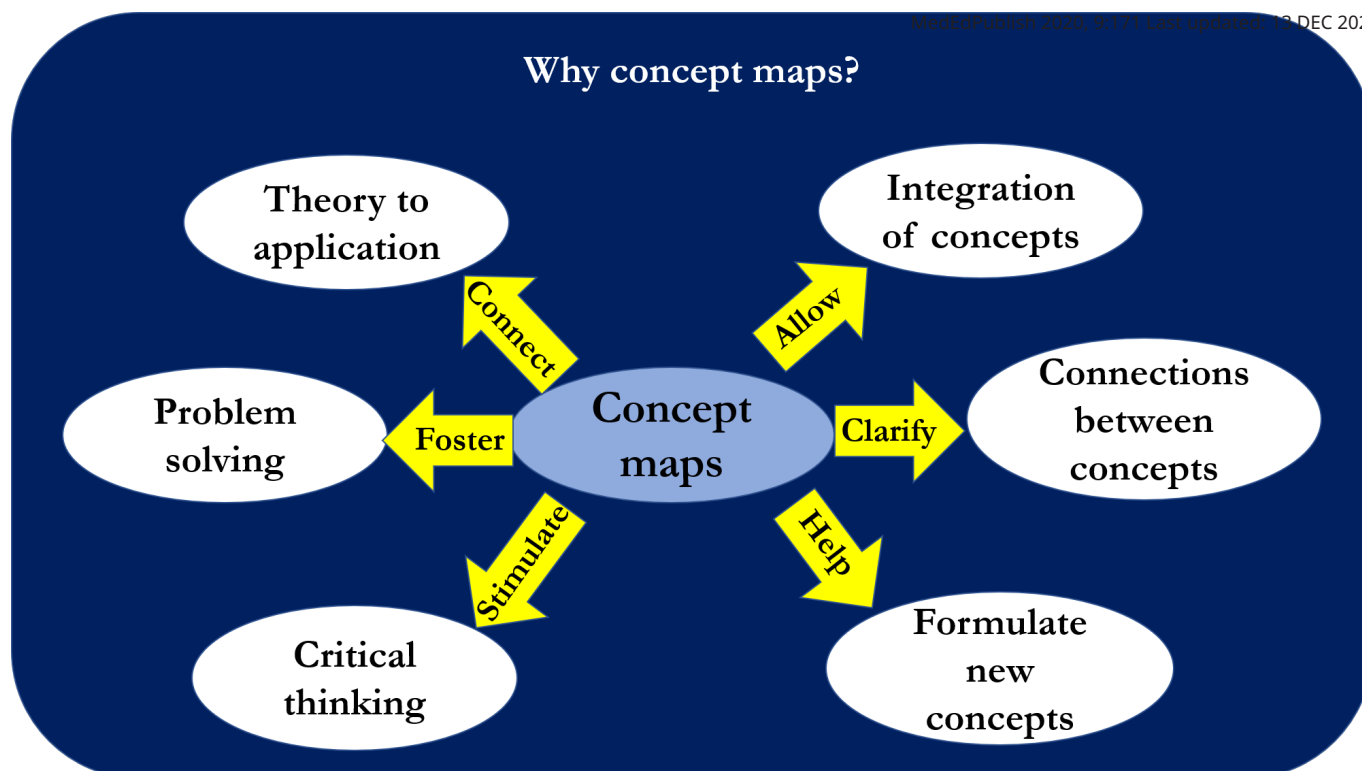
Novak and Canas (2006) and collaborators developed concept maps from David Ausubel's theory called the 'meaningful learning theory' which proposed that knowledge construction is based on relevance and integration and not on arbitrariness or rote learning (Figure 1).

Figure 1: Ausubel's theory represented as a Concept Map



Ausubel reasoned that pre-existing cognitive structures promote assimilation of the new proposals and nurtures connection between concepts, allows development of new concepts and integration of concepts (Gomes *et al.*, 2011). Concept maps when used appropriately promote critical thinking and problem-solving capabilities allowing students to convert theoretical into application-based knowledge (Figure 2).

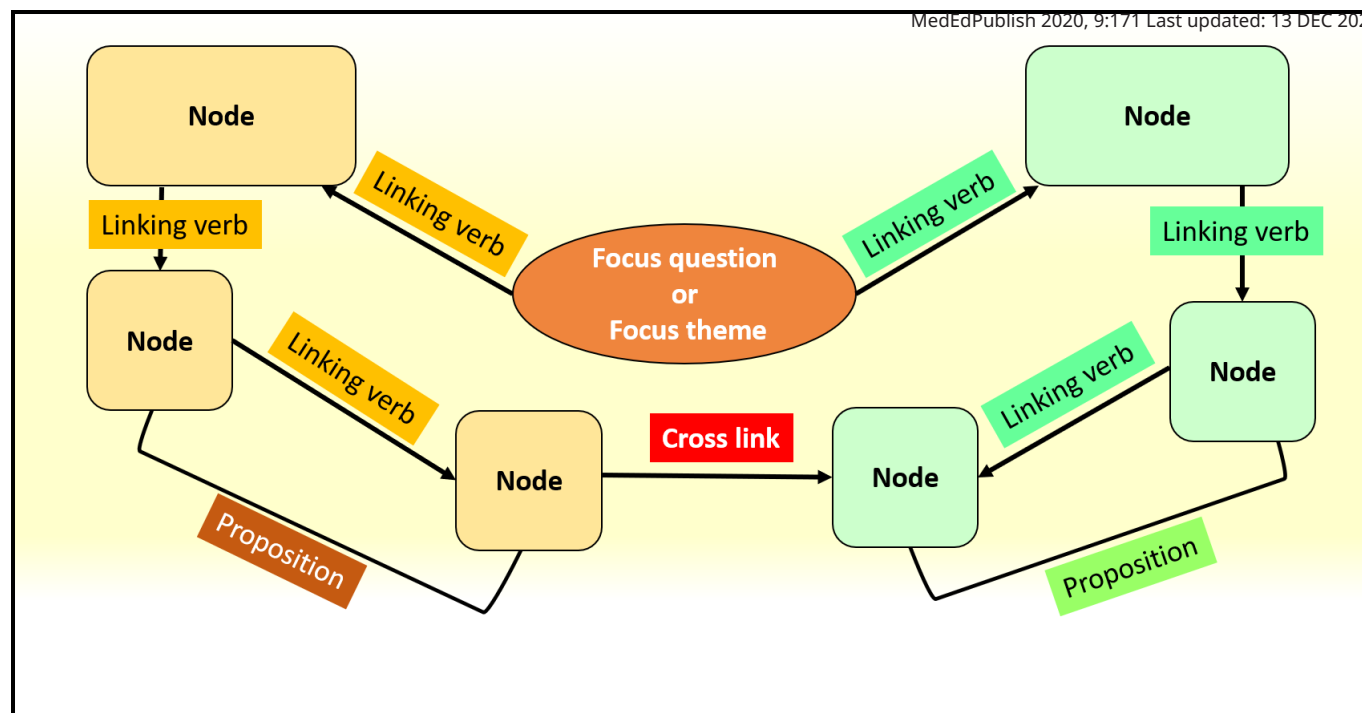
Figure 2: Uses of Concept Maps



How to construct a Concept Map

The structure of a concept map is made up of nodes, linking verbs, cross-links and propositions. The complete structure of a concept map is built around a focus question or theme. Every concept or idea is represented as a word or short phrase and lies inside a box which is called a *node*. A *linking verb* connects the nodes and explains the relationship between them. *Cross-links* are relationships between concepts in different domains of the concept map, allowing us to visualize the connection between them. *Proposition* of a concept map involves two nodes and their linking verbs; a proposition should form a meaningful sentence and represents the smallest unit in the map (Gul and Boman, 2006; Gomes *et al.*, 2011) (Figure 3).

Figure 3: Structure of Concept Maps



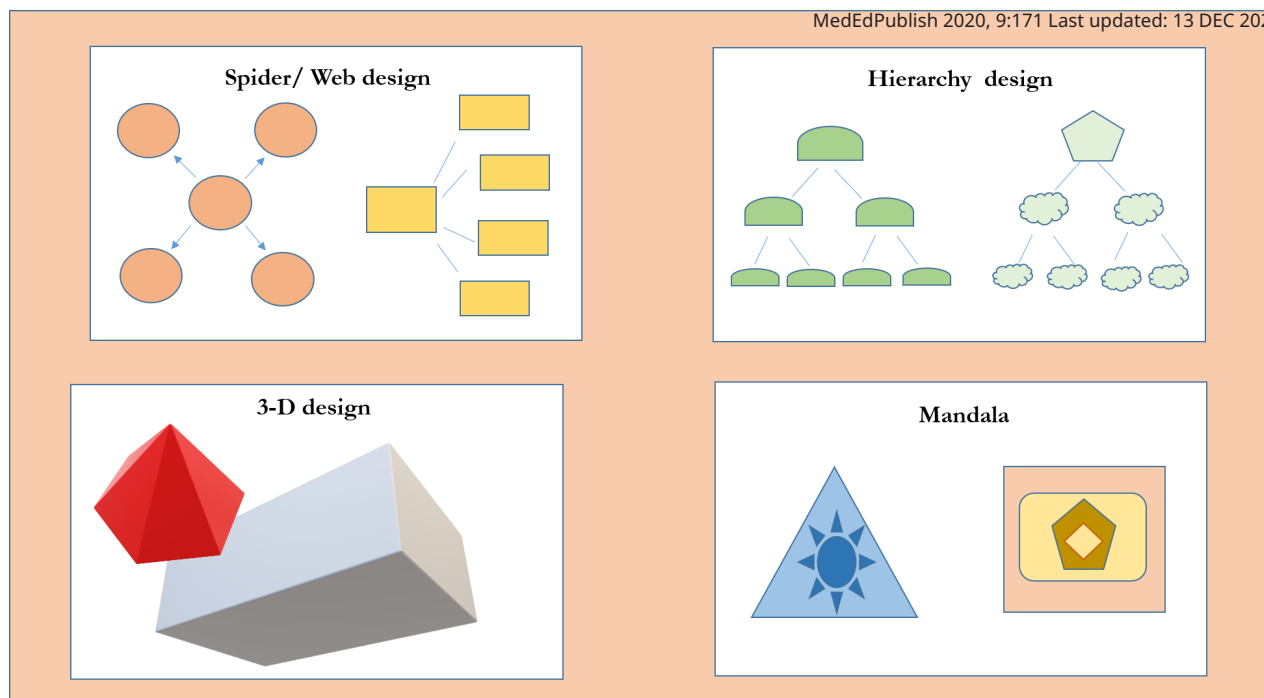
Prior to the drawing of a concept map, it will be worthwhile to generate a list of the key concepts that need to be included. This list must be in a rank order from the most general concept to the most specific. This list is referred to as a *parking lot*, as items are picked from here and moved into the map accordingly. The interrelationship between concepts is critical. This requires meticulous usage of cross-links and precision in the choice of linking words.

Types of Concept Maps

Organization of concept maps depends on the creativity and innovation of the individual drawing them. Different types of concept maps have been described in the literature (Gomes *et al.*, 2011).

- **Spider/ Web design:** in which the center represents the focus question or theme with linking words spreading out to connect different nodes depicting a spider web.
- **Hierarchical design:** where the information is represented as a scale of importance usually in the descending order.
- **Flowchart:** where the information is represented in a linear fashion.
- **Conceptual way:** which is very similar to a flowchart, with the possibility of adding new concepts or deleting some.
- **Landscape structure:** which displays information in panoramic manner.
- **Multidirectional structure (3-D):** which uses depth to represent relationships that cannot be shown with 2-dimensional maps.
- **Mandala:** in which information is presented in geometric forms (Figure 4).

Figure 4: Examples of different types of Concept Maps



It is vital to understand that concept maps are not rigid, although they are a product of logical thought. The maps are very flexible and are in constant change as new knowledge is acquired (Gul and Boman, 2006; Gomes *et al.*, 2011).

Digital Concept Maps:

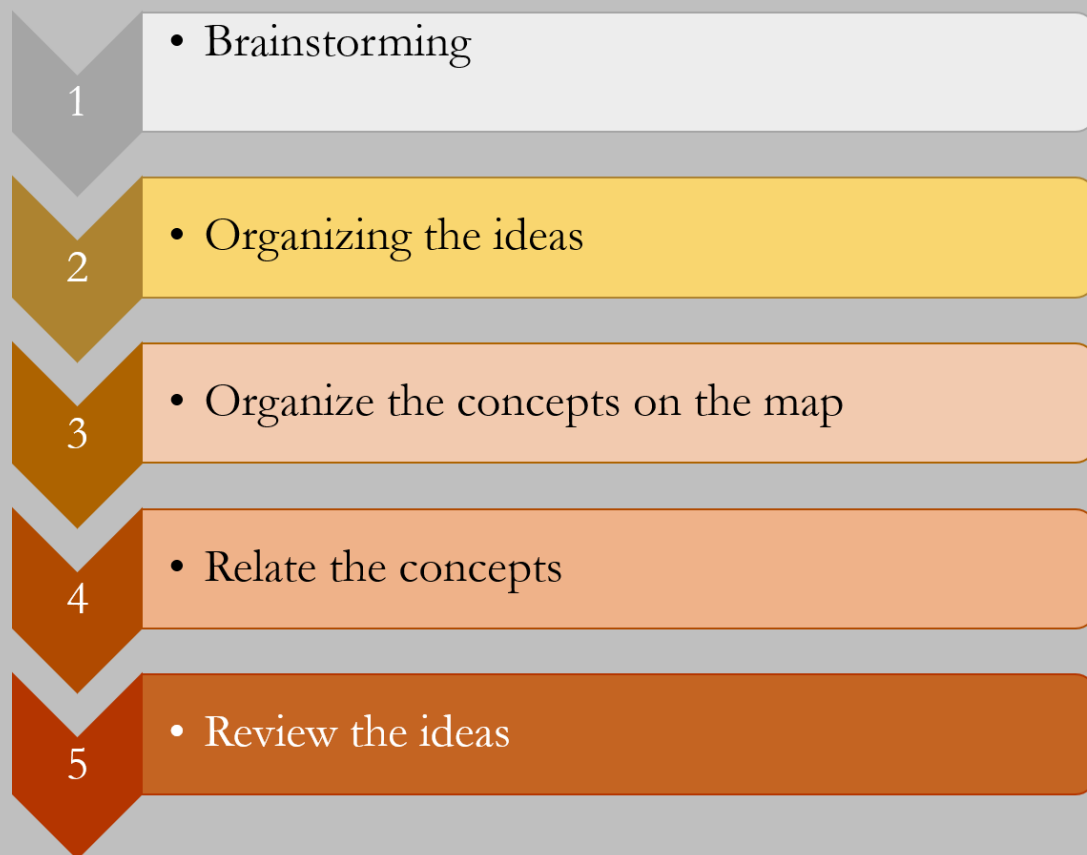
Digital concept maps facilitate real time interaction and feedback between learner and instructor. The digital platform allows learners to include images, photos and hyperlinks (to other websites) to support the content (Chang, Sung and Chen, 2008). It also provides the flexibility to co-create and co-edit concepts more easily (Gijlers and Jong, 2013). For today's student generation of technophiles these applications are akin to putty in their hands for creating concept maps thus enabling more focus on knowledge construction than on its designing (Chiu, Huang and Chang, 2000). Of the numerous online concept map applications available, [Mindmup](#), [Gliffy](#), [Mindmeister](#), [Bubbl](#) and [Minddomo](#) are some of the commonly used ones (Chiu, Huang and Chang, 2000; Gijlers and Jong, 2013).

Blueprinting for constructing Concept Maps

The purpose, the conceptual clarity and prior planning will determine how concept maps are designed. When concept maps are used for learning, the primary step is a list building exercise through brainstorming. Following this, the items in the list can be grouped and sub-grouped. The key concepts can be generated from these groups. Attempts can now be made to link and cross-link. Finally, the concept map can be reviewed to ascertain if it faithfully reflects the thought process (Croasdell, Freeman and Urbaczewski, 2003) (Figure 5).

Figure 5: Blueprint for constructing Concept Maps for students

Steps in constructing concept maps as a learning tool for students



When a teacher used maps to conceptualize, it is also an opportunity to involve students in meaningful linking of the concepts (Croasdell, Freeman and Urbaczewski, 2003). From the teacher's viewpoint, there is a stepwise approach to generating concept maps (Figure 6).

Figure 6: Blueprint for Concept Map construction for teachers

- Identify the structure according to the topic
- Identify advanced organizers needed to reach the meaningful learning of the subject
- Identify pre-existing meanings in the students cognitive structure
- sequentially organize the subject using progressive differentiation and linking between the concepts
- Build links between the concepts that the student already has and the ones that are required to be learnt

Our experience with Concept Maps

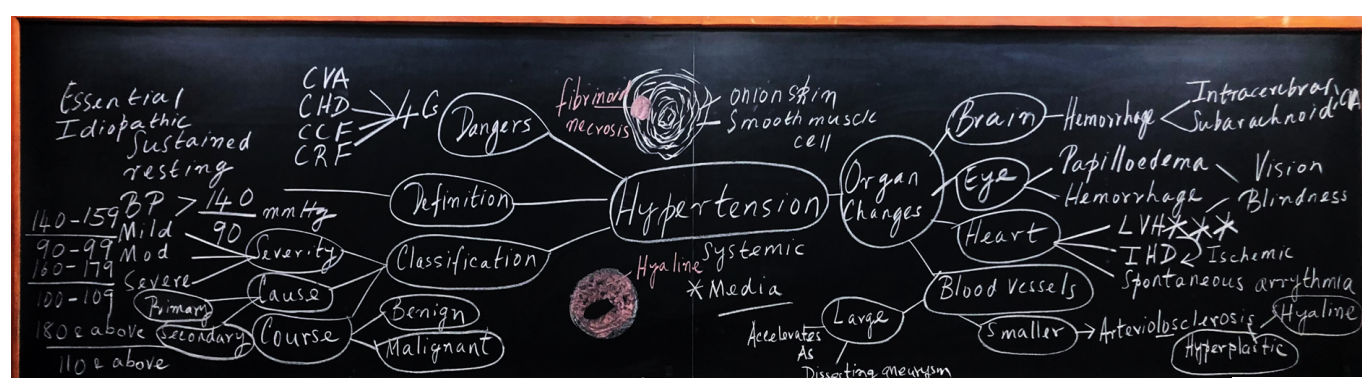
We used concept maps in the departments of Prosthodontics and Pathology for teaching, training, testing and thinking. The ethical approval was obtained from Institutional Research Ethics Committee -Ref No: MMMC/FOD/AR/EC 2018 (F-03). Consent to use the images was obtained from the participants.

Concept Maps for teaching:

The literature abounds in evidence supporting concept mapping as a meta-cognitive strategy that enhances meaningful learning (Novak, 1990; Irvine, 1995; Pinto and Zeitz, 1997).

While using concept maps, conceptual reinforcement takes precedence over content coverage as students learn to establish meaningful relationships between individual concepts. What emanates is a type of 'inferential and analogical reasoning' so essential for success (Mintzes, Wandersee and Novak, 2007). The aforesaid is exemplified in a pathology class, where it was used as a pedagogical tool to provide a panoramic sketching of hypertension (Figure 7).

Figure 7: Concept Map on hypertension used as a teaching tool



We also tried an experimental study where students were divided into two groups and were taught using traditional and concept map approaches. At the end of the teaching module, students in both the groups were tested using multiple-choice questions (MCQs) comprising recall and reasoning level questions. The performance of the students was the same in both groups on the recall level MCQs but the concept map approach group outperformed the traditional approach group in the reasoning level MCQs (Results in Table 1).

Table 1: Comparison of test scores

MCQ Type	Method	n	Mean SD	P -Value*
Reasoning	Traditional	68	6.13±0.98	<0.001
	Concept Map	68	7.00±1.22	

*unpaired t-test

These results were immediately after the teaching session and we are aware that the novelty of the approach could have influenced the results. Our hope is that this method will provide the sensitization and scope to train the students to constantly make links between concepts, thus enhancing their critical thinking.

Concept Maps for training:

Training differs from teaching in that the emphasis is on development of abilities rather than on conveying information or sharing knowledge (Surbhi, 2019). Training students to represent their thinking in their concept maps is vital. We used concept maps not only for teaching but also to train students in becoming adept at drawing the maps independently.

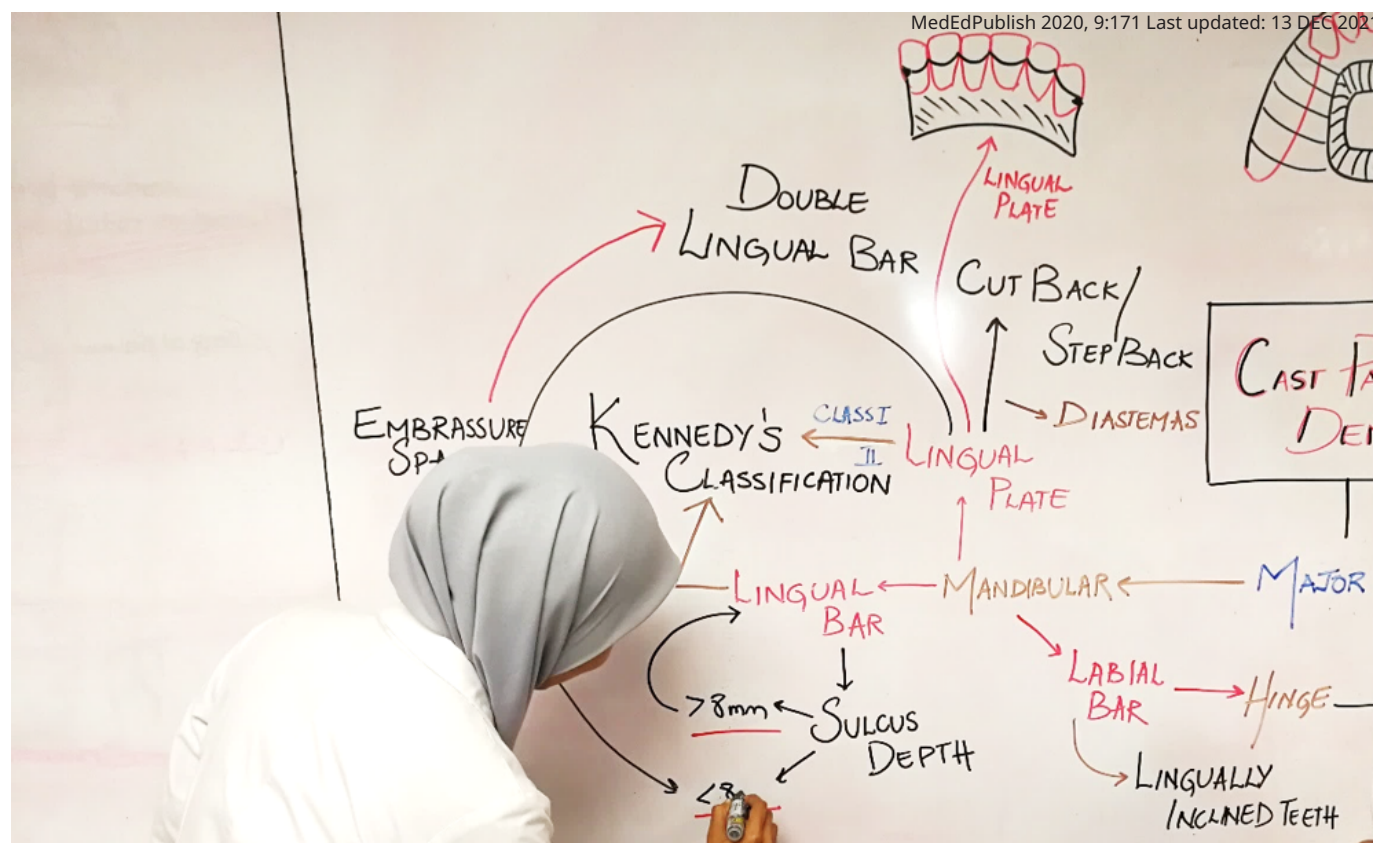
All and Huycke, (2007) suggested the use of serial maps for training students. Serial maps are concept maps drawn by students at different stages during the learning, thereby allowing teachers to monitor their students' progress through constructive and timely feedback.

We used different techniques to train students to draw concept maps. As the students were already exposed to concept map teaching, they were aware of the processes involved in drawing the map. They were encouraged not only to prepare notes but also to take down notes in the classroom in the form of concept maps. In other words, they were encouraged to use concept maps in both note-making and in note-taking.

Additionally,

- We created a map with empty nodes and students were asked to fill *in the content of the nodes* (Figure 8).

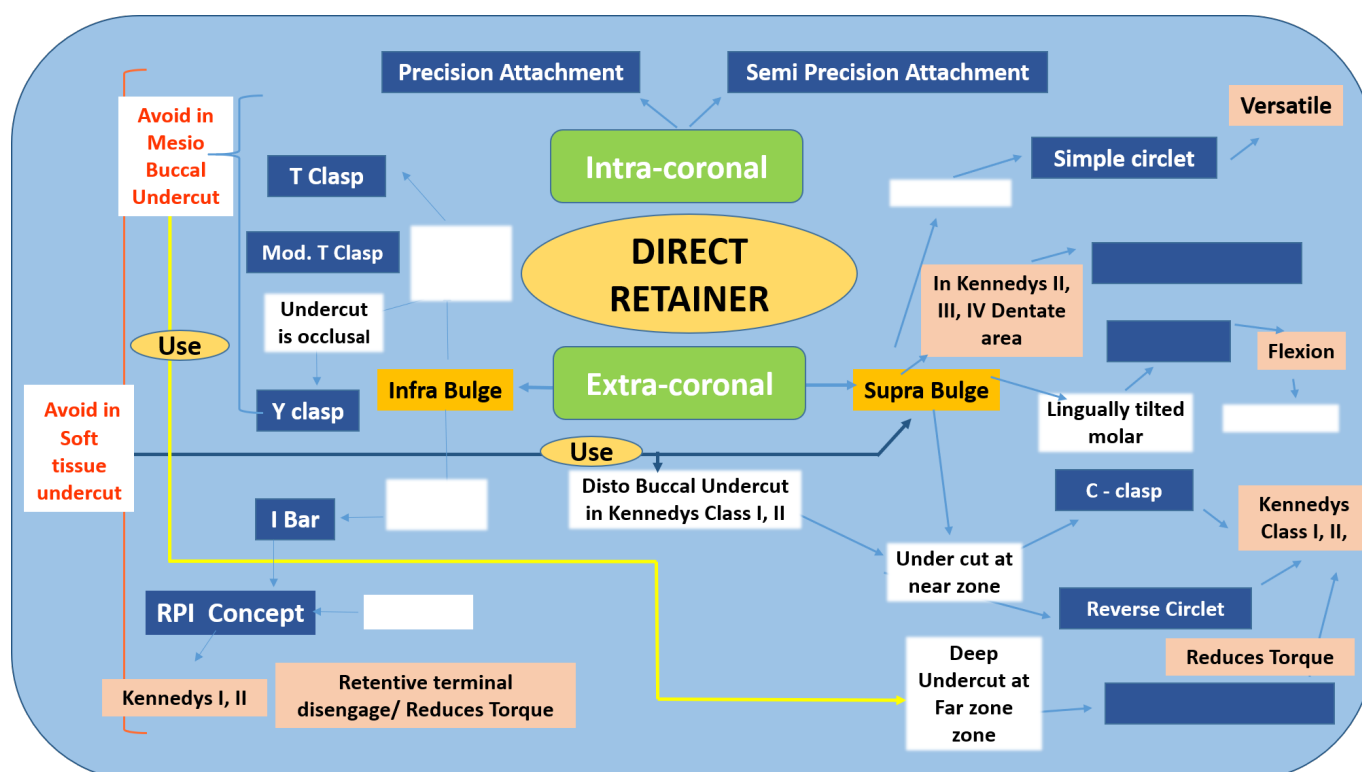
Figure 8: A student completing a Concept Map with missing nodes



b. We created a map where the students had to fill in the linking words

c. A mixed format was also used where we created a skeleton of the map and we urged the students to fill in the nodes and linking words (Figure 9).

Figure 9: Concept Map with missing nodes and links



Initially students found it challenging to add linking words onto the pre-drawn concept map. This was because of their uncertain grasp of the relationship between the concepts. We made the students practice drawing concept maps with emphasis on using meaningful linking words and identifying cross-links. At the end of a four-week training session, spanning diverse topics, students were able to appreciate that every concept could be related to every other concept.

Concept Maps for testing:

Higher levels of cognitive performance can be achieved if concept mapping is used as an instrument of evaluation. It can become a powerful weapon in the assessment armamentarium, provided it is used sagaciously.

In the transition phase from a fledgling to a full-fledged physician, aberrations in the knowledge framework cannot be picked up by conventional examinations. However, concept maps are powerful in detecting these deviations and lacunae in students' understanding (West *et al.*, 2002). Moreover, in the problem-based learning scenario, concept maps are effective tools to probe the knowledge structure (Rendas, Fonseca and Pinto, 2006; Kassab and Hussain, 2010).

The scoring system for concept maps needs further study to address validity and reliability to use it as an assessment tool (West *et al.*, 2002; Ruiz-Primo *et al.*, 2004; Nesbit and Adesope, 2006; Ingeç, 2009). We followed the structural method for scoring the maps. All the participating students were trained in drawing concept maps. Then students were asked to draw a concept map as a part of assessment for a selected topic in Prosthodontics.

We modified the criteria given by Croasdell, Freeman and Urbaczewski (2003) and scored the maps using four categories, with the following point assignments for each valid component:

- Nodes representing the concepts (5 points each)
- Concept-link (2 points each)
- Cross-links (10 points each)
- Propositions (5 points each)

Three faculty individually rated the maps. A total structural score was obtained from the sum of scores from each component. A standard structural score was calculated by sum of structural scores given by the three faculty members. After the examination, a debriefing session was conducted to provide constructive feedback to students.

Concept maps drawn by some students clearly reflected their thinking. Some others became clearer when they were asked to explain orally. If not anything else, concept maps gave an opportunity for the students to talk about the topic conceptually, hopefully, in the process, enhancing their confidence and their understanding of the topic. This was a labor-intensive effort on the part of the faculty, but the rewards came in the opportunity it provided to gauge students' understanding and plan appropriate pedagogical interventions.

Concept Maps for thinking:

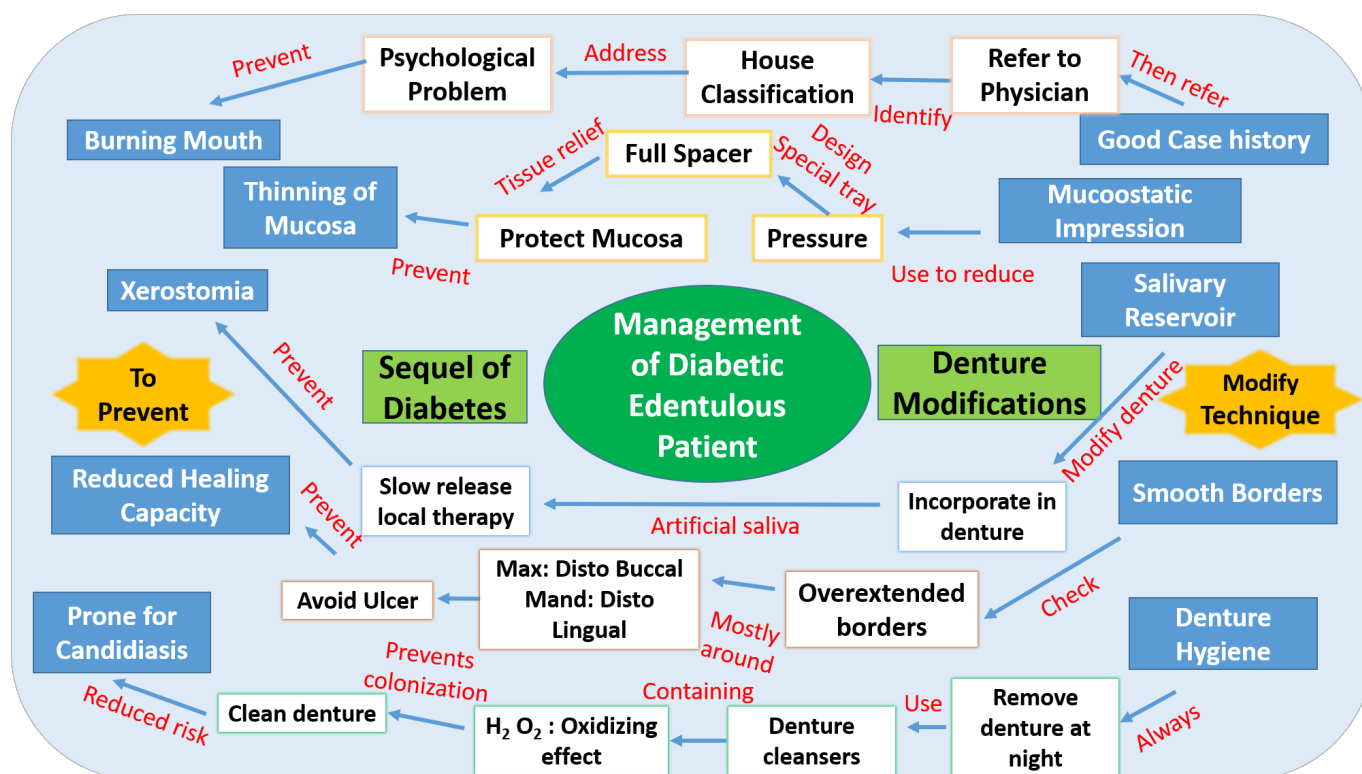
Concept maps can be an impetus to the process of thinking. While applying the principles of problem solving, it is essential to make students visualize knowledge and think discerningly. This will facilitate sequential build-up while elevating the thinking to application level (Latif *et al.*, 2016).

We chose concept mapping as a method to teach critical thinking in prosthodontics by selecting a case scenario (diabetic patient and impression making) and asking the students to integrate the two different concepts by linking

them (Figure 10).

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Figure 10: Example of a Concept Map drawn by the student



We made the students do this exercise as a group task so that each member of the group contributed to the construction of the map. This exercise helped students understand the special considerations in impression making for a diabetic patient as it required logical reasoning and critical thinking during its construction.

Conclusion

Usage of concept maps for teaching, training, testing and thinking impels students to construct a concept chain - with links functioning through relationships, yet each link maintaining its identity- this concept chain epitomizing a whole that mirrors the framework of concept thinking (Reigeluth and Jonassen, 1999). Our educational voyage using concept maps for all these four purposes was not without impediments. However, we took comfort in the conviction that the journey is as important or perhaps more significant than the destination! Yes, students did grapple with ideas to identify meaningful cross links between concepts; this provided a platform for misconceptions to erupt which were revelations (sometimes startling!) for the teachers. Nevertheless, it was gratifying to see students making valiant but sincere attempts to link the concepts they were learning thus echoing the spirit of the first stanza in the poem by Arthur Hugh Clough: (Tearle, 2020)

"Say not the struggle nought availeth,

The labour and the wounds are vain,

The enemy faints not, nor faileth,

And as things have been, they remain".

Take Home Messages

- Concept maps can be used for teaching, training, testing and thinking purposes.
- While using concept maps, conceptual reinforcement takes precedence over content coverage.
- Training students to represent their thinking in their concept maps is vitally important.
- Concept map is a powerful weapon in the assessment armamentarium, provided it is used sagaciously.
- Concept mapping allows sequential build-up of knowledge, while elevating the thinking to application level.

Notes On Contributors

Dr Prashanti Eachempati is working currently as Professor and Head of Prosthodontics at Faculty of Dentistry, Melaka Manipal Medical College, Malaysia. She is a FAIMER fellow (GSMC India), and the recipient of the prestigious Ron Harden Innovation in Medical Education Award in 2017. She has been a keynote speaker at various national and international conferences, continuing professional development programmes and conducted workshops at various institutions in medical/dental education related topics. ORCID iD: <https://orcid.org/0000-0003-1263-7423>

Dr Komattil Ramnarayan was the fifth Vice-Chancellor of Manipal University (now known as Manipal Academy of Higher Education) from 2010 to 2015. He is currently the Chancellor of Manipal University Jaipur and Professor of Pathology at Melaka Manipal Medical College, Manipal Campus, India. He is also the National Coordinator (Pathology) for the National Program on Technology Enhanced Learning (NPTEL), a Government of India project. He was one of the early recipients of the ECFMG Foreign Faculty Fellowship in Basic Sciences. He was the recipient of the Bloomberg UTV Award for Outstanding Contribution to education. He has conducted more than 500 faculty development workshops in India and its neighboring countries. ORCID ID: <https://orcid.org/0000-0002-7117-1830>

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Figures 1-10: Source – The Authors.

Bibliography/References

All, A. C. and Huycke, L. I. (2007) 'Serial Concept Maps: Tools for Concept Analysis', *Journal of Nursing*

Education, 46(5), pp. 217–224. <https://doi.org/10.3928/01484834-20070501-05>.

Chang, K., Sung, Y. and Chen, S. (2008) 'Learning through computer-based concept mapping with scaffolding aid', *Journal of Computer Assisted Learning*, 17(1), pp. 21–33. <https://doi.org/10.1111/j.1365-2729.2001.00156.x>.

Chiu, C.-H., Huang, C.-C. and Chang, W.-T. (2000) 'The evaluation and influence of interaction in network supported collaborative concept mapping', *Computers & Education*, 34(1), pp. 17–25. <https://dl.acm.org/doi/10.5555/334905.334907>.

Croasdell, D. T., Freeman, L. A. and Urbaczewski, A. (2003) 'Concept Maps for Teaching and Assessment', *Communications of the Association for Information Systems*, 12, pp. 396–405. <https://doi.org/10.17705/1cais.01224>.

Gijlers, H. and Jong, T. D. (2013) 'Using Concept Maps to Facilitate Collaborative Simulation-Based Inquiry Learning', *Journal of the Learning Sciences*, 22(3), pp. 340–374. <https://doi.org/10.1080/10508406.2012.748664>.

Gomes, A. P., Dias-Coelho, U. C., Cavaleiro, P. D. O. and Siqueira-Batista, R. (2011) 'The Role of Concept Maps in the Medical Education', *Revista Brasileira de Educação Médica*, 35(2), pp. 275–282. <https://doi.org/10.1590/s0100-55022011000200018>.

Gul, R. B. and Boman, J. A. (2006) 'Concept mapping: A strategy for teaching and evaluation in nursing education', *Nurse Education in Practice*, 6(4), pp. 199–206. <https://doi.org/10.1016/j.nepr.2006.01.001>.

Ingeç, Ş. K. (2009) 'Analysing Concept Maps as an Assessment Tool in Teaching Physics and Comparison with the Achievement Tests', *International Journal of Science Education*, 31(14), pp. 1897–1915. <https://doi.org/10.1080/09500690802275820>.

Irvine, L. M. (1995) 'Can concept mapping be used to promote meaningful learning in nurse education?', *Journal of Advanced Nursing*, 21(6), pp. 1175–117 <http://doi.org/10.1046/j.1365-2648.1995.21061175.x>.

Kassab, S. E. and Hussain, S. (2010) 'Concept mapping assessment in a problem-based medical curriculum', *Medical Teacher*, 32(11), pp. 926–931. <https://doi.org/3109/0142159x.2010.497824>.

Latif, R. A., Mohamed, R., Dahlan, A. and Nor, M. Z. M. (2016) 'Concept Mapping as a Teaching Tool on Critical Thinking Skills and Academic Performance of Diploma Nursing Students', *Education in Medicine Journal*, 8(1), pp. 66–74. <https://doi.org/10.5959/eimj.v8i1.406>.

Mintzes, J. J., Wandersee, J. H. and Novak, J. (2007) *Teaching science for understanding: a human constructivist view*. San Diego, California: Elsevier.

Nesbit, J. C. and Adesope, O. O. (2006) 'Learning With Concept and Knowledge Maps: A Meta-Analysis', *Review of Educational Research*, 76(3), pp. 413–448. <https://doi.org/10.3102/00346543076003413>.

Novak, J. D. (1990) 'Concept maps and Vee diagrams: two metacognitive tools to facilitate meaningful learning', *Instructional Science*, 19(1), pp. 29–52. <https://doi.org/10.1007/bf00377984>.

Novak, J. D. and Canas, A. J. (2006) *The Theory Underlying Concept Maps and How to Construct, Cmap*. Available at: <https://cmap.ihmc.us/docs/theory-of-concept-maps> (Accessed: 29 September 2020).

Pintoi, A. J. and Zeitz, H. J. (1997) 'Concept mapping: A strategy for promoting meaningful learning in medical

education', *Medical Teacher*, 19(2), pp. 114–121. <http://doi.org/10.3109/01421599700019363>. MedEdPublish 2020; 9:171 Last updated: 13 DEC 2021

Reigeluth, C. M. and H Jonassen, D. H. (1999) 'Designing Constructivist Learning Environments', in *Instructional-Design Theories and Models: Volume 2: A New Paradigm of Instructional Theory*. Mahwah, New Jersey: Lawrence Erlbaum Associates, pp. 51–68.

Rendas, A. B., Fonseca, M. and Pinto, P. R. (2006) 'Toward meaningful learning in undergraduate medical education using concept maps in a PBL pathophysiology course', *Advances in Physiology Education*, 30(1), pp. 23–29. <http://doi.org/10.1152/advan.00036.2005>.

Ruiz-Primo, M. A., Li, M., Ayala, C. and Shavelson, R. J. (2004) 'Evaluating students' science notebooks as an assessment tool', *International Journal of Science Education*, 26(12), pp. 1477–1506. <https://doi.org/10.1080/0950069042000177299>.

Surbhi, S. (2019) Difference Between Teaching and Training, Key Differences. Available at: <https://keydifferences.com/difference-between-teaching-and-training.html> (Accessed: 7 August 2020).

Tearle, O. (2020) *A Short Analysis of Arthur Hugh Clough's 'Say Not the Struggle Nought Availeth'*, *Interesting Literature*. Available at: <https://interestingliterature.com/2017/03/a-short-analysis-of-arthur-hugh-cloughs-say-not-the-struggle-nought-availeth> (Accessed: 5 August 2020).

Torre, D. M., Durning, S. J. and Daley, B. J. (2013) 'Twelve tips for teaching with concept maps in medical education', *Medical Teacher*, 35(3), pp. 201–208. <http://doi.org/10.3109/0142159x.2013.759644>.

West, D. C., Park, J. K., Pomeroy, J. R. and Sandoval, J. (2002) 'Concept mapping assessment in medical education: a comparison of two scoring systems', *Medical Education*, 36(9), pp. 820–826. <https://doi.org/10.1046/j.1365-292002.01292.x>.

Appendices

None.

Declarations

The author has declared that there are no conflicts of interest.

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Ethics Statement

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P Ravi Shankar

American International Medical University

This review has been migrated. The reviewer awarded 4 stars out of 5

This article starts by providing basic concepts about concept maps and then explores the use of concept maps for teaching, training, testing and thinking. The article provides basic information about concept maps in a simple and readable form supplemented by diagrams. The authors experience with concept maps is also of interest. Greater details about the use of concept maps at the author's institution will be of interest. Further details about the use of the concept maps shown in Figures 7, 8, 9 and 10 will be of interest.

Competing Interests: No conflicts of interest were disclosed.

Reviewer Report 28 August 2020

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Monika Sharma

CMC Ludhiana , India

This review has been migrated. The reviewer awarded 3 stars out of 5

Concept maps is a great concept. Many of us would remember using something like a concept map when we tried to memorize complicated patho-physiological concepts. A better understanding of how a

concept map is created would enhance learning for students at the undergraduate level. It is worth writing about it and introducing it to students. I read this article with interest and enjoyed the authors assimilation of available information about the concepts and utility of concept map. It was interesting to note their attempt of training their students to utilize concept maps. However, as this is presented as a 'case study', I was looking for more details of the 'case'. The article reads out more like a review of literature with a brief mention of what the authors did at their institute. I would like to read more about how they trained their faculty, not assuming that every one knows that perfectly. How did the faculty receive the concept of introducing concept mapping to the undergraduate students and how did the students perceive the concept? It goes without saying that a new concept impacts learning positively, hence it is too early to comment on how using concept maps as a tool for learning has been useful. Rather, I would like to read more about faculty and student feedback, if taken. The authors can consider writing a shorter introduction followed by presenting their work with concept maps and then discussing it with the available literature.

Competing Interests: No conflicts of interest were disclosed.

Reviewer Report 24 August 2020

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Nuno Neuparth

Nova Medical School

This review has been migrated. The reviewer awarded 3 stars out of 5

Writing about concept mapping is slowly becoming a more frequent topic in health education. For that reason, all the information made public about the use and experience with concept mapping, reporting undescribed experiences and supporting new approaches, is worthwhile. Recently, our group presented in MedEdPublish (2) a proposal of a template to be used in concept mapping in medical education as part of our ongoing research project in this area which was even more very recently complemented by another publication of different depth and breadth (1). In the present case, starting with a description of the use of concept mapping based on examples and figures is relevant for the local team but it needs to be reinforced by broad research questions, particularly in the area of evaluation in order to be useful for the health education community. As Pudenko et al (3) clearly state: "Current empirical research on mapping as a learning strategy presents methodological shortcomings that limit internal and external validity". In this revived and fascinating field of concept mapping, with no single solutions and multiple approaches, we are all beginners and need to humbly learn as much as we can from each other. Bibliografia 1. Marta Fonseca, Beatriz Oliveira, Pedro Carreiro-Martins, Neuparth N, and Rendas aA.

Revisiting the role of concept mapping in teaching and learning pathophysiology for medical students Adv Physiol Educ 44: 475-481, 2020.2. Marta Fonseca BO, Pedro Carreiro-Martins, Nuno Neuparth, Antonio Rendas. A concept map template to be used by medical students for displaying pathophysiological mechanisms within clinical cases MedEdPublish 9: 2020.3. Pudielko B, Young M, Vincent-Lamarre P, and Charlin B. Mapping as a learning strategy in health professions education: a critical analysis. Med Educ 46: 1215-1225, 2012.

Competing Interests: No conflicts of interest were disclosed.

Reviewer Report 23 August 2020

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Megan Anakin

University of Otago

This review has been migrated. The reviewer awarded 3 stars out of 5

I read this case study with interest because I am familiar with using concept maps as a learning tool. I appreciated reading about your experiences and recommendations about using concept maps. Health professional educators will appreciate reading the descriptions of how you used concept maps with your students. I have a few suggestions that might help to enhance your article. To help the reader appreciate the first sentence in the introduction, please consider identifying which “cognitive processes undergirding teaching- learning” and explain how they “are so distinctly dissimilar” to support your claim “that it is important to use variegated tools to enhance knowledge construction in learners”. Please consider identifying a few pedagogical changes that have been propounded and describe their strengths and limitations related to the cognitive processes they emphasise so that the reader understands why this article is focused on concept maps as an appropriate pedagogical intervention. To strengthen the section about the initiation of concepts maps, please consider using direct references Ausubel’s work to support your claims about his “meaningful learning theory”. In the section titled ‘Our experience with concept maps’, please explain the features of the evidence in the literature that supports concept mapping “as a meta-cognitive strategy that enhances meaningful learning”. Also in this section, there is a two-paragraph description of an experimental study conducted by the authors about the impact of concept mapping on student reasoning. Please consider describing the methods and results in greater detail so the reader can better assess the meaningfulness of the claims made about the experimental study’s results. To help the reader appreciate and be able to use the scoring criteria presented in the testing section of the article, please explain how a concept map would earn points in each of the four categories and why it was necessary to sum the scores from three assessors. In the conclusion, the authors note that there were

impediments. Please consider discussing these impediments in a discussion section before the concluding paragraph. In the take home messages, please consider revising each point to better represent the evidence from practice presented in this article. For example, please provide a brief reason why training students to represent their thinking in their concept maps is vitally important. To enhance the connection between the title and the beginning of the article, please consider signposting and defining the four functions of concept maps (for Teaching, Training, Testing and Thinking). Please explain also how these four functions link to cognitive processes in the introduction section of the article to prepare the reader for the examples from practice in the later sections of the article. I would be very happy to review a revised version of this article and I would like to encourage you to submit one.

Competing Interests: No conflicts of interest were disclosed.

Reviewer Report 19 August 2020

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Richard J. Nierenberg

Hackensack University Medical Center, Hackensack Meridian Health

This review has been migrated. The reviewer awarded 4 stars out of 5

This is an interesting introduction and summary of the notion of concept mapping to educate students in determining and organizing information to develop expertise. There is a somewhat lengthy introduction of the concept leading to several linked proprietary websites which are instructive. This introduction could have been more streamlined. The initial chart, which includes concepts along with authors in the place of concepts does not further the concept as well as subsequent charts. The strength of the article seems to be in its demonstration of the nuts and bolts of a concept map. This is introduced with a black board image of the analysis of hypertension, which is stimulating but hard to assess. The more comprehensive chart is, however, done with the orthodontic literature, which limits its application somewhat. I believe if the authors took either one of those charts and in narrative form "walked us through" how the use of the concept map would broaden understanding for a student and therefore aspiring expert would make the article even more useful. Still it is a comprehensive, and enticing introduction and presentation of an interesting and engaging pedagogical process, and worth the read.

Competing Interests: No conflicts of interest were disclosed.
