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Enhancing anatomy learning: A concept map-based approach for first-term MBBS students

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Abstract

Background: The complexity of the subject content, and its 3D orientation in anatomy makes students difficult to learn, assimilate, and recapitulate the topics. There is a need for innovative teaching methods in anatomy for better understanding of the subject and improved performance of students. In this context, an attempt is made to use concept maps as a tool for learning anatomy.

Material and methods: After obtaining ethical committee approval and informed consent, 128 first-term MBBS students were divided into 2 groups, 64 in the study and the control group. After the lecture on each topic from anatomy (radial nerve, median nerve, and ulnar nerve), a pre-test was conducted on 128 MBBS students. Post-test multiple-choice questions-based assessment was conducted for both groups after 1 week of each lecture. Difference in knowledge by comparing the assessment scores of the study group and control group. A feedback form with a 5-point Likert scale was administered to all students at the end of 3 sessions. Mann−Whitney *U*-test and Wilcoxon signed-rank test were applied to check the significance ($p \leq .01$) of the results.

Results: There was a statistically significant difference between the 2 groups during the pre-test for cognition, and total scores and the post-test for recall, cognition, and total scores. 98% of students perceived that the concept map-based approach helped better retain the topic.

Conclusions: Concept maps promote comprehensive learning and applying knowledge in new situations. From this study, we recommend that concept mapping can be a pedagogical tool in Anatomy.

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Mejora del aprendizaje de anatomía: Un enfoque basado en mapas conceptuales para estudiantes de MBBS del primer trimestre

Resumen

Antecedentes: La complejidad del contenido de la asignatura y su orientación 3D en Anatomía dificulta que los estudiantes aprendan, asimilen y recapitulen los temas. Existe la necesidad de métodos de enseñanza innovadores en Anatomía para una mejor comprensión de la materia y un mejor rendimiento de los estudiantes. En este contexto, se intenta utilizar los mapas conceptuales como herramienta para el aprendizaje de Anatomía.

Material y métodos: Después de obtener la aprobación del comité ético y el consentimiento informado, 128 estudiantes de primer semestre de MBBS se dividieron en 2 grupos, 64 en el estudio y el grupo control. Después de la conferencia sobre cada tema de Anatomía (nervio radial, nervio mediano y nervio cubital), se realizó una prueba previa a 128 estudiantes de MBBS. Se realizó una evaluación posterior a la prueba basada en MCQ para ambos grupos después de una semana de cada conferencia. Diferencia en el conocimiento al comparar las puntuaciones de evaluación entre el grupo de estudio y el grupo de control. Se administró a todos los estudiantes un formulario de retroalimentación con una escala Likert de cinco puntos al final de 3 sesiones. Se aplicaron la prueba U de Mann Whitney y la prueba de rangos con signo de Wilcoxon para comprobar la significancia ($p \le 0,01$) de los resultados.

Resultados: Hubo una diferencia estadísticamente significativa entre los dos grupos durante la prueba previa de cognición y puntuaciones totales y la prueba posterior de memoria, cognición y puntuaciones totales. El 98% de los estudiantes percibió que el enfoque basado en mapas conceptuales ayudó a retener mejor el tema.

Conclusiones: Los mapas conceptuales promueven el aprendizaje integral y la aplicación del conocimiento en situaciones nuevas. A partir de este estudio, recomendamos que los mapas conceptuales pueden ser una herramienta pedagógica en Anatomía.

Introduction

A concept map is a visual organization and representation of knowledge. It shows concepts, ideas, and the relationship of the subject. Students write keywords onto sticky notes and then organize them into a flowchart.[1] Concept mapping is a great way to build upon previous knowledge by relating new information to existing knowledge. When new knowledge is integrated with and connected to existing knowledge, the new knowledge is easier to understand and remember. Novak and Govin developed concept mapping based on Ausubel's learning theory.[2]

The medical curriculum proposed by NMC in 2019 emphasizes self-directed learning as a part of the learning process. A significant attempt has been made in the outcome-driven undergraduate curriculum to provide the orientation and the skills necessary for life-long learning and to enable proper care of the patient. The educators need to know about the process of teaching and making learning easy for the students. The new curriculum recommended by the Medical Council of India for undergraduate medical education emphasizes the competencies, where various domains of teaching learning methods, and assessment form the framework of competencies.[3] Concept maps have been used to develop the knowledge of students in the basic sciences and this can be integrated with clinical sciences.[2]

The conceptualization through concept maps allows students to in-depth learning and allows the learner to identify relationships between seemingly isolated concepts while developing a cohesive knowledge structure.[4] Students' learning strategy and their achievement would improve through concept mapping compared to the traditional method as reported.[5] The concept map method of study helps students in self-directed learning to integrate and connect various bits of information related to the subject. It facilitates the development of clinical reasoning and promotes interprofessional education, thereby enhancing collaborative skills and improving the overall learning experience.[6] The complexity of the subject content and its 3D orientation in anatomy makes students difficult to learn, assimilate, and recapitulate. It requires motivation to keep them interested in learning anatomy. Traditional didactic lectures will not involve the effective participation of students in learning anatomy and retention of knowledge. In this context, an attempt is made to use concept maps as a tool for learning anatomy.

Material and method

A mixed-methods interventional study with feedback was carried out in the Department of Anatomy. Ethical approval was obtained from the Institution's Ethics Committee. Informed consent was obtained from 128 first-year MBBS students (2022−2023 batch) who participated in the study. The students were divided into 2 groups, with 64 individuals in the study and control groups. Following lectures on each topic from Anatomy
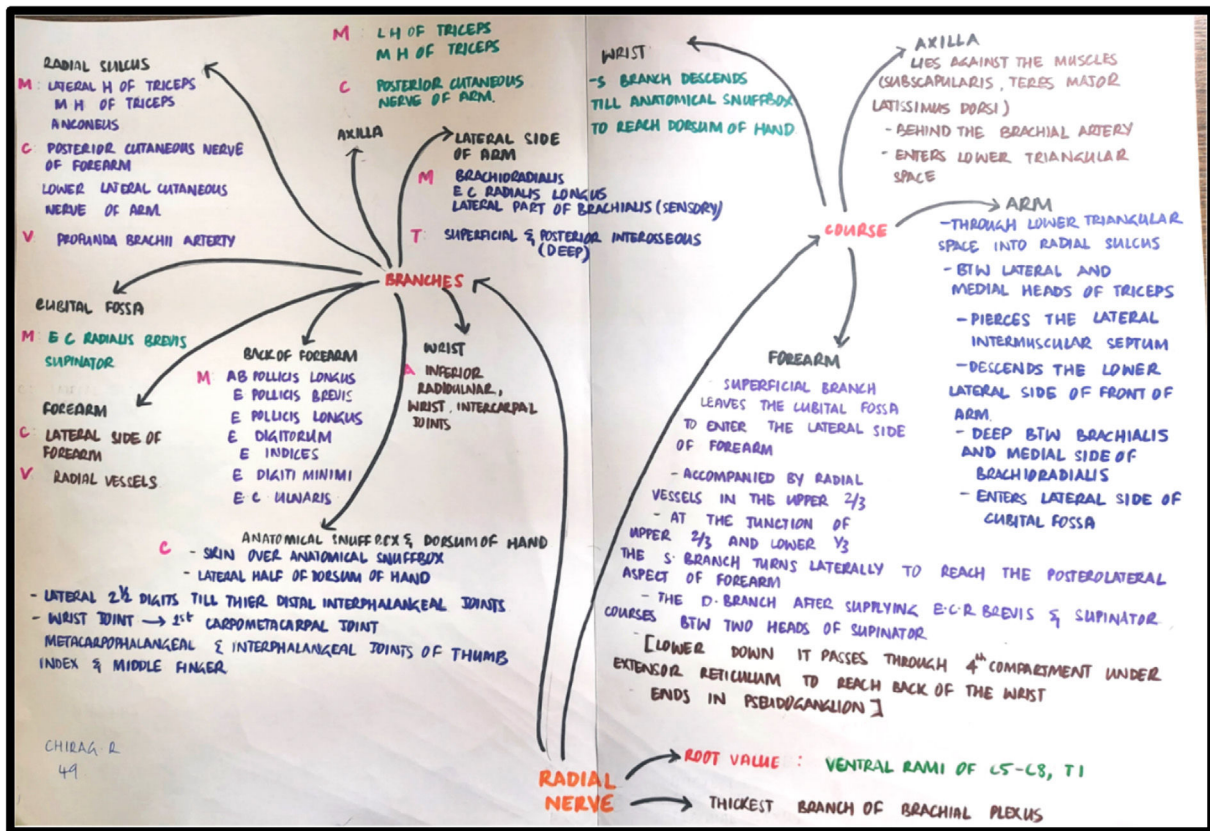
Fig. 1 Showing concept map of radial nerve details developed by the student.

(Radial nerve, Median nerve, and Ulnar nerve) for both groups, a pre-test was administered to assess the baseline knowledge of all 128 MBBS students. Subsequently, the study group, after receiving prior sensitization on concept maps, was tasked with preparing concept maps (Fig. 1). Post-test assessments consisting of multiple-choice questions (MCQs) were administered to both the study and control groups 1 week after each lecture. These assessments aimed to evaluate the difference in knowledge by comparing the assessment scores of the study group and the control group based on their recall of the topic. Google feedback form, consisting of validated questions on concept maps with a 5-point Likert scale, was administered to the study group after 3 sessions. The form was provided via the Google Forms website tool.

Statistical analysis

Data were entered in the MS Excel sheet and analyzed using SPSS version 22 (licensed to JSS AHER). Mann–Whitney U test and Wilcoxon signed rank test were applied to check the significance ($p \leq .01$) of the results. Non-parametric tests were used for interpretation of the data. Descriptive statistics were used to analyze the perceptions of the students.

Results

Among the 64 participants, 30 (46.9%) were females and 34 (53.1%) were males in the study group, while the control group consisted of 37 (57.8%) females and 27 (42.2%) males.

A statistically significant difference was found for recall, cognition, and total scores within the same group, i.e., study and control group ($p < .001$) (Table 1). While there was no statistically significant difference in recall scores before the intervention between the study and control groups, there was a significant statistical difference between the 2 groups in pre-intervention for cognition and total scores, as well as

Table 1 Differences in scores within the group.

Variable	Study group		Z value	p-value*
	Pre-intervention	Post-intervention		
Recall score	4 (3–4)	8 (6–10)	−6.997	<.001
Cognition score	4 (3–5)	8 (7–8)	−7.001	<.001
Total	8 (6–9)	16 (14–18)	−6.985	<.001
Variable	Control group		Z value	p-value*
	Pre-intervention	Post-intervention		
Recall score	4 (3–4)	6 (5–6)	−6.777	<.001
Cognition score	3 (2–4)	5 (4–6)	−5.981	<.001
Total	7 (5–8)	10 (10–12)	−6.934	<.001

Table 2 Difference in scores between the study and control group.

Variable	Group		Z value	p-value*
	Study group	Control group		
Recall - At the time of pre-test	4 (3−4)	4 (3−4)	−1.431	.152
Recall -At the time of post-test	8 (6−10)	6 (5−6)	−3.835	<.001
Cognition - At the time of pre-test	4 (3−5)	3 (2−4)	−4.462	<.001
Cognition - At the time of the post-test	8 (7−8)	5 (4−6)	−7.238	<.001
Total score at the time of pre-test	8 (6−9)	7 (5−8)	−8.679	<.001
Total score at the time of the post-test	16 (14−18)	10 (10−12)	−9.533	<.001

post-intervention for recall, cognition, and total scores (Table 2).

95% of students opined that concept maps helped in understanding the topic better and improved rational thinking. 98% of students opined that concept maps helped to correlate the applied aspect of the given topic and better retention of the topic. 65% of students strongly agreed that developing concept maps is time-consuming and other details are shown in Fig. 2.

Discussion

The rapid changes in the medical field and the need for future health professionals to be competent necessitate students to learn in meaningful and integrated ways. Concept maps, in medical education, have been used to develop the knowledge structures of students in the basic sciences and this can be integrated with clinical sciences.[2] The conceptualization through concept maps allows students to learn in-depth and allows the learner to identify relationships between seemingly isolated concepts while developing a cohesive knowledge structure.[4] Students' learning strategy and their achievement would improve through concept mapping compared to the traditional method as reported.[5] In the present study after obtaining feedback on concept maps, 95% of students opined that concept maps helped in understanding the topic better and improved rational thinking. 98% of students opined that concept maps helped to correlate the applied aspect of the given topic.

In the present study, total scores of post-tests were higher in both the study group and control group compared to the pre-test. Mukhopadhyay et al. conducted a study for second-year medical students to compare traditional tutorial and concept map methods and authors reported significant improvement in student performance in both groups in the post-test compared to the pre-test.[7] In the present study, both the groups also scored better compared to pre-test. Mahindra Kumar et al. stated that concept maps for neuroanatomy for teaching students and reported that students performed better in high cognitive type MCQs compared to lecture and demonstration methods and stated that there was significant improvement of knowledge.[8]

In the present study, post-test cognitive scores were higher in both groups compared to pre-test scores which are under to present study. Nicoara et al. researched 505 students from the Department of General Medicine who were randomly selected and divided into groups, to observe changes in the grades they obtained when learning anatomy
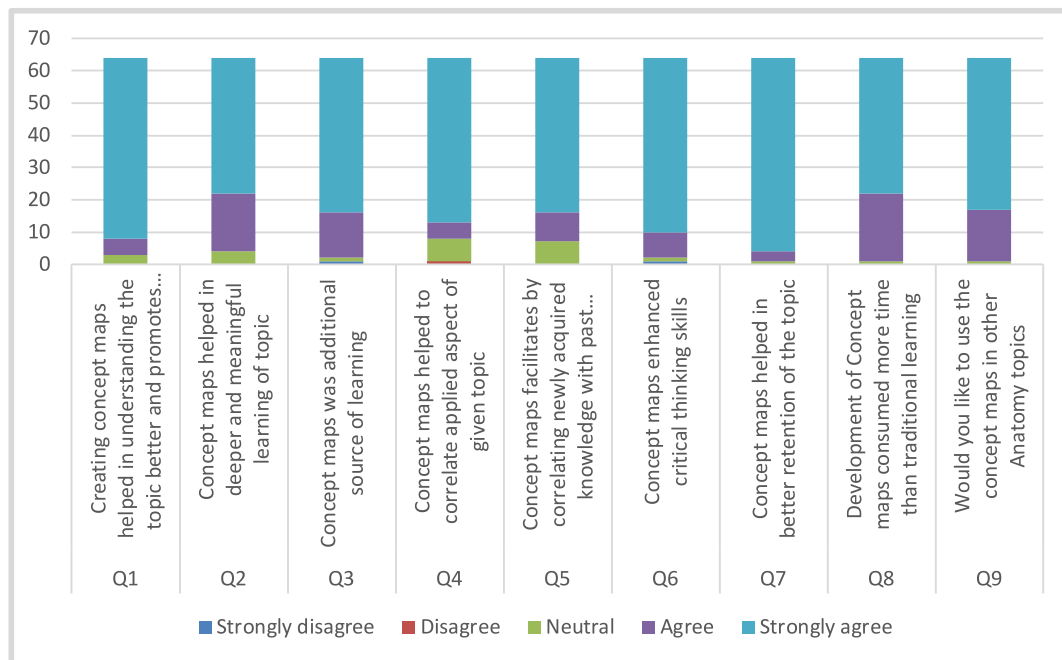
Fig. 2 Perception of students (study group) toward concept mapping.

with the concept mapping method versus traditional methods. The results were statistically significant, and scores were higher in the study group.[9]

Farida Qadir et al. used concept maps in topics for CNS pharmacology during tutorial sessions for 50 BDS students and scores obtained were compared between the study and control groups. MCQ test of the control group showed a mean grade of $57.1 + 16.7$ versus the test group's mean of $58.8 + 13$. For the short essay questions, the control group obtained a mean of $52.3 + 18.8$ versus the test group's mean grade of $53.8 + 22.5$. The results were not significantly different $p > .05$. However, feedback about concept mapping showed that the technique helped the students to conceptualize difficult topics in CNS and was beneficial in preparing for exams.[10]

Concept maps can be used in various domains of medical education both for undergraduate as well as post-graduate student learning activities. It involves identifying the topic, brainstorming ideas, organizing the concept, and ultimately linking the conceptual ideas to create a meaningful and rational outcome.[11] Concept maps create a rational link between the knowledge contents delivered through conventional classroom teaching. Comparing the outcome of pre- and post-test underscores our study showing the ease of synchronizing the basic science knowledge toward clinical case understanding and its hypothetical application in scenario-based case learning which is facilitating its comprehensive utility.

Limitation of the study

The study's applicability could be limited to the specific group of first-term MBBS students and its focus on short-term outcomes. Due to the time-consuming nature of creating concept maps by students, we restricted the evaluation to just 3 topics to assess its efficacy in teaching anatomy.

Concept maps provide a tool for spatial representation of content which helps in retention of memory and promotes comprehensive learning. Enhances the retention of the subject and allows the integration of diverse anatomical concepts. Our study scores signify the meaningful concept application in learning anatomy among students, showing consistency in the outcome of the study. From this study, we recommend that concept mapping can be a pedagogical tool that could be applied to a few more topics in anatomy.

Source(s) of support

Nil.

Presentation at a meeting

Nil.

Ethical responsibilities

This study was approved by the Institutional ethics committee, JSS medical college (approval number: ECR/387/Inst/

KA/2013/RR-19). All participants provided informed consent to participate in the study through each online survey submitted.

Declaration of competing interest

Nil.

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