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ENHANCING MEDICAL EDUCATION USING CHATGPT- GENERATED CONCEPT MAPS

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I. INTRODUCTION

Medical education is a cognitively demanding endeavor due to its expansive curriculum covering fundamental biological and chemical principles as well as practical clinical applications. Often, students struggle to assimilate and retain the immense volumes of information presented to them efficiently. While conventional lectures provide a systematic framework, they tend to convey facts in isolation, failing to facilitate intuitive connections between topics. This highlights the pressing need for groundbreaking pedagogical tactics that instill deep comprehension and durable retention (Sadeghi et al., 2014).

Concept maps are widely accepted as a powerful educational tool, offering a structured framework to methodically arrange and interweave concepts. By visually portraying relationships, these maps foster integrative thinking and analytical reasoning. However, manually generating well-formed concept maps can demand significant time commitments, especially for educators managing bloated enrollments. Alternatives are sought that retain concept maps' benefits while automating production to ease the load on instructors.(Baliga et al., 2021; Al Rashid et al., 2024; Al Rashid & Rahman, 2023).

II.GENERATING CONCEPT MAPS WITH ChatGPT

A crucial step in creating effective concept maps is selecting relevant medical content. Topics such as pharmacological classifications, physiological processes, clinical management pathways, and anatomical structures lend themselves well to concept maps. Educators can source core concepts from textbooks, lecture notes, or reputable online references. Additionally, Optical Character Recognition (OCR) can help convert printed materials into digital text, facilitating AI-based processing (Masters et al., 2025).

Providing clear and specific prompts is essential for generating well-structured concept maps with ChatGPT. Vague prompts may yield incomplete or suboptimal outputs. For instance, an educator teaching hematology might use the following prompt:

"Create a concept map for anemia, including its classification (microcytic, normocytic, macrocytic), underlying causes, clinical manifestations, diagnostic evaluations, and therapeutic interventions."

By structuring content hierarchically, ChatGPT enables seamless integration into medical curricula, allowing educators to refine and validate AI-generated maps before implementing them in instruction.

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III. STRUCTURING AND REFINING CONCEPT MAPS

Effective concept maps follow a hierarchical format, with a central node representing the primary topic and sub-nodes branching into key components (Masters et al., 2025).

For example:

- Central Node: Diabetes Mellitus
    - Sub-Nodes:
        - Types: Type 1, Type 2, MODY, Gestational Diabetes
        - Pathophysiology: Insulin Deficiency, Insulin Resistance
        - Clinical Features: Polyuria, Polydipsia, Weight Loss
        - Diagnosis: Fasting Blood Glucose, HbA1c, OGTT
        - Management: Lifestyle Modifications, Oral Hypoglycemics, Insulin Therapy

Educators must critically review and validate AI-generated content to ensure accuracy and relevance. While ChatGPT effectively structures information, verification against trusted medical sources is essential to avoid errors.

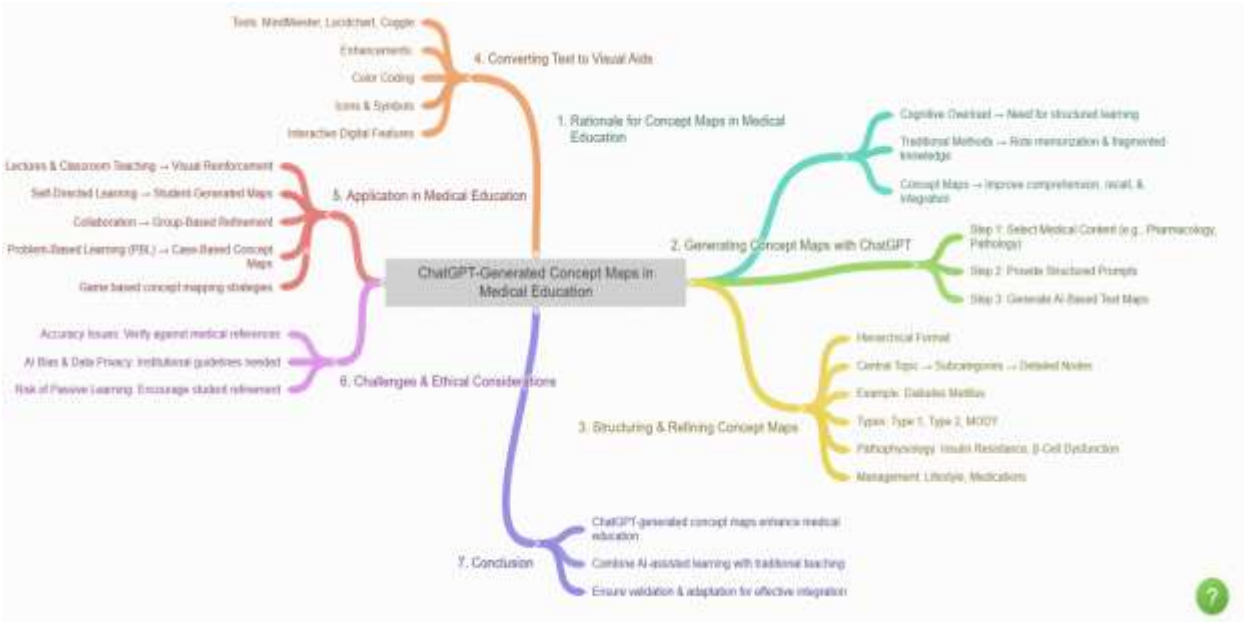

Figure 1. ChatGPT-Generated Concept Maps in Medical Education

IV. TRANSFORMING TEXT-BASED MAPS INTO VISUAL AIDS

While ChatGPT produces text-based concept maps, converting them into visual representations enhances their effectiveness. Educators can use digital tools such as MindMeister, Lucidchart, or Coggle to create visually engaging maps (Masters et al., 2025). [Figure 1]

For instance, a ChatGPT-generated concept map on respiratory diseases can be enriched with:

- Color coding to differentiate obstructive, restrictive, and infectious conditions
- Icons and symbols to highlight critical risk factors
- Interactive digital elements to facilitate self-paced learning

V. INCORPORATING CONCEPT MAPS INTO LECTURES AND SELF-DIRECTED LEARNING

Concept maps serve as valuable instructional aids for structuring lectures and discussions. When integrated into classroom teaching, they provide visual reinforcement of complex concepts. For example, during a session on antimicrobial therapy, a concept map illustrating drug classifications, mechanisms of action, therapeutic applications, and resistance patterns can enhance students' comprehension efficiency (Baliga et al., 2021; Al Rashid et al., 2024; Al Rashid & Rahman, 2023).
Additionally, self-directed learning can be strengthened by encouraging students to generate their own concept maps using ChatGPT. Educators can guide students in crafting precise prompts and critically evaluating AI-generated content.

Example Activity:

- Assign students to develop a concept map on liver diseases using the prompt: *"Generate a concept map outlining types of liver diseases, etiologies, clinical presentations, diagnostic methodologies, and treatment options."*
- Facilitate peer discussions to refine and enhance the maps collaboratively.

VI. ENCOURAGING COLLABORATION AND GROUP ACTIVITIES

Collaborative learning is fundamental in medical education. AI-generated concept maps can support group-based discussions and problem-solving exercises. Educators can assign topics and provide AI-generated templates for students to refine collaboratively.

Example:

- Divide students into groups, assigning topics such as hypertension, myocardial infarction, or sepsis.
- Encourage students to expand and validate AI-generated concept maps using external references and faculty guidance.

This interactive approach fosters teamwork, knowledge sharing, and a deeper grasp of medical subjects.

VII. INTEGRATING CONCEPT MAPS WITH PROBLEM-BASED LEARNING (PBL)/ CASE-BASED LEARNING

Problem-based learning (PBL) is a cornerstone of modern medical education, emphasizing student-driven case analysis. AI-generated concept maps complement PBL by structuring clinical case evaluations systematically.

For instance, a session on diabetic ketoacidosis (DKA) can include a concept map covering:

- Pathophysiology: Insulin Deficiency, Ketogenesis, Acidosis
- Clinical Manifestations: Polyuria, Dehydration, Kussmaul Breathing
- Diagnostic Approach: Arterial Blood Gas, Serum Ketones, Anion Gap Calculation
- Management Strategies: IV Fluid Resuscitation, Insulin Therapy, Electrolyte Correction

Concept maps provide a framework for students to visualize and systematically approach case-solving, reinforcing critical thinking and clinical reasoning skills.

Case-Based Learning (CBL) is more faculty-guided, focusing on structured discussion of real-world patient cases, encouraging clinical decision-making.

In CBL, students analyze a guided case scenario, discuss potential diagnoses, and apply treatment protocols using concept maps, promoting structured learning and clinical pattern recognition.

By integrating concept maps into both PBL and CBL, medical students can visually organize case elements, improve clinical reasoning, and enhance retention of key concepts.

VIII. INTEGRATING CONCEPT MAPPING WITH GAMING STRATEGIES

Gamification in medical education enhances engagement, motivation, and active learning. Integrating concept maps with gaming strategies can transform traditional learning into an interactive and enjoyable experience while reinforcing critical thinking and knowledge retention.

Examples of Gamified Concept Mapping Approaches

1. Concept Map Quiz Challenges
    - Students are given incomplete concept maps related to a topic (e.g., Antibiotics, Cardiovascular Pharmacology, Endocrine Disorders).
    - They must fill in missing components (e.g., drug names, mechanisms, side effects) within a time limit.
    - Points are awarded for accuracy and speed.
    - Example: “Complete the Concept Map” Challenge for Antibiotic Classes
        - Categories: Mechanism of Action | Spectrum of Activity | Adverse Effects
        - Teams compete to complete the missing nodes correctly.
2. Escape Room with Concept Maps
    - A medical escape room where students solve clinical puzzles using concept maps.
    - Each correct answer unlocks a part of the next case clue.
    - Example: Sepsis Management Escape Room
        - Students must arrange a concept map of sepsis pathophysiology and treatment to “escape” the septic shock scenario.

3. Concept Map-Based Role-Playing Game (RPG)
    - Students take on roles (e.g., physician, pharmacist, nurse) and navigate clinical decision-making through an evolving concept map.
    - Example: Emergency Department RPG
        - A patient with multiple co-morbidities presents with hypoglycemia.
        - Teams build a concept map of differential diagnoses and management while "treating" the patient in real-time.
        - Correct choices expand the map, while incorrect ones lead to complications in the case.
4. Jeopardy-Style Concept Mapping
    - Students answer questions in a Jeopardy format, but instead of simple responses, they build or modify a concept map based on the correct answer.
    - Example: Pharmacology Jeopardy
        - Categories: Drug Mechanisms, Side Effects, Interactions
        - Each correct answer expands the concept map, visually demonstrating connections between topics.
5. Battle of the Concept Maps
    - Teams are given a clinical scenario and must create the most comprehensive concept map within a given time.
    - Faculty or peers vote on the best-structured and most logical map.
    - Example: Battle of the Concept Maps – Shock Types
        - Teams develop a concept map comparing Hypovolemic, Cardiogenic, Distributive, and Obstructive Shock.
        - The best organized and detailed map wins the round.

By integrating gaming strategies with concept mapping, educators can create a dynamic learning environment that fosters critical thinking, active learning, and clinical reasoning in medical education.

IX. ADDRESSING CHALLENGES AND ETHICAL CONSIDERATIONS

Despite its benefits, AI-generated concept maps present challenges, including potential factual inaccuracies, lack of depth in complex topics, and student over-reliance on AI-generated materials. To mitigate these issues, educators should:

1. Verify AI-generated content against standard medical references.
2. Enhance contextual relevance by integrating real-world clinical applications.
3. Supplement AI-generated maps with case discussions and traditional learning materials.

Ethical concerns such as data privacy, AI biases, and the risk of passive learning must also be considered. Institutions adopting AI-driven tools should implement guidelines to ensure responsible use and continuous quality assessment.

X. CONCLUSION

ChatGPT-generated concept maps present an innovative avenue for organizing and delivering medical knowledge. By improving content structuring, fostering active learning, and promoting student engagement, AI-assisted concept maps significantly enhance medical education. However, their implementation requires careful validation and adaptation to maintain educational integrity. When integrated with traditional teaching methods, PBL, CBL, and game-based learning, AI-generated concept maps offer a scalable and effective strategy for strengthening comprehension, retention, and clinical application in medical training.

Notes on Contributors

Sulthan Al Rashid was responsible for the conceptualization, scientific content, data collection, and manuscript preparation.

Madhusudhan B played a valuable role in manuscript preparation, editing, and proof reading.

Ethical Approval

Ethical approval is not required since this study does not involve human participants.

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Declaration of Interest

The authors confirm that they have no conflicts of interest to disclose.

REFERENCES

1. Al Rashid, S. and S.Z. Rahman, Pharmacology Teaching by Concept Map Method. *Bangladesh Journal of Medical Science*, 2023. **22**(4): p. 942-944.
2. Al Rashid, S., et al., Enhancing concept map teaching technology with student's handwritten concept map notes. *The Asia Pacific Scholar*, 2024. **9**(4): p. 71. DOI: 10.29060/TAPS.2024-9-4/CS3161.
3. Baliga, S.S., P.R. Walvekar, and G.J. Mahantshetti, Concept map as a teaching and learning tool for medical students. *Journal of education and health promotion*, 2021. **10**(1).
4. Masters K, MacNeil H, Benjamin J, Carver T, Nemethy K, Valanci-Aroesty S, Taylor DCM, Thoma B, Thesen T. Artificial Intelligence in Health Professions Education assessment: AMEE Guide No. 178. Med Teach. 2025 Jan 9:1-15. doi: 10.1080/0142159X.2024.2445037. Epub ahead of print. PMID: 39787028.
5. Sadeghi R, Sedaghat MM, Sha Ahmadi F. Comparison of the effect of lecture and blended teaching methods on students' learning and satisfaction. J Adv Med Educ Prof. 2014 Oct;2(4):146-50.