
Effect of Digital Mind Map Strategy versus Traditional Approach on Nursing Students' knowledge about Urinary Tract Infection

Mahitab Mohamed Ahmed¹, Esraa Hassan Ismail² & Ali Dabo Soliman³

¹ Lecturer of Nursing Administration, Faculty of Nursing, Suez Canal University, Egypt,

² Lecturer of Adult Health Nursing, Faculty of Nursing, Suez Canal University, Egypt.

³ Lecturer of Nursing Administration, Faculty of Nursing, Kafr Elsheikh University, Egypt

Abstract

Background: Digital mind map is a technology increasingly used as a visual tool in education. In today's digital environment, the digital mind map has several benefits for learners, teachers, and professionals. **Aim:** This study examined the effects of a digital mind map strategy compared with a traditional approach on nursing students' knowledge about urinary tract infection. **Design:** A randomized controlled trial with a posttest for the control group (traditional lecture) and the experimental group (digital mind map strategy). **Setting:** This study was conducted at the Faculty of Nursing, Suez Canal University. **Participants:** A random sample of (N=241 students) was selected from second-year nursing students, (128) as a control group and (113) as a study group. **Methods:** Two instruments were used to collect data: a knowledge assessment questionnaire to assess cognitive skills and a satisfaction questionnaire to assess students' level of satisfaction with each educational strategy. **Results:** The results show that students taught using the digital mind-mapping strategy performed better on the cognitive exam than those taught in the traditional way (p=0.001). They were also more satisfied than the control group (p=0.001). **Conclusion:** This study focused on using technology, which is now more readily available, to teach nursing students using an innovative teaching strategy as the digital mind map strategy improved their knowledge and increased their satisfaction. **Recommendation:** The study recommends adding digital mind maps to the other methods of teaching strategies in nursing schools to improve students' cognitive skills and critical thinking.

Keywords: Digital Mind Map, Nursing Students, Traditional Approach & Urinary Tract Infection.

Introduction

Urinary Tract Infections (UTIs) are the second most common bacterial infection worldwide (Pezeshki Najafabadi et al., 2018). In Egypt, the reported ICU-onset infections were UTIs at 15%, with a Catheter-associated Urinary Tract Infections (CAUTI) rate of 3.1 per 1,000 patient days in trauma ICU (Talaat et al., 2016).

Emerging antibiotic resistance against common uropathogens has become a significant problem for UTI care in recent years. The severity of this issue is exacerbated in low- and middle-income countries, where the indiscriminate and irrational use of antimicrobials is a widespread practice that hastens the emergence of antimicrobial resistance (Van Driel et al., 2019).

Antimicrobial Resistance (AMR) occurs when an antimicrobial known to kill the microorganism is no longer working (CDC, 2020). The current number of AMR-related deaths is about 700000 per year, predicted to reach 10 million per year in 2050 (WHO, 2019). Besides that, it affects countries' economic status (WHO, 2020). AMR is the most vigorous adverse effect of healthcare. The acquired infection rate indicates the integrity of the infection control system, patient safety issues, and quality of healthcare provided (Gupta & Rokade, 2016; Monegro, et al.,

2020; WHO, 2017).

Nurses are responsible for inserting, caring for, and removing the indwelling catheter, representing 75% of UTI causes (CDC, 2017). So, they must be well-trained and educated and apply evidence-based practices to prevent UTIs (Gray et al., 2016). Redesigning learning methodologies is essential to fulfilling nursing students' aspirations for an admirable and fulfilling classroom experience in today's educational settings (Barkley & Major, 2020). Faculty need to modify outdated teacher-centered educational strategies. Providing educational opportunities that promote critical thinking, problem-solving, knowledge acquisition, and reflection is crucial (Brookfield, 2015; Gourlay & Oliver, 2018). The conventional lecture method is one of the earliest ways that is described as a teacher-centered educational strategy where information is imparted by the teachers and is passively recognized by the students (Samuelson et al., 2017). Due to the lack of opportunities for active participation, the lecture-teaching approach is seen as uninteresting. However, combining information technology tools may become effective (Fulford & Mahon, 2018).

Mind maps educational strategy helps users convey their ideas in front of the class more readily, increase their capacity to remember knowledge and foster

creative thinking. It is also a method for generating ideas, collecting notes, developing thoughts, and strengthening memory. It aids students in developing clarity of thought and lays the groundwork for in-depth knowledge concerning their course topic, literature review, and conceptual framework. Additionally, it promotes learning desire and interest while enhancing learning process effectiveness (Kotcherlakota, et al., 2013; Murley, 2007; Tavares, et al., 2021; Wu & Wu, 2020).

There are two types of mind maps: first, traditional mind maps that are created by hand using a pen and paper or on a whiteboard, and the other type, Electronic or digital mind maps that use the same techniques but through computer software to create flow branches of ideas that originate from the central one (Abdulbaset, 2016).

Digital mind maps provide learner and teacher feedback and real-time engagement. Using the digital platform, users may add pictures, photos, and connections to other websites to enhance their course material (Aydogdu & Güyer, 2019). Additionally, it makes building and revising concepts easier, emphasizing knowledge construction (Aydogdu & Güyer, 2019; Gijlers & de Jong, 2013; Tavares et al., 2021). However, there are not enough research articles investigating digital mind maps educational strategies to enhance teaching like traditional mind maps (Mammen, 2016). So, the current research aim is to explore the effect of the digital mind map strategy versus the traditional approach on nursing students' knowledge about urinary tract infections.

Through the following hypotheses:

H1: Using a digital mind map strategy is more effective than traditional education on students' acquisition of theoretical knowledge.

H2: Using a digital mind map strategy leads to greater student satisfaction than traditional education.

Operational definition

Mind Map Strategy: This brainstorming approach enables users to break down large subjects into component subtopics and related themes (Kernan et al., 2018).

Digital Mind Maps are the application of the same steps of a mind map using computer software that automatically generates flow branches of ideas derived from the central one (Abdulbaset, 2016).

Methodology

Study Design

An experimental research design (randomized controlled trial) with posttest only to both the control group (traditional lecture) and the intervention group (digital mind map).

Setting

The study was conducted at the Faculty of Nursing, Suez Canal University.

Participants

Nursing students registered in the 1st semester of the second year and enrolled in the adult nursing course. The study sample size was determined based on G*power version 3.1.9.6 (Faul et al., 2007), using the following parameters: effect size (f^2) = 0.5; α = .05; and power = 0.95 according to the following equation: $n = (Z\alpha)^2 \times pq/d^2$. After adding 20% dropout, the sample became 260 out of 500 randomly selected using a computer-generating record. They were randomly divided into two equal groups. Finally, only (128) students from the control group and (113) from the experimental group finished the post-test questionnaires.

Study tools:

Tool I. Knowledge assessment questionnaire, which was composed of two parts:

Part 1: Student's personal information that included information about the nursing students, such as age, gender, and place of residence.

Part 2: Nursing students' knowledge assessment questionnaire about UTIs that the researchers developed to gauge students' knowledge about UTIs definition, clinical manifestations, causes and risk factors, nursing care for the infected patients, and prevention methods. There were 20 questions, 5 true or false and 15 multiple choice questions developed based on the literature review and categorized into the higher and lower order of thinking questions according to the revised Bloom's taxonomy. One mark was awarded for a correct response and (zero) for an incorrect answer. Scores range from 0 to 20, with 0 being the lowest and 20 denoting the highest.

Tool II. Students' satisfaction questionnaire:

It was composed of ten items developed by the researchers based on previous researches (Wu & Wu, 2020; Yildizli & Şimşek, 2020). It was used to determine how satisfied the two groups were with the selected teaching strategies. Each item was given a score on a 5-point Likert scale ranged from 1 to 5, with 5 for strongly agree and 1 for strongly disagree. The score ranged from 10 to 50, with 50 grades denoting the best result and 10 grades the worst.

Ethical Considerations

The students were asked to thoroughly read the informed consent letter before participating in the study, which included the following information: a confirmation that their participation was anonymous with confidentiality for the data collected; give them an overview of the study's objectives, an assurance that answering the questions would not cause undue hardship; and their scores would not affect their semester or final grades. They had the option to

withdraw from the study participation at any time. The Research Ethical Committee of the Faculty of Nursing, Suez Canal University revised the research proposal with approval NO. (155/6-2022).

Pilot Study

It was conducted on 10% of the study sample (N=26 students) to assess the tools' clarity and applicability and identify any difficulties they may face during the current study. In addition, the time needed to answer the tools were also estimated. The required modifications were made. To avoid data duplication, students included in the pilot study were excluded from the current study by omitting them from the computer-generating record.

Data Collection

Data were collected from the mid to the end of October 2022, spanning two weeks. After gathering the students, the researchers split them randomly into two groups (130 students), gave them an overview of the study, and obtained their permission to participate in the study.

During the first week, a three-hour lecture using PowerPoint presentation about UTIs was given to the control group. Immediately after the lecture, the participants were asked to complete the satisfaction questionnaire.

In the first week, the researchers gave an hour presentation about the digital mind map strategy to the experimental group. This additional presentation included the significance, types, features, and applications used to design digital mind maps. The identical three-hour lecture given to the control group was also given to the experimental group. However, it was provided via the digital mind map strategy instead of a PowerPoint presentation, as shown in (figure 1). After that, the students were asked to complete the satisfaction questionnaire. Finally, in the second week, the researchers requested all the study students to answer the knowledge assessment questionnaire concurrently.

Results

Table (1): Participants' personal information (N = 241).

Participant characteristics	Mind-map (Experimental group) N=113	Traditional Education (Control group) N=128	χ^2	P value
Age:				
Maximum	18.00	18	1.158 ^a	.248
Minimum	21.00	21		
Mean, (\pm SD)	18.86 (\pm .61)	18.96 (\pm .63)		
Sex:			.009	.923
Male	42 (37.2%)	48 (37.5%)		
Female	71 (62.8%)	80 (62.5%)		
Place of residence:			.654	.419
Urban	61 (54%)	77 (60.2%)		
Rural	52 (46%)	51 (39.8%)	.654 ^a	

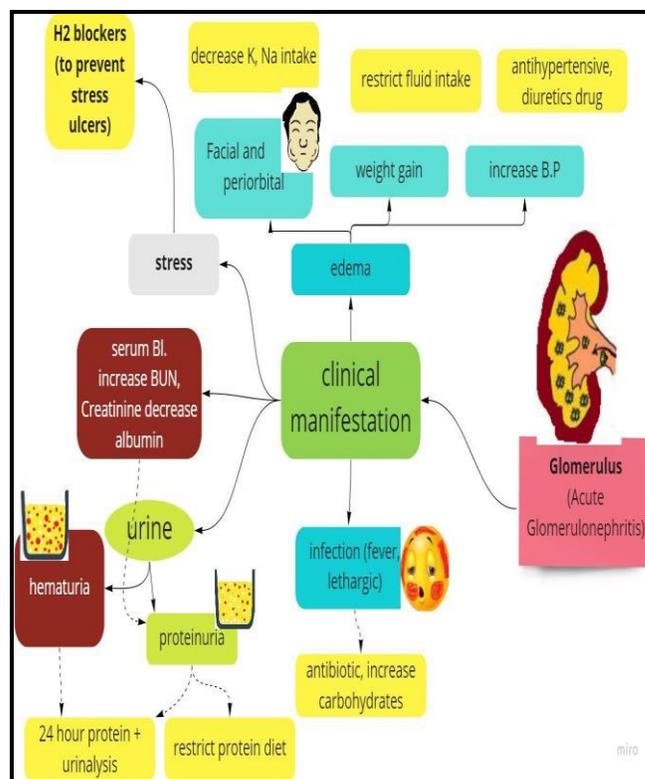


Figure (1): Digital mind map about clinical manifestation and related management of UTIs.

Statistical Analysis

Data were analyzed using IBM SPSS Statistics (version 23). Mean scores and standard deviations were used for students' satisfaction and knowledge of UTIs. Frequencies and percentages were used for participant personal information. The researchers used student t-test and chi-square depending on the type of data. The results of the Kolmogorov-Smirnov test showed that the data were normally distributed. The confidence interval was 95%, and the significance level was 0.05.

Table (2): Comparison between students' knowledge scores based on Bloom's Taxonomy (N = 241).

Levels of Bloom's Taxonomy	Mind-map (Experimental group) N=113		Traditional Education (Control group) N=128		t	P value
	M	±SD	M	±SD		
Lower intellectual abilities:	9.32	3.18	8.50	2.20	2.36	.019*
Higher intellectual abilities:	3.59	1.44	3.01	1.13	3.46	.001*

*Statistically Significant Difference

Table (3): Comparison between students in the digital mind-map and traditional education groups related to their satisfaction and knowledge scores. (N = 241)

Variables		Scores					t	p	Cronbach alpha
Dependent variables	Independent variables	N	Mean	SD	Min	Max			
Satisfaction	Digital mind map (Experimental group)	113	36.22	11.69	10	50	5.671	.001*	.962
	Traditional Education (Control group)	128	28.76	8.64	11	50			
	Total	241							
Knowledge	Digital mind map (Experimental group)	113	13.32	3.69	6	20	4.339	.001*	.774
	Traditional Education (Control group)	128	11.51	2.76	6	18			
	Total	241							

*Statistically Significant Difference

Table (1): A dropout rate of 7.3%, as the study began with 260 students and ended with 241 students. shows no significant differences regarding their personal information between students in the experimental and the control groups, so the study participant groups were homogeneous. The average age of participants in the experimental group was 18.86 years, whereas, in the control group, it was 18.96 years. About five-eighths of the students in the experimental and control groups were female (62.8%) and (62.5%), respectively. More than half of the students in the experimental and control groups lived in an urban area (54%) and (60.2%), respectively.

Table (2): Showed statistically significant differences between participants in the experimental and control groups related to their lower intellectual abilities ($p = .019$) and higher intellectual abilities ($p = .001$).

Table (3): According to the experimental group's mean score was 36.22 on the student satisfaction scale, compared to 28.76 for the control group, with a statistically significant difference ($p = .001$). The experimental group also scored higher regarding the knowledge test, with mean scoring equal to 13.32 as opposed to 11.51 for the control group, with a statistically significant difference ($p = .001$). Regarding Cronbach's alpha, the satisfaction questionnaire was .962, representing a satisfactorily high level, and the knowledge assessment questionnaire was .774, which was satisfactory.

Discussion

Education in the nursing profession depends on acquiring knowledge and critical thinking abilities that guide future nurses to act regarding nursing concepts and ethics according to different situations and patient requirements (Amanian et al., 2020). In the same context, the mind map strategy enhanced critical-thinking skills as a student-centered teaching method (Aein & Aliakbari, 2017; Aghakhani et al., 2015; Ordu & Caliskan, 2022; Rezapour-Nasrabad, 2019).

The current study investigated the digital mind map as a new teaching method for the student. It showed a highly significant difference in students' abilities to retain knowledge and high cognitive skills, which require critical thinking abilities. This was in line with Mammen & Mammen (2018), who examined the effect of digital mind maps on students' analytic abilities of qualitative data and showed enhancement of students' analytic skills. Also Saxena, (2022) found that a digital mind map enhances in-depth learning, boosts memory recall and retention, raises engagement, sparks creativity, and increases productivity. This may be attributed to two advantages of presenting theoretical knowledge in a concept map or mind map. First, linking new information with previously learned which assists a student in grasping knowledge in clear, organized relation (Amanian et al., 2020; Daley et al., 2016; Mammen, 2016). Second, the whole range of left and

right human cortical abilities are utilized during mind mapping; wherefore, students can simplify complex ideas into simpler ones by using graphics. So, their brains get used to depicting their ideas in graphs and relations, which encourages critical thinking **Kotcherlakota et al. (2013)**. This enhances learners recalling, interpreting, summarizing, and manipulation of information easily.

Conversely, **Zipp et al., (2009)** reported that students needed to be more motivated to integrate the mind map teaching method into their program curriculum. Furthermore, **Noonan (2013)** explained that the students prefer the usual and easy teaching method, influencing their decision about the method that anticipated usefulness.

According to the study results, both groups of students were delighted with the teaching strategy, even though the experimental group's participants indicated higher satisfaction levels than the control groups. From the researchers' point of view, these results were because of the benefits of mind map strategies as they let people more readily remember the key information, store it on their phones or computers, and disseminate it with others in a file or even a picture. These results corroborate those of **Wu & Wu (2020)**, who discovered that most students believe using mind-mapping education improves their instruction. The majority of participants, as shown in a study done by **Aljaser (2017)**, who found a high mean of agreement with utilizing e-mind maps to teach the curriculum.

Conclusions

Using the digital mind map strategy is more effective than the traditional education in improving students' knowledge acquisition and increasing students' satisfaction.

Recommendations

The study recommends adding digital mind maps strategy to the used methods of teaching strategies in nursing schools to improve their cognitive abilities and critical thinking skills. Moreover, to develop a training program for nursing instructors about using the digital mind map strategy in teaching the curriculums.

Declaration of interest

The researchers declare that they have no financial or other conflicts of interest.

Funding:

No specific grant was given to this research by any funding organization.

Acknowledgement:

We thank everyone who participated in the study.

References

- **Abdulbaset, H. (2016):** Digital Mind Maps: Their activities in education and learning. *E-Learning Journal*, 12, 89-98.
- **Aein, F., & Aliakbari, F. (2017):** Effectiveness of concept mapping and traditional linear nursing care plans on critical thinking skills in clinical pediatric nursing course. *Journal of education health promotion*, 6.
- **Aghakhani, N., Nia, H., Eghtedar, S., & Torabizadeh, C. (2015):** The Effect of Concept Mapping on the Learning Levels of Students in Taking the Course of. *Jundishapur Journal of Chronic Disease Care*, 4(2).
- **Aljaser, A. (2017):** The Effectiveness of Electronic Mind Maps in Developing Academic Achievement and the Attitude towards Learning English among Primary School Students. *International Education Studies*, 10(12), 80-95.
- **Amaniyan, S., Pouyesh, V., Bashiri, Y., Snelgrove, S., & Vaismoradi, M. (2020):** Comparison of the conceptual map and traditional lecture methods on students' learning based on the VARK learning style model: A randomized controlled trial. *SAGE open nursing*, 6, 2377960820940550.
- **Aydogdu, S., & Güyer, T. (2019):** The Effect of Digital Concept Maps in Online Learning Environments on Students' Success and Disorientation. *Malaysian Online Journal of Educational Technology*, 7(1), 76-93.
- **Barkley, E., & Major, C. (2020):** Student engagement techniques: A handbook for college faculty: John Wiley & Sons.
- **Brookfield, S. (2015):** The skillful teacher: On technique, trust, and responsiveness in the classroom: John Wiley & Sons.
- **CDC. (2017):** Catheter-associated Urinary Tract Infections (CAUTI). Retrieved from https://www.cdc.gov/hai/ca_uti/uti.html
- **CDC. (2020):** About Antibiotic Resistance. Retrieved from <https://www.cdc.gov/drugresistance/about.html>
- **Daley, B., Morgan, S., & Black, S. (2016):** Concept maps in nursing education: A historical literature review and research directions. *Journal of Nursing Education*, 55(11), 631-639.
- **Faul, F., Erdfelder, E., Lang, A.-G., & Buchner, A. (2007):** G* Power 3: A flexible statistical power analysis program for the social, behavioral, and biomedical sciences. *Behavior research methods*, 39(2), 175-191.
- **Fulford, A., & Mahon, A. (2018):** The philosophical defence of the traditional lecture. Retrieved from Retrieved from <https://www.times-higher-education.com/blog/philosophical-defence-traditional-lecture#survey-answer>

- **Gijlers, H., & de Jong, T. (2013):** Using concept maps to facilitate collaborative simulation-based inquiry learning. *Journal of the learning sciences*, 22(3), 340-374.
- **Gourlay, L., & Oliver, M. (2018):** Student engagement in the digital university: Sociomaterial assemblages: Routledge. New York
- **Gray, D., Nussle, R., Cruz, A., Kane, G., Toomey, M., Bay, C., & Ostovar, G. (2016):** Effects of a catheter-associated urinary tract infection prevention campaign on infection rate, catheter utilization, and health care workers' perspective at a community safety net hospital. *American Journal of Infection Control*, 44(1), 115-116. doi:<https://doi.org/10.1016/j.ajic.2015.08.011>
- **Gupta, K., & Rokade, V. (2016):** Importance of quality in health care sector: A review. *Journal of Health Management*, 18(1), 84-94.
- **Kernan, W., Basch, C., & Cadorett, V. (2018):** Using mind mapping to identify research topics: A lesson for teaching research methods. *Pedagogy in Health Promotion*, 4(2), 101-107.
- **Kotcherlakota, S., Zimmerman, L., & Berger, A. M. (2013):** Developing scholarly thinking using mind maps in graduate nursing education. *Nurse educator*, 27(6), 252-255.
- **Mammen, J. (2016):** Computer-assisted concept mapping: Visual aids for knowledge construction. *Journal of nursing education*, 55(7), 403-406.
- **Mammen, J., & Mammen, C. (2018):** Beyond concept analysis: Uses of mind mapping software for visual representation, management, and analysis of diverse digital data. *Research in nursing health*, 41(6), 583-592.
- **Monegro, A., Muppidi, V., & Regunath, H. (2020):** Hospital acquired infections. *StatPearls*. In. Retrieved from <https://www.ncbi.nlm.nih.gov/books/NBK441857/>
- **Murley, D. (2007):** Technology for everyone...: Mind mapping complex information. *Law Libr. J.*, 99, 175.
- **Noonan, M. (2013):** Mind maps: Enhancing midwifery education. *Nurse education today*, 33(8), 847-852.
- **Ordu, Y., & Caliskan, N. (2022):** The impact of a web-based mind map learning technique on students' nursing knowledge of the nursing process. *International Journal of Nursing Knowledge*, 33(2) 81-161
- **Pezeshki Najafabadi, M., Dagoohian, A., Rajaie, S., Zarkesh-Esfahani, S., & Edalati, M. (2018):** Common microbial causes of significant bacteriuria and their antibiotic resistance pattern in the Isfahan Province of Iran. *Journal of Chemotherapy*, 30(6-8), 348-353.
- **Rezapour-Nasrabad, R. (2019):** Mind map learning technique: An educational interactive approach. *International Journal of Pharmaceutical Research*, 11(1), 1593-1597.
- **Samuelson, D., Divaris, K., & De Kok, I. (2017):** Benefits of case-based versus traditional lecture-based instruction in a preclinical removable prosthodontics course. *Journal of dental education*, 81(4), 387-394.
- **Saxena, H. (2022):** Enhancing learning experience with augmented mind maps. (Master degree Master of Science in Applied Sciences and Engineering: Applied Computer Science), Faculty of Engineering, Vrije Universiteit, Brussel, 1-106
- **Talaat, M., El-Shokry, M., El-Kholy, J., Ismail, G., Kotb, S., Hafez, S., Lessa, F. (2016):** National surveillance of health care-associated infections in Egypt: Developing a sustainable program in a resource-limited country. *American journal of infection control*, 44(11), 1296-1301.
- **Tavares, L., Meira, M., & do Amaral, S. (2021):** Interactive mind map: A model for pedagogical resource. *Open Education Studies*, 3(1), 120-131.
- **Van Driel, A., Notermans, D., Meima, A., Mulder, M., Donker, G., Stobberingh, E., & Verbon, A. (2019):** Antibiotic resistance of *Escherichia coli* isolated from uncomplicated UTI in general practice patients over a 10-year period. *European Journal of Clinical Microbiology Infectious Diseases*, 38, 2151-2158.
- **WHO. (2017):** The burden of health care-associated infection worldwide. Retrieved from https://www.who.int/infection-prevention/publications/burden_hcai/en/
- **WHO. (2019):** New report calls for urgent action to avert antimicrobial resistance crisis. Retrieved from <https://www.who.int/news/item/29-04-2019-new-report-calls-for-urgent-action-to-avert-antimicrobial-resistance-crisis>
- **WHO. (2020):** Antimicrobial resistance. Retrieved from <https://www.who.int/news-room/factsheets/detail/antimicrobial-resistance>
- **Wu, H.-Z., & Wu, Q.-T. (2020):** Impact of mind mapping on the critical thinking ability of clinical nursing students and teaching application. *Journal of International Medical Research*, 48(3), 0300060519893225.
- **Yildizli, H., & Şimşek, İ. (2020):** The Effects of Software-Aided Mind and Argument Mapping on Learning in Higher Education. *International Journal of Contemporary Educational Research*, 7(2), 187-201.
- **Zipp, G., Maher, C., & D'Antoni, A. (2009):** Mind Maps: Useful schematic tool for organizing and integrating concepts of complex patient care in the clinic and classroom. *Journal of College Teaching Learning*, 6(2).