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Investigating the impact of mind mapping and speech on creativity in nursing students

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Abstract

Background Nurses require techniques to boost creativity for complex health and care challenges, one of which is mind mapping. The purpose of the current study was to evaluate, using mind mapping, how problem-solving training affected the development of creativity in first-year nursing students.

Methods In the interventional present study, the samples were randomly selected among first-year nursing students from nursing schools. Standard questionnaires were used for data collection after validity and reliability assessment. Data were analyzed using SPSS 20.

Results According to the findings, mind mapping, and problem-solving training have a stronger impact on boosting nursing students' creativity than conventional and text-based training ($P < 0.05$).

Conclusions Problem-solving abilities in the nursing profession, including the fields of education, research, and clinical care, as well as their undeniable contribution to nurses' success in management, research, education, and care, it stands to reason that developing these abilities through mind maps will help nurses perform their serious tasks.

Keywords Creativity, Learning, Mind mapping, Nursing, Teaching

Background

Creativity plays a crucial role in problem-solving and decision-making within the healthcare field, especially for nursing students who must often make critical decisions under pressure [1, 2]. From a psychological perspective, creativity is considered a vital aspect of thinking, involving divergent thinking, which allows individuals to generate innovative solutions by combining information and experiences stored in long-term memory. Research suggests that creativity is not an inherent trait but rather a skill that can be developed and taught through appropriate educational strategies [3, 4].

Many psychologists also believe that creativity is not a personality trait of some individuals but a unique knowledge and experience that can be taught to others [5, 6].

In nursing education, the development of critical thinking and creativity is essential as students prepare for real-world clinical challenges. Traditional teaching methods, such as lectures, often fail to engage students actively and do not foster the necessary problem-solving skills [7]. These methods are particularly ineffective in teaching students to solve complex clinical problems [8]. Students learn new concepts when they feel that the need and activities are involved in the learning process, and they are also able to make connections between new concepts and previously learned concepts [9, 10]. To address this issue, new teaching strategies that foster active learning and creativity are essential. One such method is the use of mind mapping, which helps organize and connect concepts in a way that mirrors the brain's natural processing

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of information. Mind mapping enhances students' ability to think critically, solve problems creatively, and integrate knowledge more effectively [11, 12]. Mind mapping has been shown to improve cognitive achievement and critical thinking skills by encouraging students to visualize relationships between concepts and generate new ideas [13–15]. Indeed, a mind map is an organized tool for presenting knowledge, depicting the thematic relationship between concepts in a hierarchical way, as well as a metacognitive method to promote meaningful learning [9, 16]. In the context of nursing education, where creativity and problem-solving are paramount, this technique can support students in navigating complex clinical scenarios. Research by Buran et al. (2018) found that early exposure to mind mapping in educational settings enhances active learning, critical thinking, and creativity, which are vital for effective decision-making and patient care [13, 17]. In addition, the results of a study by Yates and Moore (2019) on the effect of mind mapping on students' learning showed that encouraging students to create mind maps leads to a better understanding of concepts as well as the logical connection between them, which is of great importance in the learning-teaching process and methods of achieving cognition and metacognition [18, 19]. The ultimate goal of nursing education is to gain clinical expertise, including the personal and professional skills, attitudes, and values necessary to enter the care and treatment system. Nursing is based on teaching skills that, along with the development of science and technology, can encounter many clinical problems and use creative methods to solve them. Different perspectives cause different performances, and if we want to have creative students, it is necessary to develop creativity by using new teaching methods so that they can think and act creatively [7, 18].

Young and Paterson (2018) also questioned the use of traditional methods of nursing education to solve various problems and stated that these methods forget lessons and are useless for the current world. They added that these methods are not sufficiently effective in teaching problem-solving and clinical decision-making and need to be replaced by new training methods [20]. Thus, the ability to play with the general imagination of the mind is necessary for problem-solving, better decision-making, and creativity. The structure of mind mapping helps create certain ideas and information and provides integration, connection, composition, dependence, and alignment between different concepts. Due to the urgent need to solve problems and make quick decisions in healthcare, nurses need methods to increase creativity for complex health and care issues and develop creative solutions to solve most problems [8, 21]. Therefore, given the pressing need for nurses to make quick and informed decisions in clinical environments, it is essential to adopt teaching methods that foster creativity and critical thinking. This study aims to investigate the impact of mind-mapping-based problem-solving training on the creativity and cognitive development of first-year nursing students, providing a practical solution to the challenges faced by nursing students in their educational journey.

Methods and materials

Sample and data collection

In this intervention-controlled study, sampling was performed using convenience and purposeful sampling methods. Due to the closure of colleges during the Covid-19 epidemic and the lack of face-to-face training classes, the researcher, after obtaining permission to enter the nursing schools from the deputy director of the faculty and referring to the nursing schools who had the necessary cooperation, including School of Nursing and Midwifery, obtained the contact numbers of eligible students and contacted them via telephone. In both the control and intervention groups, two people were employed and 41 people were unemployed. In the control group, there were 27 students in the first semester and 16 students in the second semester, whereas in the intervention group, there were 19 and 24 students in the first and second semesters, respectively. In the control group, there were 32 students from Shahid Beheshti Medical University, six from Iran Medical University, and five from Tehran Medical University; in the intervention group, there were 28 students from Shahid Beheshti Medical University, six from Iran Medical University, and nine from Tehran Medical University. None of the students in either sample had a history of participating in creativity or mind-development classes.

Among the first-year nursing students of the mentioned faculties who met the inclusion criteria and were inclined to participate in the study, the study population was selected after explaining the objectives of the project and its results, obtaining informed electronic consent from them, and providing the researcher's contact numbers and e-mail to the participants.

The study participants were randomly assigned to the intervention and control groups. Both intervention and control groups completed the study instruments electronically (Google Form) before starting the relevant training courses. Then, to start the training course for the intervention group, the 6-step technique of social problem-solving skills (Table 1) was given by creating a mind map with the participation of students after dividing them into nine groups (five groups). Then, the mind map was created using the principles of the mind map (drawing the main subject in the center with branch keywords in the divergent pattern) and was explained to the intervention group for four months (two days a week and two

Table 1 Stages of social problem-solving skills training based on the theory of goldfried & D'Zurilla

Session 1:	
Step 1: General Orientation	– Ability to recognize the problem – Accept the problem as a potentially changeable natural phenomenon – Knowing the effectiveness of the problem-solving framework in dealing with the problem – Expectations of high self-efficacy to implement the model steps – The habit of stopping, thinking, and then trying to solve a problem
Session 2:	
Step 2: Define and formulate the problem	– Gathering all available information – Separation of facts from hypotheses that need much research – Problem analysis – Define real goals
Session 3:	
Step 3: Production of alternative solutions	– Determination of a range of possible solutions – The ability to choose the most effective solution from among the solutions
Session 4:	
Step 4: Decision making	– Predict the possible consequences of each action – Pay attention to the usefulness of these consequences
Session 5:	
Step 5: Solution execution	– Execute the selected method
Session 6:	
Step 6: Review	– Observe the results of the performance

hours per day) using Skype educational software according to the following steps.

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1. The mind map begins by writing a concept in the center of the paper, which is the main symbol of the subject.
2. It starts with an open and creative attitude and a brain-drain process that stimulates new connections and ideas.
3. Place all categories related to the central concept without evaluating and judging them as branches and sub-branches focused on the central concept.
4. Keywords, pictures, and symbols were used to quickly record the ideas.
5. Topics related to the central concept should be organized around it.

In the control group, the 6-step technique of problem-solving skills was taught in an explanatory and text-based manner with the traditional method (lectures and slides via Skype software) and the same duration of the intervention group training (four months) and with a short distance from the training of the intervention group. At the end of the training course, Abedi's electronic questionnaire was completed again by the intervention and control groups, and the results were compared.

The Creativity Assessment Questionnaire, commonly known as Abedi's Creativity Test (CT), was developed in 1984 by Abedi in Tehran, based on Torrance's theory of creativity. This questionnaire has undergone several revisions, and its final 60-item version was developed by Abedi at the University of California [22]. The test consists of 60 three-option questions, categorized into four subtests: fluency, elaboration, originality, and flexibility. The response options represent low, moderate, and high levels of creativity, with a score of 1 for low creativity, 2 for moderate creativity, and 3 for high creativity.

Scoring and Interpretation of the Questionnaire.

As mentioned, the questionnaire consists of 60 items, each with three response options. The options represent increasing levels of creativity, receiving a score from 1 to 3 accordingly. The total score for each subtest reflects the participant's creativity in that specific area, while the sum of scores across all four subtests (fluency, elaboration, originality, and flexibility) represents the overall creativity score. The total creativity score ranges between 60 and 180. The items are categorized as follows:

- Fluency: Items 1 to 22.
- Elaboration: Items 23 to 33.
- Originality: Items 34 to 49.
- Flexibility: Items 50 to 60.

Higher scores in this questionnaire indicate a higher level of creativity.

Validity and Reliability of the Questionnaire.

The reliability of Abedi's Creativity Test was assessed through a test-retest method among middle school students in Tehran in 1984, yielding the following reliability coefficients for each subtest:

- Fluency: 0.85.
- Originality: 0.82.
- Flexibility: 0.84.
- Elaboration: 0.80.

Additionally, the internal consistency of the test was measured using Cronbach's alpha on a sample of 2,270 Spanish students, yielding the following coefficients:

- Fluency: 0.75.
- Flexibility: 0.66.
- Originality: 0.61.
- Elaboration: 0.61.

Table 2 Demographic characteristics (gender, marital status, employment) of first-year nursing students at Tehran university of medical sciences in 2020 by intervention and control groups

Group	Control		Intervention		P-value
	F	%	F	%	
Man	16	37.2	21	48.8	0.38 Chi-square test
Woman	27	62.8	22	0.51.2	
Total	43	100	43	100	
Married	1	2.3	4	9.3	0.36 Fisher's exact test
Single	42	97.7	39	90.7	
Total	43	100	43	100	
Working	2	4.7	2	4.7	0.99 Fisher's exact test
Non-working	41	95.3	41	95.3	
Total	43	100	43	100	
First semester	27	62.8	19	44.2	0.13 Chi-square test
Second semester	16	37.2	24	55.8	
Total	43	100	43	100	
Shahid Beheshti University of Medical Sciences	32	74.4	28	65.1	0.49 Chi-square test
Tehran University of Medical Sciences	6	14	6	14	
Iran University of Medical Sciences	5	11.6	9	20.9	
Total	43	100	43	100	
Age					0.14 (-1.49) Independent t-test
Mean	19.6		20.12		
SD	1.01		2.01		
Min	18		18		
Max	23		27		
N	43		43		

Analyzing of data

Data were analyzed using SPSS software version 20, descriptive statistics, and correlation tests.

Results

The results of the data analysis are summarized in the following tables.

Table 2 shows that 62.8% of the students participating in the study in the control group were female and 37.2% male. In the intervention group, 48.8% of the participants were male and 51.2% were female. The results of the chi-square test showed no statistically significant difference between the two groups in terms of sex. Therefore, the two groups were homogeneous in terms of sex (P-value = 0.38).

In addition, 97.7 participants of the participants in the control group were single, and 2.3% were married. In the intervention group, 90.7% were single and 9.3% were married. Fisher's exact test showed no statistically significant difference between the two groups in terms of marital status. Therefore, the two groups were homogeneous in terms of marital status ($p = 0.36$).

According to the above table, 95.3% of the students in the control group did not work, and 4.7% had a job. In the intervention group, 95.3% were not working and 4.7% had a job. Fisher's exact test showed no statistically significant difference between the two groups in terms of employment status. Therefore, the two groups were homogeneous in employment status ($p = 0.99$).

In addition, 62.8% of the students in the control group participated in the study in the first semester and 37.2% in the second semester. In the intervention group, 55.8% were in the second semester and 44.2% were in the first semester. The results of the chi-square test showed that there was no statistically significant difference between the intervention and control groups in terms of the academic semester. Therefore, the two groups were homogeneous in terms of academic semesters (P-value = 0.13).

According to the above table, 74.4% of the students in the study group studied at Shahid Beheshti Medical University, 14% at the Medical University of Iran, and 11.6%

Table 3 Comparison of creativity of first-year nursing students of Tehran Province universities of medical sciences in 2020 in two intervention and control groups, before the intervention

Group Creativity dimensions before intervention	Control		Intervention		*P*-value* (T-statistics)
	Mean	SD	Mean	SD	
Fluency	38.32	6.22	39.72	5.11	0.26 (1.13-)
Elaboration	17.76	2.83	17.86	3.04	0.88 (0.15-)
Originality	26.25	4.15	26.97	3.93	0.41 (0.83-)
Flexibility	18.04	2.71	17.81	2.21	0.66 (0.43)
The total score of creativity	100.39	12.80	102.37	11.19	0.45 (0.76-)

*Independent T-test

at the Medical University of Tehran. In the intervention group, 65.1% studied at Shahid Beheshti Medical University, 14% at the Medical University of Tehran, and 20.9% at the Medical University of Iran. The results of the chi-square test showed no statistically significant difference between the two groups in terms of university, and the two groups were homogeneous in terms of university (P-value = 0.49).

The above table also shows that the mean age of students participating in the control group was 19.60 years with a standard deviation of 1.01 and the mean age of students in the intervention group was 20.12 years with a standard deviation of 2.01. In the control group, the minimum and maximum ages were 18 and 23 years, respectively; in the intervention group, the minimum and maximum ages were 18 and 27 years, respectively. The results of the independent t-test showed that the mean age between the intervention and control groups did not differ significantly, and the two groups were homogeneous in terms of age (P-value = 0.14).

In Table 3, the results of the independent t-test show that there is no statistically significant difference between the mean of each dimension of creativity and the mean total score of creativity in the two groups of intervention and control before the intervention (P-value < 0.05). In the fluency dimension, the means of the control and intervention groups were 38.32 and 39.72 (P-value = 0.26), respectively. In the elaboration dimension, the means of the control and intervention groups were 17.76 and 17.86 (P-value = 0.88), respectively. The mean originality in the control and intervention groups was 26.25 and 26.97 (P-value = 0.41), and the mean flexibility in the control and intervention was calculated as 18.04 and 17.81, respectively (P-value = 0.66). The mean total scores of creativity in the intervention and control groups were 100.39 and 102.37, respectively (P-value = 0.45).

In Table 4, the results of the independent t-test show that there was a statistically significant difference between the mean of each dimension of creativity and the mean total score of creativity in the intervention and control groups after the intervention (P-value < 0.05). In the fluency dimension, the mean of the control and intervention groups was 50.18 and 55.88 (P-value < 0.001), respectively. In the elaboration dimension, the mean of the control and intervention groups was 22.56 and 25.44, respectively (P-value < 0.001), the mean originality dimension in the control and intervention groups was 32 and 37.63, respectively (P-value < 0.001), and the mean flexibility dimension in the control and intervention group was 23.16 and 26.49, respectively. ($p < 0.001$), respectively. The mean total score of creativity in the control and intervention groups was 127.91 and 145.44, respectively ($p < 0.001$).

The results in Table 5 show the independent t-test on the difference between the mean of different dimensions of creativity before and after the intervention in the two groups of intervention and control. In all dimensions as well as the total creativity score, the mean difference between the intervention and control groups had a statistically significant difference, which indicates the greater

Table 4 Comparison of creativity of first-year nursing students of medical universities in 2020 in intervention and control groups, after intervention

Group Creativity dimensions before intervention	Control		Intervention		*P*-value (T-statistics)
	Mean	SD	Mean	SD	
Fluency	50.18	2.86	55.88	1.78	< 0.001 (-11.1)
Elaboration	22.56	2.12	25.44	2.27	< 0.001 (-6.10)
Originality	32	2.39	37.63	2.38	< 0.001 (-10.94)
Flexibility	23.16	1.89	26.49	2.19	< 0.001 (-7.52)
The total score of creativity	127.91	7.32	145.44	5.78	< 0.001 (-12.32)

Table 5 Comparison of the difference between the average dimensions of creativity of first-year nursing students of Tehran Province universities of medical sciences in 2020 in two intervention and control groups

Group Creativity dimensions		Control ($n=43$) Mean difference (SD)	Control ($n=43$) Mean difference (SD) Intervention ($n=43$) Mean difference (SD)	Total ($n=86$) Mean difference (SD)	*P*-value*
Fluency	**Before intervention-after intervention**	11.86-(6.68)	16.16-(5.12)	14.01-(6.30)	0.001
Elaboration	**Before intervention-after intervention**	4.79-(3.66)	7.58-(3.88)	6.18-(4.01)	0.001
Originality	**Before intervention-after intervention**	5.74-(4.33)	10.65-(4.61)	8.19-(5.08)	0.001>
Flexibility	**Before intervention-after intervention**	5.12-(3.08)	8.67-(3.12)	6.89-(3.57)	0.001>
The total score of creativity	**Before intervention-after intervention**	27.51-(13.77)	43.07-(12.33)	35.29-(15.17)	0.001>

*Independent T-test

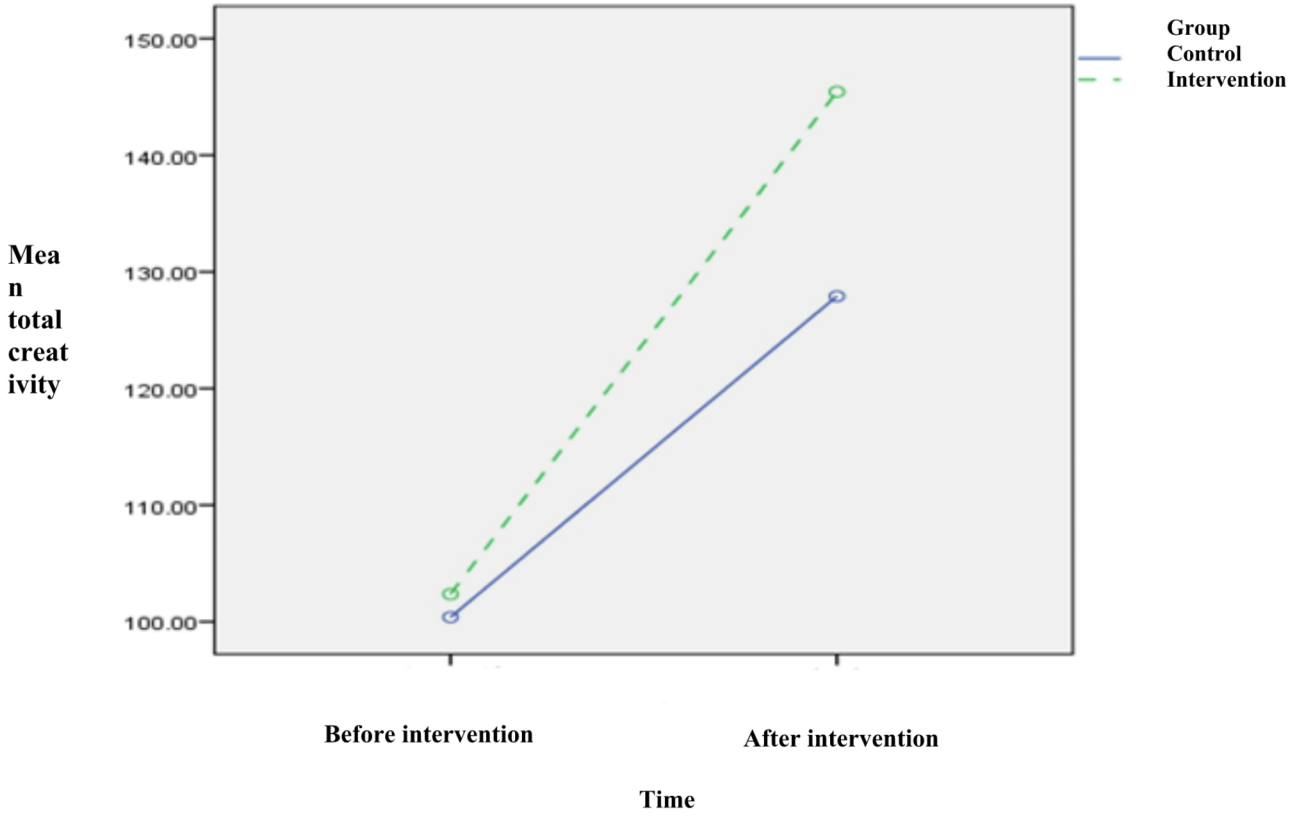

Fig. 1 Comparison of the mean of the total creativity of first-year nursing students of Tehran University of Medical Sciences, before and after the intervention in the two groups of intervention and control

effect of mind map training on the creativity of first-year nursing students ($p<0.001$), respectively.

Figure 1, shows the changes in the total creativity score over time in the intervention and control groups. The level of creativity in the two groups of intervention and control, which were taught by the researcher to solve the problem using mind mapping and traditional methods, respectively, showed an ascending trend over time. However, this increasing trend in the intervention group, who were trained to solve the problem using the mind mapping method, was higher than that in the control group, which indicates the greater effect of problem-solving training by the mind mapping method on creativity in students participating in the study.

Discussion

Education and learning play a crucial role in healthcare, making it essential to train nursing students in decision-making and creative problem-solving skills for their future work environments [19]. The statistical findings of this study indicate that both problem-solving skills training using mind mapping and traditional training positively impact students' creativity levels. Although creativity increased in both groups, the rate of improvement was significantly higher in the intervention group. A total of 86 students participated in this study, with 43 in the control group and 43 in the intervention group.

Demographic data analysis showed that the average age in the control group was 19.60 years, while in the intervention group, it was 20.12 years. The control group consisted of 16 men and 27 women, while the intervention group had 21 men and 22 women. Regarding marital status, the control group included one married participant and 42 single participants, whereas the intervention group had four married participants and 39 single participants. In terms of employment, two participants in each group were employed, while the remaining 41 were unemployed. Additionally, first-semester students comprised 27 individuals in the control group and 19 in the intervention group, while second-semester students accounted for 16 in the control group and 24 in the intervention group. Participants came from three universities: Shahid Beheshti Medical University, Iran Medical University, and Tehran Medical University, with the majority enrolled at Shahid Beheshti Medical University. Importantly, none of the participants had prior experience in creativity or mind-development training.

In the present study, the independent t-test results showed that before the intervention, there was no significant difference between the averages of all areas of creativity in the intervention and control groups. Additionally, the results showed that after the intervention, there was a significant difference between the averages of all areas of creativity in the intervention and control groups. Additionally, the two groups showed significant differences in total creativity scores.

The results of this study align with those of Sadeghi-Gandomani et al. (2018), demonstrating that mind mapping significantly enhances nursing students' creativity compared to traditional methods [15]. This can be explained through Cognitive Load Theory, which suggests that visual learning strategies, such as mind mapping, reduce extraneous cognitive load by organizing complex information into structured, interconnected nodes. This structured approach facilitates deeper cognitive processing, enabling students to retrieve and apply knowledge more flexibly. In contrast, traditional methods rely heavily on passive learning, which does not actively engage students in knowledge construction, potentially limiting their creative problem-solving abilities.

Previous studies have shown that traditional teaching methods, such as lectures, have a limited impact on enhancing students' critical thinking and creativity skills. In this regard, a study conducted by Sadeghi-Gandomani investigated the impact of using mind mapping in comparison to conventional methods on nursing students' critical thinking skills. The results of this study revealed that students who received mind mapping-based instruction demonstrated significant improvements in their critical thinking and decision-making skills. The average critical thinking score in the mind mapping-based training group was significantly higher after the intervention compared to the group that received traditional methods ($p = 0.01$). These findings emphasize the importance of using innovative teaching strategies, such as mind mapping, to enhance nursing students' cognitive skills and suggest that this method could be a suitable alternative to traditional education in this field [23].

Other studies have also confirmed the benefits of mind mapping in educational settings. Zubaidah et al. (2017) [24], conducted a quasi-experimental study in Indonesia, comparing different science learning models. Their results showed that integrating differentiated science inquiry with mind mapping significantly improved students' creative thinking skills, supporting the findings of the present study. Similarly, Dong et al. (2021) [8] investigated the impact of mind mapping in graphic design education in Switzerland, concluding that this technique effectively promotes divergent thinking and sustainable creativity, further reinforcing its potential as an innovative educational tool.

In addition, Molazadeh et al. (2018) [21], explored the effects of 2D and 3D educational video games on students' creativity. Their findings indicated that both types of games enhanced fluency, while 3D video games specifically improved flexibility, both of which are key components of creativity. These results align with the present study's conclusions regarding the impact of interactive and visually engaging learning strategies on creativity development.

Jafari-Aghaei's research on the flipped classroom model further supports the argument for modern educational approaches [25]. The study found that this model positively influenced nursing students' experiences and engagement, similar to other studies highlighting the effectiveness of active learning strategies over traditional lecture-based methods. These findings suggest that universities should prioritize innovative educational techniques to enhance student learning outcomes.

Moreover, a study conducted at Al-Azhar Faculty of Nursing in Cairo investigated the effect of mind mapping on cognitive achievement and critical thinking among

nursing students. The results revealed that 89.7% of students in the study group attained a satisfactory understanding of mind mapping, with 85.9% demonstrating significant cognitive achievement. Furthermore, 84.6% of students in the intervention group exhibited high levels of critical thinking, highlighting a strong correlation between cognitive achievement and critical thinking skills. The study concluded that mind mapping is a valuable tool in nursing education and recommended its broader implementation across various nursing courses [25].

In summary, the present study provides compelling evidence for the effectiveness of mind mapping in enhancing nursing students' creativity. The findings align with a growing body of research emphasizing the advantages of innovative learning strategies over traditional methods. Given the increasing demands of the healthcare sector, incorporating mind mapping into nursing curricula could significantly improve students' problem-solving abilities, critical thinking skills, and overall creativity. Future research should explore the long-term impacts of mind mapping on professional performance and patient care outcomes to further validate its educational benefits.

This study aimed to investigate the impact of combining the Problem-Based Learning (PBL) method with mind mapping on educational outcomes in nursing. The results showed that the use of this teaching model significantly improved nursing knowledge tests, pediatric practice tests, and students' independent learning abilities. Specifically, in nursing knowledge tests and pediatric practical skills, the groups using the PBL method combined with mind mapping achieved significantly better results compared to the control groups [22, 26].

These findings align with similar studies that have shown that combining problem-based learning with mind mapping can lead to improved student performance across various educational areas. For instance, Yan et al. (2024) also highlighted the positive impact of this combination on improving both theoretical and practical tests [27].

Another result of this study was the increased ability of students to learn independently, which further supports the positive effects of active teaching methods such as PBL combined with mind mapping. These findings suggest that using these methods can help students enhance their critical thinking and problem-solving abilities, which is particularly essential in clinical fields like nursing.

Overall, this research indicates that innovative and combined methods, such as PBL and mind mapping, can have a positive impact on creativity, independent learning, and problem-solving in nursing students. This combination plays a crucial role, especially in teaching clinical skills and better preparing students for real-world challenges in clinical settings.

These findings emphasize the importance of innovation in teaching methods and can contribute to the design and improvement of nursing education programs that better prepare students for real-world scenarios, thereby enhancing the quality of education in this field.

Conclusion

The findings of this study highlight the effectiveness of mind mapping as an educational tool to enhance creativity in nursing students. Unlike traditional teaching methods, mind mapping offers a more engaging and stimulating approach, improving creative thinking and problem-solving skills. Given the increasing complexity of healthcare environments, it is essential to incorporate such innovative strategies in preparing future nurses.

Recommendations

As an interactive learning technique, mind mapping plays a crucial role in improving effective communication, learning skills, and creativity. Creating mind mapping is a creative way of learning in which learners with a unique way of learning, can promote and develop memory and help create a new environment for information processing. Nursing educators are required to provide students with opportunities to gain experience and learn effectively in new ways so that they can learn effectively and creatively.

Limitations

Some limitations of the present study include the following:

1. The scheduling of online mind mapping training sessions and traditional teaching methods occasionally conflicted with students' classroom schedules, creating challenges in coordinating virtual classes. The researcher addressed these issues and resolved them to the extent possible.
2. At the beginning of the course, a significant amount of time was required to instruct students on group formation and the process of creating mind maps. Despite being conducted virtually, the training duration was nearly twice as long. To mitigate this issue, special measures were implemented, including providing additional explanations via other communication channels such as WhatsApp. These efforts helped clarify the process for students and ensured their understanding.
3. The lack of appropriate electronic platforms posed difficulties for students working collaboratively in virtual environments. To address this, offline group work was encouraged, and students were instructed

to submit their group assignments via email to the researcher. This approach helped manage the challenges as effectively as possible.

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s12912-025-03005-z.

Supplementary Material 1

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Author contributions
This manuscript is the result of a research project that has been completed by Dr.Rafat Rezapour-Nasrabad, including design project, data collection, training nursing students, writing the main manuscript and submission. the autor reviewed the manuscript.R.R. Design ProjectR.R. collected the dataR.R. tranied nursing studentsR.R. wrote the main manuscript textR.R. prepared tables and figures.

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Data availability
The data supporting the results of this study can be provided to readers upon request from the author.these data are under the ownership of the school of nursing and midwifery of shahid beheshti university of medical sciences, located at https://nm.sbmu.ac.ir.

Declarations

Ethics approval and consent to participants
The author confirms that all experiments involving human participants in this study were conducted in accordance with the Helsinki Declaration. Every effort was made to respect participants and safeguard their health and rights throughout the research. The study was approved by the Ethics Committee of Shahid Beheshti University of Medical Sciences (Ethical Code: IR.SBMU.PHARMACY.REC.1398.260). Additionally, all participants provided written informed consent before taking part in the study.

Consent for publication
Not applicable.

Competing interests
The authors declare no competing interests.

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