



## Effect of Metacognitive Program on Nursing Students Critical Thinking

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### Abstract

Metacognitive skills are an important component of lifelong learning that can help individuals become more effective self-directed learners, critical thinker, and decision-makers and can be developed through deliberate practice and instruction. **The aim** of this study was to assess the effect of metacognitive program on Nursing Students critical thinking. **Methodology:** An experimental design was used to conduct the present study, at the faculty of nursing, Zagazig University. The sample included 70 nursing students in the fourth academic year divided into two equal groups; study and control group. Two tools were used for data collection; 1) Metacognitive Awareness Inventory 2) California Critical Thinking Skills Test. **Results:** After the program implementation the highest nursing students in the study group had a significantly higher level of metacognition compared to those in the control group (80% & 11.42% respectively). Before the program implementation, the highest percentage of nursing students in both the study and control groups had low level of critical thinking (91.7% & 90.4% respectively). However, after the program was implemented, more than half of the nursing students in the study group (57.4%) had high level of critical thinking compared to (0%) of those in the control group. **Conclusion:** There was a significant improvement in nursing students' metacognition and critical in the study group compared to the control group after the program implementation. Therefore, it is **recommended** that the faculty of nursing should integrate metacognitive skills training into the nursing curriculum and provide training courses to faculty members on how to develop students' metacognitive skills.

**Key words:** Metacognitive skills, Nursing Students, Academic Achievement

### Introduction:

Metacognition refers to the cognitive processes involved in thinking about one's own thinking. It involves the ability to reflect on and monitor one's own mental processes, including attention, memory, and problem-solving strategies. Metacognition is crucial for effective learning, as it enables individuals to monitor their own progress, identify areas of strength and weakness, and make adjustments to their learning strategies as needed. Metacognitive skills include self-awareness, self-regulation, and self-evaluation (Simonsmeier & Flunger, 2021; Yoo & Huang, 2021).

Metacognitive skills of students refer to their ability to understand and be aware of their own cognitive processes, including their strategies for learning, thinking, and problem-solving. These skills allow students to reflect on their own learning processes and make changes as necessary, which results in better academic outcomes. The skills include self-reflection, self-monitoring, self-regulation, and self-evaluation. Students with strong metacognitive abilities tend to perform better academically, have higher levels of self-confidence, and are better equipped to handle complex academic challenges. Consequently, there is a

growing emphasis on the development of students' metacognitive skills in education, with educators focusing on equipping students with the essential skills needed for success in college and beyond (**Efklides, 2021; McGuire & McGuire, 2021**).

Critical thinking is an intentional and self-regulated cognitive process that involves the interpretation, analysis, evaluation, and reasoning of information. It is an integral part of nursing science, as it enables nursing students to accurately collect and analyze information, and use logical reasoning to adapt their knowledge to different situations (**Jin & Ji, 2021**).

Critical thinking abilities refer to the cognitive skills and processes involved in analyzing, evaluating, and synthesizing information to make informed decisions and solve complex problems. These abilities include skills such as analyzing arguments, recognizing biases, identifying assumptions, evaluating evidence, and drawing conclusions. Critical thinking abilities are essential for success in many areas of life, including education, the workplace, and everyday decision making (**Koch et al., 2021; Abrami et al., 2021**).

Critical thinking abilities can be developed and improved through intentional instruction and practice. Effective instructional approaches include providing opportunities for students to engage in argumentation, problem-solving, and decision-making activities, as well as explicitly teaching critical thinking skills and strategies (**Ruiz-Primo & Brookhart, 2021**). Metacognition plays a key role in the development of critical thinking abilities. Metacognitive skills, such as self-reflection, self-monitoring, and self-evaluation, allow individuals to reflect on their own thinking processes and to make adjustments as necessary, leading to

improve critical thinking outcomes (**Facione, & Gittens, 2021**).

Metacognition is positively correlated with critical thinking abilities, as it allows individuals to reflect on their own thinking processes, evaluate their own thought patterns, and adjust their thinking strategies accordingly. Metacognitive strategies can be effective in improving critical thinking skills among college students. By developing strong metacognitive abilities, students can become more effective critical thinkers and problem-solvers, which can lead to improved academic and professional outcomes (**Zhang et al. 2021**).

#### **Significance of the study:**

Metacognitive skills can shift nursing education from a teacher-centered teaching to student-centered learning and promote nursing students self-directed learning readiness, critical thinking ability, autonomy, and professional identity. So, metacognitive skills help nursing students identify their strengths and weaknesses in problem-solving, critical thinking, self-directed learning leading to enhance their academic performance and prepare them for labor market.

#### **Aim of the study**

Assess the effect of metacognitive program on nursing students' critical thinking.

1. Identify nursing students' metacognition level before and after the training program implementation.
2. Determine nursing students' critical thinking level before and after the training program implementation.

#### **Research hypothesis:**

1. Nursing students' metacognition level in the study group will be improved after the training program implementation.
2. Nursing students' critical thinking level in the study group will be

improved after the training program implementation.

### **Subject & Methods:**

**Research Design:** An experimental design

**Setting:** Faculty of Nursing, Zgazig University

**Subjects:** A representative sample of the fourth-year nursing students; the required sample size was consisted of 70 nursing students. They were divided into two equal groups; 35 study group and 35 control group.

### **Tools of data collection:**

#### **Tool I: Metacognitive Awareness Inventory (MAI):**

It was developed by **Schraw and Dennison in (1994)**, to assess an individual's metacognitive awareness. It consists of two parts:

**Part I:** Personal characteristics data sheet for nursing students to collect data about their code no, age, gender, marital status and residence.

**Part II:** Consists of 52 statements representing two dimensions of metacognition. First dimension is "knowledge of cognition", includes three sub-dimensions: declarative knowledge (knowledge about self and strategies) 8 items, procedural knowledge (knowledge about how to use strategies) 4 items and conditional knowledge (knowledge about when and why to use strategies) 5 items. The second dimension is "regulation of cognition", includes five sub-dimensions: planning (goal setting) 7 items, information management strategies (organizing) 10 items, comprehension monitoring (assessment of one's learning and strategy) 7 items, debugging strategies (strategies used to correct errors) 5 items and evaluation (analysis of performance and strategy effectiveness after a learning episode) 6 items.

### **Scoring system:**

The responses of the items were measured by using 5-point Likert scale as follows: strongly agree (5), agree (4), neutral (3), disagree (2), and strongly disagree (1). Scores were ranging between 52 and 260. The total score was calculated and converted into percent score by dividing students total score by the maximum possible score then multiply by 100. In this study, metacognition level was considered;

- Low, if the score less than 55%.
- Moderate, if the score ranges from 55% to 82%.
- High, if the score more than 82%.

#### **Tool II: California Critical Thinking Skills Test (CCTST):**

It was developed by **Facione et al. (1990)**, to assess critical thinking skills level among nursing students. It consists of 34 multiple choice questions grouped into five critical thinking cognitive skills domains as follows: analysis, inference, evaluation, deductive reasoning and inductive reasoning.

### **Scoring system:**

The questions were scored as one for correct answer and zero for incorrect answer, the total score was calculated and converted into percent score by dividing nursing students total score by the maximum possible score then multiply by 100. In this study, critical thinking skills level was considered;

- Low, if the score less than 50%.
- Moderate, if the score ranges from 50% to 83%.
- High, if the score more than 83%.

### **Validity & Reliability:**

The tools of data collection were tested for their content and face validity by a jury of three experts at the faculty of nursing, Zgazig University. The reliability

of tools was tested by the author using Cronbach's alpha: Metacognitive Awareness Inventory = 0.923; California Critical Thinking Skills Test = 0.892

#### **Pilot study:**

A pilot study was carried out on 10% of nursing students (7) to test the tools feasibility, understandability and to estimate the time consumed for filling in the forms.

#### **Administrative Design:**

Official permissions were obtained from the dean of the faculty of nursing, Zagazig University to conduct the study.

#### **Ethical Considerations:**

The study was approved by the Ethics Research Committee at the Faculty of Nursing; Zagazig University. Oral and written consent were taken from subjects and reassured them about the confidentiality and anonymity of the study. They were informed about their right to refuse or withdraw from the study at any time.

#### **Statistical Design**

Data entry and statistical analysis were performed using computer software, the (SPSS), version 20. Suitable descriptive statistics were used. Paired test was used to compare between paired variable of normally distributed. The Chi-square test was used to detect the relation between the quantitative variables, correlation coefficient ( $r$ ) test was used to estimate the close association between variables. P-values which were less than 0.05, 0.001 were considered as statistically significant and highly significant respectively.

#### **Result:**

Table (1) shows personal characteristics of nursing students in the study and control groups. It is clear from the table that the highest percentage of nursing students in the study and control

groups were in the age group less and equal twenty-one years, female, single and residence in urban areas (68.6%, 62.5%, 74.3%, 77.1%, 91.4%, 85.7%, 80%, and 82.9%, respectively).

Table (2) shows metacognition levels of nursing students in the study and control groups throughout the program phases. It's clear from the table that the highest nursing students in both the study and control groups had low level of metacognition before the metacognitive skills training program implementation (82.9% & 85.71% respectively). However, after the metacognitive skills training program was implemented, the highest nursing students in the study group had a significantly higher level of metacognition compared to those in the control group (80% & 11.42% respectively).

Figure (1) displays nursing students' knowledge of cognition in the study and control groups throughout the program phases. It indicates that there was a significant improvement in the level of knowledge of cognition in the study group compared to those in the control group throughout the program phases. As, it is clear from the figure that the highest percentage of nursing students had low level of knowledge of cognition before program implementation in both the study and control groups (84% & 80%, respectively). Conversely, after the program implementation, the majority of nursing students in the study group (88%) had high level of knowledge of cognition compared to (6%) of nursing students in the control group.

Figure (2) displays levels of nursing students' regulation of cognition in the study and control groups throughout the program phases. It indicates that there was a significant improvement in the level of regulation of cognition in the study group

compared to those in the control group throughout the program phases. As, it is clear from the figure that the highest percentage of nursing students had low level of knowledge of cognition before program implementation in both the study and control groups (84% & 83%, respectively). Conversely, after the program implementation, the majority of nursing students in the study group (79%) had high level of knowledge of cognition compared to (9%) of those in the control group.

It can be observed from figure (3) that there was a significant improvement in critical thinking abilities among nursing students in the study group compared to the control group. As, before the program implementation, the highest percentage of nursing students in both the study and control groups had low level of critical thinking abilities (91.7% & 90.4% respectively). However, after the program was implemented, more than half of the nursing students in the study group (57.4%) had high level of critical thinking abilities compared to (0%) of those in the control group.

Table (3) shows the total mean score of critical thinking abilities among nursing students in the study group throughout the program phases. It is well-defined from the table that, before the program implementation, the highest mean score of critical thinking abilities of nursing students in the study group was related to the inference domain ( $15.33 \pm 4.04$ ). While, after the program implementation, the highest mean score of critical thinking abilities of nursing students in the study group was related to the analysis domain ( $21.10 \pm 2.48$ ). Additionally, there are a statically significance differences between total mean scores of critical thinking abilities among nursing students in the

study group throughout the program phases ( $p < 0.001$ ).

Table (4) show relation between personal characteristics of nursing students and total score of metacognition throughout the program phases. It is clear from the table that there was no statistically significant relation between nursing students' metacognition in the study group and their personal characteristics throughout the program phases, where  $p \text{ value} > 0.05$ .

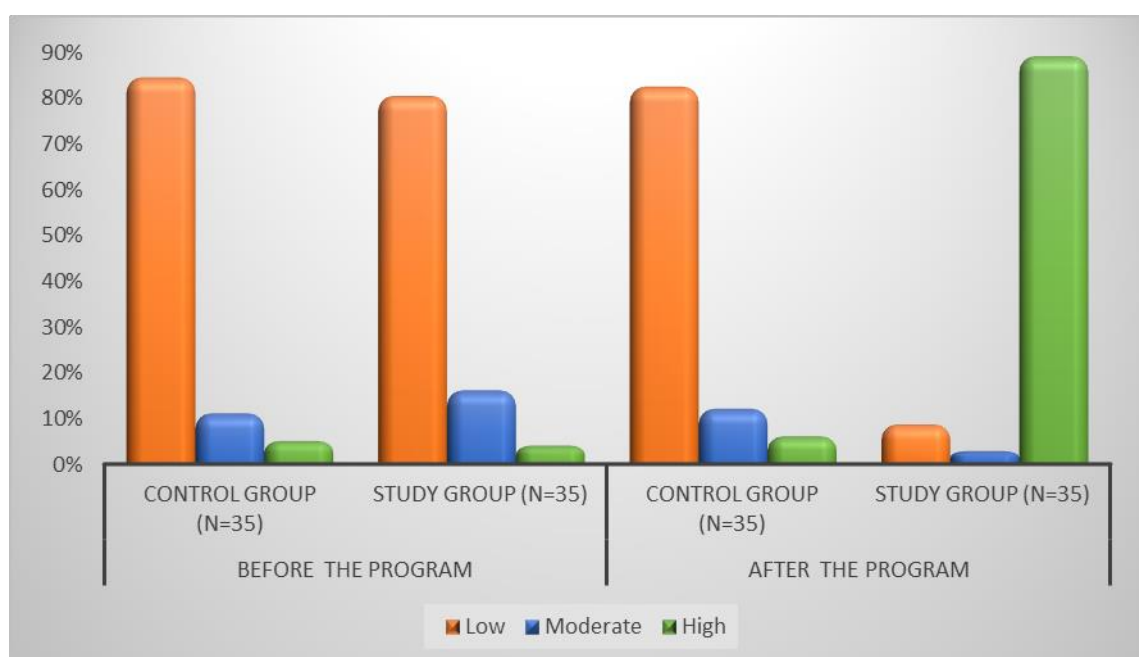
Table (5) shows relation between nursing students' critical thinking in the study group and their personal characteristics throughout the program phases. It is clear from the table that there was no statistically significant relation between nursing students' critical thinking in the study group and their personal characteristics before and after implementation of the training program, where  $p \text{ value} > 0.05$ .

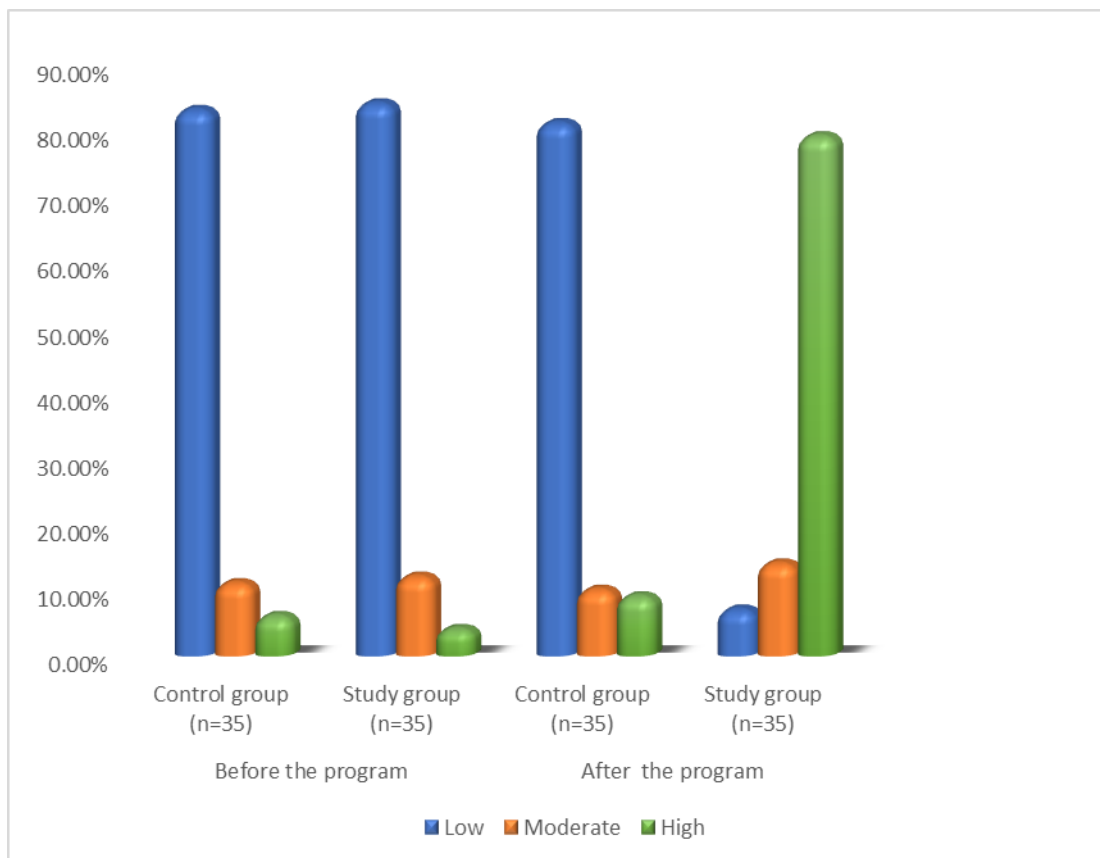
**Table 1: Personal characteristics of nursing students in the study and control groups (n=70).**

Personal Characteristics	Study group (n=35)		Control group (n=35)		$\chi^2$	p-value
	No	%	No	%		
<b>Age (per years)</b>						
≤21	24	68.6	23	62.5	0.00	1
>21	11	31.4	12	37.5		
<b>Mean +SD</b>	21.3±0.52		21.3±0.54			
<b>Gender</b>						
Male	9	25.7	8	22.9	0.078	0.78
Female	26	74.3	27	77.1		
<b>Marital status</b>						
Single	32	91.4	30	85.7	0.00	1
Married	3	8.6	5	14.3		
<b>Residence</b>						
Rural	7	20	6	17.1	0.00	1
Urban	28	80	29	82.9		

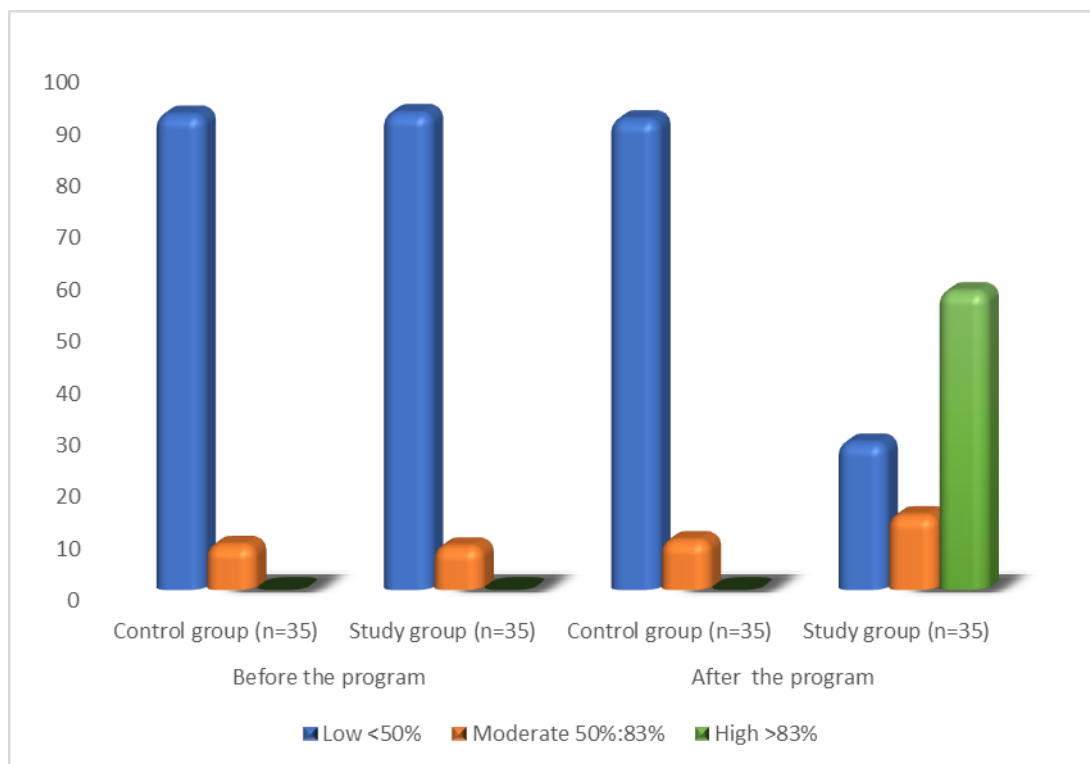
**Table 2: Metacognition levels of nursing students in the study and control groups throughout the program phases (n=70).**

Metacognition levels	Before the program				After the program			
	Control group (n=35)		Study group (n=35)		Control group (n=35)		Study group (n=35)	
	No	%	No	%	No	%	No	%
<b>Low &lt; 55%</b>	30	<b>85.71</b>	29	<b>82.9</b>	25	71.42	2	8.6
<b>Moderate 55%:82%</b>	5	14.28	6	17.1	6	17.1	5	14.28
<b>High &gt; 82%</b>	0	0	0	0	4	<b>11.42</b>	28	<b>80</b>

**Figure 1: Levels of nursing students' knowledge of cognition in the study and control groups throughout the program phases (n=70).**



**Figure 2: Levels of nursing students' regulation of cognition in the study and control groups throughout the program phases (n=70).**



**Figure 3: Levels of critical thinking abilities among nursing students in the study and control groups throughout the program phases (n=70).**

**Table 3: Total mean score of critical thinking domains among nursing students in the study group throughout the program phases (n=35).**

Critical thinking domains	Before the program (n=35)	After the program (n=35)	Paired t	P. value
	Mean $\pm$ SD	Mean $\pm$ SD		
Analysis	14.26 $\pm$ 4.10	<b>21.10<math>\pm</math>2.48</b>	21.18	<0.001**
Evaluation	12.51 $\pm$ 3.91	16.96 $\pm$ 3.27	12.80	<0.001**
Inference	<b>15.33<math>\pm</math>4.04</b>	19.78 $\pm$ 3.04	13.34	<0.001**
Deductive reasoning	11.54 $\pm$ 4.30	14.93 $\pm$ 4.20	10.60	<0.001**
Inductive reasoning.	10.30 $\pm$ 2.04	15.90 $\pm$ 3.21	8.28	<0.001**
<b>Total scores</b>	<b>16.70<math>\pm</math>2.60</b>	<b>30.60<math>\pm</math>3.00</b>	<b>85.92</b>	<b>&lt;0.001**</b>

**Table 4: Relation between nursing students' metacognition in the study group and their personal characteristics throughout the program phases (n=35)**

Variables	Metacognition					
	Before the program			After the program		
	Mean $\pm$ SD	T	p-value	Mean $\pm$ SD	T	p-value
<b>Age (years):</b>						
$\leq$ 21	8.6 $\pm$ 2.5	0.303	0.587	23.6 $\pm$ 2.4	0.563	0.406
>21	7.66 $\pm$ 2.5	0.025	0.894	22.3 $\pm$ 1.8	1.257	0.724
<b>Gender:</b>						
-Male	7.1 $\pm$ 2.3	1.607	0.062	21.6 $\pm$ 1.8	1.307	0.151
-Female	9.6 $\pm$ 2.6	0.257	0.071	23.2 $\pm$ 1.6	0.636	0.461
<b>Marital status:</b>						
Single	8.7 $\pm$ 2.5	0.247	0.508	23.4 $\pm$ 1.9	0.808	0.36
Married	7.5 $\pm$ 2.1	1.607	0.062	21.6 $\pm$ 1.8	1.307	0.151
<b>Residence:</b>						
- Rural	8.6 $\pm$ 2.5	0.303	0.587	23.6 $\pm$ 2.4	0.563	0.406
- Urban	7.66 $\pm$ 2.5	0.025	0.894	23.2 $\pm$ 1.6	0.636	0.461

**Table 5: Relation between nursing students' critical thinking in the study group and their personal characteristics throughout the program phases (n=35)**

Variables	Critical thinking					
	Before the program			After the program		
	Mean $\pm$ SD	T	p-value	Mean $\pm$ SD	t	p-value
<b>Age (years):</b>						
$\leq$ 21	11.9 $\pm$ 2.4	0.185	0.746	30.2 $\pm$ 2.4	2.055	0.632
>21	10.7 $\pm$ 2.3	0.164	0.601	29.7 $\pm$ 2.2	0.831	0.252
<b>Gender:</b>						
Male	10.52 $\pm$ 2.3	0.033	0.856	27.53 $\pm$ 2.2	0.123	0.777
Female	11.64 $\pm$ 2.5	0.412	0.092	28.28 $\pm$ 2.3	0.571	0.195
<b>Marital status:</b>						
Single	12.6 $\pm$ 2.4	1.468	0.124	29.2 $\pm$ 2.2	0.632	0.364
Married	10.5 $\pm$ 2.3	0.036	0.866	27.3 $\pm$ 1.3	0.117	0.719
<b>Residence:</b>						
Rural	13.1 $\pm$ 2.5	1.670	0.159	32.6 $\pm$ 2.4	2.611	0.802
Urban	11.4 $\pm$ 2.6	0.536	0.64	29.8 $\pm$ 2.2	0.572	0.727



## Discussion:

Regarding to personal characteristics of the nursing students in the study and control groups, the findings of the present study showed that the highest percentage of nursing students were female. This may be due to that entering of male to nursing faculties is recent in Egypt in general and Zagazig University particularly. In addition, the community vision of nursing career as a female impression make restriction on male students to enter the faculty of nursing. Nursing has historically been a female-dominated profession, and women continue to make up the majority of nursing students. Also, there are several factors that contribute to the gender imbalance in nursing. One factor is societal expectations and gender roles, which have traditionally placed a greater emphasis on caregiving and nurturing roles for women. Additionally, nursing has often been portrayed as a "feminine" profession, which may discourage men from pursuing careers in nursing.

This finding agreed with **El-Guindy et al., (2022)**, who carried out a study to determine metacognition and mindfulness and its relation to decision making abilities and found that the highest percentage of participants were females. In the same line, **Chan, Yen, & Ting (2021)**, who assessed generic capabilities and metacognitive awareness of first-year nursing students and found that the majority of nursing students were female.

Also, **Jin and Ji (2020)**, who conducted a study to examine the correlation of metacognitive ability, self-directed learning ability and critical thinking in nursing students and reported that most of nursing students were female. Likewise, **Hind, Awatef, Hanan (2019)**, carried out a study in Egypt to assess

nursing students' perspective of metacognition competency, self-regulation, and problem-based learning strategy and found that most of nursing students were females.

### **Metacognition level of nursing students in both the study and control groups throughout the program phases**

The findings of the present study revealed that the nursing students in both the study and control groups had a low level of metacognition before the training program implementation. However, after the metacognitive training program was implemented, the nursing students in the study group had a significantly higher level of metacognition compared to those in the control group. This was likely due to the fact that the program provided actual practice and instruction on metacognitive strategies and skills, which helped the nursing students in the study group to better understand their own knowledge and improve their problem-solving, self-assessment, and self-correction capabilities.

Also, this may be due to before the implementation of the program the nursing students did not have any idea regarding metacognition. While, the metacognitive skills training program implementation enrich the knowledge of nursing students in the study group regarding metacognition than those in control group. The finding that the highest percentage of nursing students in the study group had a high level of metacognition after the program implementation is consistent with the goal of metacognitive training program, which is to help students develop their metacognitive skills and the fact that the control group did not show the same improvement suggests that the program

was effective in promoting metacognitive development among nursing students.

The current study findings were consistent with a study carried out by **Li et al., (2022)**, to examine the effect of a nursing comprehensive skill training course on nursing students' metacognitive awareness and concluded that the training program had a significant positive effect on the nursing students' metacognitive awareness. Also, these findings in the same line with a study carried out by **Li & Yuan (2022)**, to assess the effectiveness of a metacognitive intervention on enhancing students' metacognitive development and reported that the metacognitive intervention had a significant positive effect on the students' metacognitive development and the students reported higher levels of metacognitive skills and use of metacognitive strategies after the intervention.

Similarly, these findings agreed with **Yıldırım (2021)**, who carried out a study to investigate the effect of metacognitive training on the metacognitive awareness of nursing students and found that the nursing students in the study group had a significantly higher level of metacognitive awareness compared to the control group after the intervention. Also, **Karabacak & Karadağ (2021)**, conducted a study to examine the effect of metacognitive training on nursing students' metacognitive awareness and found that the nursing students in the study group had a significantly higher level of metacognitive awareness compared to the control group after the intervention.

Likewise, **Hsu, Chang & Lee (2021)**, carried out a study to determine the effects of metacognitive training on nursing students' metacognitive knowledge and regulation and reported that the nursing students in the study group

had a significantly higher level of metacognitive knowledge and regulation compared to the control group after the intervention. Additionally, these findings were consistent with a study carried out by **Kaya, Avcı & Bulduk, (2020)**, to investigate the effect of metacognitive training on nursing students' metacognition and academic achievement and concluded that the nursing students in the study group had a significantly higher level of metacognitive knowledge and regulation compared to those in control group after the intervention.

#### **Nursing students' knowledge of cognition domain of metacognition throughout the program phases in the study group.**

As regarding knowledge of cognition domain of metacognition, the current study findings showed that the nursing students in the study group demonstrated a significant improvement in their knowledge of cognition after the metacognitive training program compared to those in the control group. These findings were in agreement with **Mok and Li (2021)**, who conducted a study to examine the effects of metacognitive training on metacognitive knowledge and found that the metacognitive training had a significant positive effect on the students' metacognitive knowledge and the students of the study group showed greater improvement in their metacognitive knowledge than the control group.

Also, **Chen, Zhang & Zhang (2021)**, who conducted a study to examine the effects of metacognitive training on self-regulated learning and metacognitive knowledge of nursing students and the results of the study showed that the metacognitive training had a significant positive effect on the students'

metacognitive knowledge. Likewise, **Wu et al. (2021)**, who conducted a study to investigate the effects of metacognitive strategy training on metacognitive knowledge and self-regulated learning strategies among nursing students and concluded that a metacognitive training program improved nursing students' metacognitive knowledge.

Similarly, **Park and Shin (2020)**, conducted a study to investigate the effect of a metacognitive training program on metacognition and academic performance in nursing students and the results of the study showed that the nursing students who received the metacognitive training program had significantly higher levels of metacognitive knowledge than those who did not receive the training.

Similar results found in a study carried out in Taiwan by **Kuo, Chen & Lin (2020)**, to examine the effect of metacognitive training on metacognitive knowledge and reported that the metacognitive training had a significant positive effect on the students' metacognitive knowledge. Also, **Alesi, Bianco, and Pepi (2020)**, conducted a study in Italy to examine the effectiveness of a metacognitive training program on metacognitive knowledge and academic achievement and found that the metacognitive training program had a significant positive effect on the students' metacognitive knowledge.

#### **Regarding nursing students' regulation of cognition in the study and control groups throughout the program phases**

The study findings showed that there was a significant improvement in the level of regulation of cognition in the study group compared to those in the control group throughout the program phases. As, the highest percentage of nursing students had low level of metacognitive regulation

before program implementation in both study and control groups. However, after the program implementation, the majority of nursing students in the study group had high level of metacognitive regulation compared to the control group.

These findings may be attributed to that the training program provided the nursing students in the study group with the requirements knowledge and skills to be able to monitor, regulate, adjust their cognitive processes, evaluate the knowledge, proficiency and performance in order to increase their ability to skillfully plan and implement activities in their learning. In addition, the training program enabled nursing students to organize their time, pace themselves enough time during making decision, consciously focus attention on important information, consider several alternatives to a problem before they answer, ask themselves periodically if they are meeting their goals, re-evaluate their assumptions when get confused and ask themselves how well accomplish their goals once they finished.

These findings were in agreement with a study carried out by **Li et al. (2022)**, who conducted a study to examine the effect of a nursing comprehensive skill training course on nursing students' metacognitive awareness and concluded that the majority of the study group of nursing students had high level of regulation of cognition after the program implementation compared to the control group. Also, a study carried out by **Milliner & Dimoski (2021)**, to explore the metacognitive regulation of nursing students and concluded that the majority of the study group of nursing students had significantly higher levels of metacognitive regulation.

Likewise, **Kopp et al. (2021)**, who conducted a study to investigate the effect of a metacognitive training program on self-regulated learning and academic performance in medical students and found that the medical students who received the metacognitive training program had significantly higher levels of metacognitive regulation than those who did not receive the training program. Similarly, a study carried out by **Li et al. (2021)**, in China to investigate the effect of a metacognitive training program on the metacognitive ability of college students and showed that the college students of the study group had significantly higher levels of metacognitive regulation than the control group.

Also, **Shin and Park (2021)**, who conducted a study to investigate the effect of a metacognitive training program on self-regulated learning and academic performance in nursing students and reported that the nursing students of the study group had significantly higher levels of metacognitive regulation after the implementation of the training program. Likewise, **Yoo and Kim (2020)**, who conducted a study to investigate the effects of a metacognitive strategy-based nursing education program on problem-solving ability, critical thinking disposition, and academic stress in nursing students and concluded that the nursing students of the study group had significantly higher levels of regulation of cognition.

Moreover, these findings consistent with a study carried out by **Han, Kim, & Yoo (2020)**, to investigate the effects of a metacognitive strategy-based nursing education program on self-efficacy, learning attitude, and academic performance in nursing students and the results of the study showed that the nursing students who received the metacognitive strategy-based nursing education program

had significantly higher levels of metacognitive regulation.

In the same line, **Tan and Ng (2020)** who conducted a study to investigate the effect of a metacognitive training intervention on self-regulated learning and academic performance and concluded that the students who received the metacognitive training intervention had significantly higher levels of metacognitive regulation after implementation of the training program. Also, a study carried out by **Park and Shin (2020)**, to investigate the effect of a metacognitive training program on metacognition and academic performance in nursing students and the results of the study showed that the nursing students who received the metacognitive training program had significantly higher levels of metacognitive regulation than those who did not receive the training.

#### **Concerning level of critical thinking abilities among nursing students in the study and control groups throughout the program phases**

According to the present study findings, there was a significant improvement in critical thinking abilities among nursing students in the study group compared to the control group. As, before the program implementation, the highest percentage of nursing students in both the study and control groups had a low level of critical thinking abilities. However, after the program implementation, more than half of the nursing students in the study group had high level of critical thinking abilities compared to those in the control group.

The findings of the present study suggest that the metacognitive training program was effective in improving the critical thinking abilities of nursing students. The program likely helped students to develop skills such as analyzing

information, evaluating situations, and applying appropriate problem-solving strategies. The program may have also promoted reflection and self-evaluation, which are important components of critical thinking. Also, the improvement in critical thinking abilities observed in the present study may be attributed to the use of teaching methods that may promote critical thinking and encourage nursing students to take an active role in their learning process. These methods included problem-solving exercises, hypothesis generation, and open discussion of issues related to the subject matter. By engaging in these activities, nursing students developed the skills and strategies needed to think critically.

These findings of the current study were consistent with a study carried out by **Alharbi, Almutairi & Alhusaini (2021)**, to investigate the effect of metacognitive training on critical thinking skills among nursing students and found that the mean scores of critical thinking skills significantly increased in the study group after the implementation of the metacognitive training program. Also, **Al-Qadire et al., (2021)**, carried out a study in Jordan to investigate the effect of a metacognitive intervention on critical thinking among nursing students and the results of the study showed that the students in the study group had significantly higher levels of critical thinking abilities compared to the control group.

Likewise, **Huang & Lin (2021)**, who conducted a study in Taiwan to investigate the effects of a metacognitive training program on the critical thinking and self-regulated learning abilities and concluded that the students in the study group had significantly higher levels of critical thinking after implementation of the

training program. Additionally, **Kaya & Bulduk (2020)**, conducted a study to examine the effect of metacognitive training on nursing students' critical thinking and self-efficacy and found that the nursing students in the study group had a significantly higher level of critical thinking compared to the control group after the intervention.

In the same line, **Huang & Lin (2020)**, conducted a study to evaluate the effects of a metacognitive training program on self-directed learning and critical thinking skills in nursing students and concluded that the students in the intervention group had significantly higher levels of critical thinking skills compared to the control group. Moreover, these findings of the current study were in agreement with a study carried out in Iran by **Bakhtiari, Javadi & Khademian (2020)**, to assess the effect of metacognitive training on critical thinking skills of medical students and reported that the students in the study group had significantly higher levels of critical thinking skills compared to the control group.

Similarly, these findings were in accordance with a study conducted in United States of America, by **Kachapati & Ghimire (2019)**, to investigate critical thinking skills among nursing students and found that the highest percentage of nursing students had low level of critical thinking skills before implementing of the program, while after the program implementation near from half of the nursing student had high level of critical thinking abilities. Also, **Liu et al. (2019)**, carried out a study to examine the effects of a metacognitive training program on critical thinking skills in college students and clarified that the nursing students in the study group had significantly higher

levels of critical thinking skills after the training program implementation.

### **Regarding mean score of critical thinking domains among nursing students in the study group throughout the program phases**

According to the results of the current study, before the program implementation, it is well-defined from that the highest mean score of critical thinking domains as reported by nursing students in the study group was related to an inference domain. While, after the program implementation, the highest mean score of critical thinking domains was related to analysis domain. The findings of the current study suggested that the implementation of the metacognitive training program was effective in improving the analysis subscale score of nursing students particularly the students' abilities to analyze information and situations, which is an essential component of critical thinking in nursing education.

This implies that the program likely provided nursing students with the knowledge, skills, and strategies needed to analyze information and situations effectively. Also, it may have promoted inquiry, reasoning, and task management skills, which may have contributed to the development of critical thinking abilities among nursing students.

These findings of the current study were in the same line with a study carried out in Korea by **Kim et al. (2022)**, to investigate the effect of a simulation-based education program on critical thinking skills among nursing students and found that the study group had higher mean score on the analysis domain after implementation of the training program. Also, **Yang et al. (2022)**, conducted a study in China to investigate the effect of metacognitive intervention on critical

thinking skills among nursing students and the results of the study showed that the nursing students who received the metacognitive intervention had significantly higher scores on the analysis, and evaluation domains.

Similarly, these findings were consistent with a study carried out in Korea by **Yoo and Kim (2019)**, to investigate the effect of a metacognitive training program on critical thinking skills among nursing students and found that the nursing students in the study group had significantly higher scores on the analysis and evaluation domains. As well, **Alghamdi et al. (2021)**, conducted a study in Saudi Arabia to evaluate the effect of a metacognitive intervention on critical thinking skills among nursing students and revealed that the nursing students in the study group had significantly higher score on the analysis domain after the intervention.

Additionally, these findings were in accordance with **Amini et al. (2021)**, who conducted a study in Iran to investigate the effect of metacognitive intervention on critical thinking skills among nursing students and found that the nursing students in the study group had significantly higher scores on the analysis and evaluation domains after the intervention.

### **Relation between nursing students' metacognition in the study group and their personal characteristics throughout the program phases.**

The current study findings revealed that, there was no statistically significant relation between nursing students' metacognition in the study group and their personal characteristics throughout the program phases. This might be due to that the personal characteristics examined in the study, such as age, gender, residence,

and marital status, may not be strongly related to metacognitive skills. There may be other personal characteristics, such as motivation, self-efficacy, and learning style, that are more strongly related to metacognitive skills but were not examined in the study.

These findings of the current study disagreed with a study carried out by **El-Sayed & El-Mekawy (2021)**, to investigate the relationship between metacognitive skills and critical thinking among nursing students and found that there was a significant positive correlation between metacognitive skills among nursing students in the study group and their personal characteristics such as age, gender, and academic level. Also, **Orhan & Dicle (2021)**, conducted a study to examine the relationship between metacognitive skills and academic achievement of nursing students and found a significant positive relationship between metacognitive skills and their personal characteristics such as age, gender, and academic level.

As well, these findings were inconsistent with **Chong et al. (2020)**, who carried out a study to develop metacognitive awareness and skills in undergraduate nursing students and found that personal characteristics such as age and academic level were significantly related to metacognitive awareness and skills among nursing students. Likewise, **Al-Sayed & Al-Hamdan (2021)**, conducted a study to determine the relationship between metacognitive skills and academic achievement among nursing students and found a significant positive relationship between metacognitive skills among nursing students in the study group and their personal characteristics such as age, gender, and academic year.

### **Relation between nursing students' critical thinking in the study group and their personal characteristics throughout the program phases.**

The present study findings showed that there was no statistically significant relationship between critical thinking of nursing students and their personal characteristics throughout the program phases. It is possible that critical thinking is a complex construct that is influenced by multiple factors and the present study had only examined personal characteristics and not considered other factors that may influence critical thinking including personal characteristics, academic experiences, and clinical practice.

These findings were similar to a study conducted in Iran by **Ghazivakili et al (2022)**, which aimed to determine the relationship between learning styles and critical thinking of students and their academic performance and the study found that there was no statistically significant relationship between critical thinking skills among nursing students and their personal characteristics before and after the program implementation.

Also, these findings agreed with a study conducted in Turkey by **Özcan & Elçioka (2019)**, which aimed to determine the critical thinking skills level of nursing students and the study revealed that there was no statistically significant relationship between students' personal characteristic and their critical thinking skills score. Likewise, **Ozdemir & Ozkan (2017)**, who conducted a study in Turkey to investigate the relationship between critical thinking skills and various personal characteristics in nursing students and reported that there was no statistically significant relationship between critical thinking of nursing students and their age, gender, and marital status.

Conversely, these findings of the current study were in disagreement with a study carried out by **El-Sayed & El-Mekawy (2021)**, to investigate the relationship between metacognitive skills and critical thinking among nursing students and concluded that there was a significant positive relationship between critical thinking among nursing students and their personal characteristics such as age, gender, and academic level.

#### **Conclusion:**

In the light of the main study findings, it can be concluded that there were statistically significant improvements regarding nursing students' metacognition and critical thinking levels after metacognitive program implementation in the study group than control group. In addition, there were a statistically significant correlation between metacognition and critical thinking after implementation of the training program.

#### **Recommendations:**

- Integrating metacognitive skills training into the nursing curriculum and make it a focus across courses and clinical placements, not just an add-on program.
  - Providing training courses to faculty members on how to develop students' metacognitive skills and play a role in modeling and coaching these skills.
  - Providing resources, guidance and support for faculty members to incorporating metacognitive strategies into their teaching and clinical supervision.
  - Adopting active learning strategies (case studies, reflections, simulations, group projects, and problem-solving activities) that require students to apply metacognitive skills.
  - Evaluating students' metacognitive skills at the program level using surveys and interviews to evaluate the impact of their training programs.
- Conducting research to identify best practices for teaching metacognition in a nursing context.
  - Working to ensure that developing graduates' metacognitive skills becomes a recognized priority and standard in nursing education.

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