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The Impact of Metamemory Skills and Cognitive Load on Mindfulness among College Students

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Abstract

This study aimed to identify the association of metamemory skills and cognitive load to mindfulness and to examine the effect of the interaction between metamemory skills and cognitive load on mindfulness among students at Taif University. The study sample comprised 594 male and female students at Taif University. The researcher developed the Metamemory Skills Scale and the Mindfulness Scale. Also, Al-Feil's (2013) Cognitive Load Scale was adopted. The findings revealed a positive significant relationship between metamemory skills and mindfulness and a negative significant relationship between cognitive load and mindfulness among Taif University students. The findings also showed no significant effect of the interaction between metamemory skills and cognitive load on mindfulness. The researcher set several recommendations in light of the findings of the study.

Keywords: *metamemory skills, cognitive load, mindfulness, Taif University*

Introduction

The university stage is a critical developmental stage that corresponds to late adolescence. It imposes challenges and burdens on students, such as taking responsibilities, playing different roles, and making new friendships that they were not familiar with before, which would generate many pressures, conflicts, and disturbances for them.

The concept of mindfulness gained the attention of psychologists as a psychological concept at the beginning of the 1990s. It occupied the minds of researchers and psychotherapists with cognitive and behavioral orientations, and it was used as a therapeutic technique in the treatment of many psychological disorders. The concept of mindfulness is not a new term; instead, it is a part of our lives and daily dealings, as is the ability to be fully aware. It "refers to the presence of individuals in the present moment, i.e., at present, regardless of the surrounding circumstances" (Khafagy, 2013, p. 11). We usually remain in this state for short periods, quickly absorbed into familiar daydreams and personal stories. The ability to be aware from moment to moment, especially during emotional turmoil, is a particular skill that can be learned (Siegel et al., 2009). Mindfulness is the self-regulation of attention processes that help preserve the direct experience. It is the mental events that occur at the moment, which includes adopting certain attitudes toward the individual's experiences at the present moment and is characterized by openness, curiosity, and acceptance (Bishop et al., 2004).

Metamemory skills support memory work and are involved in all cognitive processes. They consist of two basic processes: monitoring, which means collecting information and becoming

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aware of it, and control, which is concerned with the process of self-regulation to activate and direct those same cognitive processes, as happens when allocating an appropriate time to study the topic in order to facilitate recalling it later depending on the difficulty of the topic (Howard et al., 2010). Metamemory is the learner's awareness of his memory system, self-awareness of its processes, and how to organize it. It includes awareness of strategies and how to employ them and monitor their effectiveness and the efficiency of cognitive activity in facing tasks (Abdel Fattah, 2005).

Learners need more working memory, and overloading this memory hinders fruitful learning. Therefore, we must control the working memory load to facilitate learning. This is the basic premise on which the theory of cognitive load is based. (Lin, 2009). The main concern of this theory is the necessity of adapting education to suit the controls and boundaries of the learner's cognitive system. Therefore, it seeks to integrate the nature of the learner's cognitive system and the principles of educational design (Schnotz & Kürschner, 2007).

Al-Feil (2013) believes that the goal of cognitive load theory is the learning process without overloading the working memory with activities and information that are not directly related to the learning process. If the cognitive load in working memory increases, the mental effort expended by the learner to process information will increase accordingly, which will affect the construction and formation of cognitive structures in long-term memory. Cognitive load is defined as the total mental activity in working memory during a given time. It is measured by the number of cognitive units or elements, and the main factor that constitutes the cognitive load is the number of elements that must be paid attention to (Abu Rayash, 2007). It represents the resources working memory uses at a specific time (Chang et al., 2011, p190).

Mindfulness strongly predicts mental health and its practical impacts on performance, behavior, and adjustment. Although empirical studies have indicated rapid growth in the effectiveness of interventions based on mindfulness, few of them have investigated the mechanisms or processes through which mindfulness can be practiced and measured (e.g., Baer et al., 2008). Regarding the relationship of mindfulness to some variables, the results of Hollis-Walker and Colosimo's study (2011) revealed that mindfulness was positively associated with psychological well-being, self-compassion, agreeableness, extraversion, openness, and conscientiousness, while it was negatively associated with neuroticism and isolation. Al-Zubaidi (2012) reported a positive relationship between psychological stability and mindfulness among middle school students.

For the relationship of cognitive load to some variables, the results of Chen and Chang's study (2009) revealed a negative correlation between cognitive load and performance and a positive relationship between perceived difficulty and cognitive load. Al-Abadi's study (2014) revealed a negative relationship between cognitive load and ego resiliency. In addition, Al-Harthi (2015) reported a negative relationship between students' cognitive load and their cognitive skills.

Moreover, some studies have examined the relationship of metamemory skills to some variables (Al-Jarrah, 2010; Pannu & Kaszniak, 2005). The findings of Pannu and Kaszniak's study (2005) revealed a strong relationship between structural integrity and metamemory accuracy. Al-Jarrah's study (2010) also showed a significant correlation between metamemory and the internal locus of control.

Although the studies mentioned above examined the relationship of the study variables to other variables, there were scarce studies on the relationship between cognitive load and mindfulness (e.g., Bishara, 2021, 2022). Moreover, no studies examined the association between

metamemory skills and mindfulness, nor the impact of metamemory skills and cognitive load on mindfulness. Therefore, this study will examine the associations between metamemory skills and cognitive load to mindfulness and the effect of the interaction between metamemory skills and cognitive load on mindfulness among Taif University students.

This study is a response to the recommendations of previous studies that investigated metamemory skills, cognitive load, and mindfulness. Also, only some studies that examined the variables of this study (e.g., Al-Abadi, 2014; Al-Buhairi et al., 2014; DeMarie & Ferron, 2003; Fadl, 2012) did not examine the relation of the findings of this study may help specialists and researchers in the educational and psychological fields conduct more studies. The study may also stimulate many new research ideas among researchers related to its variables. The study's findings may deepen the educational and psychological research on metamemory skills, cognitive load, and mindfulness.

Literature Review

Metamemory Skills

Many concepts related to metacognition have emerged recently, such as metacognition, meta-mood, meta-motivation, and metamemory, launched by Flavell in 1971 when he organized a conference called Research in Child Social Development. This conference's main focus was 'What It Helps in the Development of Memory.' The term metacognition is considered the umbrella that includes all the terms that preceded it and is the most general. In recent decades, metamemory has been the most widespread and attractive concept for many researchers, and it has become the main topic that has captured the attention of psychology scholars (Al-Toubasi, 2007).

Matlin (2005) defined metamemory as an individual's knowledge, awareness, and control of his memory and its processes. Shams El-Din (2005) believes that metamemory consists of five components: Awareness component: it refers to individual's awareness of his memory capabilities, how they work, and their processes that include encoding, storage, and retrieval. Diagnosis component: The individual can estimate the difficulty/ease of memory tasks in terms of the amount of material, familiarity with the information, speed of presenting the material, and how it is organized. Monitoring component: It is the individual's observation of his progress when entering information into memory, the continuous observation of information processing and processing processes during the implementation of tasks, and the individual's ability to predict the possible results of mental activity in the future. Regulation component: The individual can organize information in memory in a way that helps him remember it more efficiently and divide time by processing the implementation of memory tasks to achieve the best possible performance. Metamemory strategy component: Individuals can choose the most appropriate decisions and actions while carrying out memory tasks.

Many studies were conducted to explore metamemory skills and their relation to other variables. For example, Al-Jarrah (2010) conducted a study to identify the level of metamemory, the point of control, and the relationship between them among university students. The results revealed that students have moderate awareness of how their memory works. The results also showed a significant correlation between metamemory and internal locus of control. Chua and Bliss-Moreau (2016) examined if knowledge of one's mind and body are related by examining metamemory and interoception. The findings revealed that individuals with better metamemory accuracy also had better interoceptive accuracy.

Moreover, Hu et al. (2019) explored the role of metamemory in cognitive offloading. The findings showed that participants' confidence about their memory predicted their use of the saved information, indicating that metacognitive evaluation of memory performance is associated with cognitive offloading. Moreover, it was found that there was a close link between metamemory and cognitive offloading.

Cognitive Load

The learning process is one of the cognitive processes that most attract the interest of educational and psychology scholars to improve this process and identify the best strategies and methods that can be used to facilitate its implementation and achieve the best results (Al-Feil, 2013). The primary purpose of cognitive load theory is to present new information in an organized manner to reduce the unnecessary cognitive load on working memory.

The cognitive load is divided into three categories. The first category is the intrinsic cognitive load, which depends on the interactivity of the elements determined through the interaction between the nature of the learned material and the learners' experiences. The essential cognitive load results from beneficial cognitive processes such as abstraction and elaboration that the educational presentation enhances (Anthony, 2008). The second category is the extraneous cognitive load, called the ineffective cognitive load, because it arises from information and activities that do not directly contribute to building cognitive schemas and their automatic operation (Paas et al., 2004). The intrinsic and extraneous cognitive load determine the total cognitive load, and if the cognitive load exceeds the memory capacity, then learning and information processing will decrease; that is, the change in long-term memory will be unhelpful (Sweller, 2010). The third category is the Germane cognitive load, called the effective cognitive load, because it arises from information and activities that contribute directly to building cognitive schemas and their automatic operation (Paas et al., 2004). In addition, the Germane cognitive load is a productive cognitive load that must be developed because it contributes to building and forming cognitive structures, indicating learning. This cognitive load arises from the learner's involvement in the learning process to better understand the learning materials (Al-Feil, 2013).

Substantial studies were conducted to explore the nature of cognitive load among different samples in different contexts. For example, Chen and Chang (2009) identified the relationship between listening comprehension of a foreign language and cognitive load. It also aimed to identify the relationship between levels of anxiety and cognitive load. Twenty males and 68 females participated in this study. The findings revealed a negative correlation between foreign language learning anxiety and performance. A negative correlation was found between cognitive load and performance. The findings also revealed a positive correlation between cognitive load and foreign language learning anxiety, as well as a positive relationship between perceived difficulty and cognitive load. In a different context, Gillmor et al. (2015) examined the effect of reducing the cognitive load in mathematics assessment on student's performance and anxiety. The sample consisted of (222) eighth-grade students. The findings showed that reducing the cognitive load in mathematics assessment improves students' performance. The findings also revealed no effect of reducing the cognitive load on students' anxiety.

On the other hand, Al-Abadi's study (2014) aimed to identify the level of cognitive load and ego resiliency among university students. This study was applied to a sample of (400) male and female students at the University of Diyala. The findings revealed that university students have a cognitive load and ego-resiliency. The findings also showed a negative correlation between

students' cognitive load and ego resiliency. Similarly, Al-Harthy (2015) explored the relationship of cognitive load to cognitive skills. This study was applied to a sample of (120) students in the sixth grade of primary school with academic learning difficulties in various schools in the Riyadh region. The researcher used a measure of cognitive load consisting of (40) items. The results revealed a negative relationship between students' cognitive load and cognitive skills.

Moreover, Al-Sarry et al. (2022) explored the level of cognitive load among college students and its relation to academic achievement. The sample consisted of (200) male and female students randomly chosen. It was concluded that college students have a cognitive load. Also, cognitive load was positively correlated with academic achievement.

Mindfulness

Recently, more focus has been placed on employing mindfulness in psychotherapy. Many therapists try to solve the patient's problems by unintentionally bypassing self-acceptance and self-understanding. Our emotional and behavioral problems can be amplified by our innate efforts to avoid disturbance under the pretext of changing our activities. The new approach has become that directed mindfulness is awareness and acceptance first and then come change second (Siegel et al., 2009)

Neff (2003) defined mindfulness as the ability of individuals to view their thoughts or emotional reactions from a balanced perspective in situations to what is happening in reality, which helps individuals avoid confusion with themselves. In addition, research indicates "that teaching mindfulness and providing education on the fight or flight response could support counselors in increasing observation skills. Increasing observation skills of the self-as-therapist can translate to being more observant of the client" (Murphy, 2013, p.34).

Previous research also indicated that mindfulness practices help therapists develop treatment by supporting and focusing on the self and the client and simultaneously tracking the therapeutic sessions (McCollum & Gehart, 2010). Accordingly, scholarly interests in mindfulness have expanded to study individual differences (such as the trait of mindfulness). A change has occurred in psychological research since some studies have shown some emotional fluctuations, appreciation of sex, insomnia, nicotine dependence, withdrawal, as well as contentment and stress (e.g., Sauer et al., 2011).

Moreover, previous studies on mindfulness showed rich findings. Few studies examined the relation of mindfulness to various variables. For example, Giluk (2009) conducted a study to explore the relationship between mindfulness and personality traits by analyzing (29) studies that considered these two variables. The findings revealed that despite the relationship between the five personality traits and mindfulness, especially the positive aspects of it, there was a negative relationship between mindfulness and neuroticism in particular. Also, Hollis-Walker and Colosimo's study (2011) aimed to identify the relationship between mindfulness and happiness and to explore the five-factor model of personality in its relationship to mindfulness. A total of (123) university students participated in this: (27) male and (96) female students with an average age of (20.9) years. The findings revealed that mindfulness was positively associated with happiness and positive personality traits such as openness to experience, extroversion, and agreeableness. At the same time, it was negatively correlated with neuroticism and isolation.

On the other hand, many studies aimed to measure the level of mindfulness across different samples. For instance, Al-Zubaidi's study (2012) aimed to explore psychological stability and

mindfulness and identify the relationship between psychological stability and mindfulness among middle school students. This study was applied to a sample of (600) male and female students. The results revealed that the students had psychological stability and mindfulness, and there was a positive relationship between psychological stability and mindfulness among middle school students. In addition, Al-Dabee (2016) conducted a study to explore the level of mindfulness and its relationship to academic happiness among primary school students and to identify the possibility of predicting academic happiness through mindfulness. The study sample consisted of (200) male and female students randomly selected from the sixth-grade students in Sohaj Governorate. The study's results indicated a high level of mindfulness among students and a significant relationship between mindfulness and academic happiness. The results of the study also showed that mindfulness could predict academic happiness.

Regarding the relationship between cognitive load and mindfulness, Bishara (2022) tested whether cognitive load is associated with mindfulness. Sixty students with learning disabilities and 60 students without learning disabilities were evaluated for cognitive load and mindfulness. The findings revealed a significant association between cognitive load and mindfulness only in the group of students without learning disabilities. In addition, Bishara (2021) examined if psychological availability and mindfulness were associated with cognitive load among students with and without learning disabilities. The findings showed that the study variables were strongly associated only with the students without learning disabilities but not with students with learning disabilities.

To sum up, mindfulness is believed to be a psychological structure that includes the student's ability to notice feelings of tension or physical discomfort, the psychological effect of food, and the effect of his psychological state on his feelings and thoughts. It also includes the student's ability to identify his feelings and choose appropriate words to express them precisely and immediately.

Therefore, this study will examine the relationship between metamemory skills, cognitive load and mindfulness among Taif University students, so the proposed hypotheses are:

H₁: *There is a statistically significant relationship at ($\alpha \leq 0.05$) between metamemory skills and mindfulness among Taif University students.*

H₂: *There is a statistically significant relationship at ($\alpha \leq 0.05$) between cognitive load and mindfulness among Taif University students.*

H₃: *There is a statistically significant effect at ($\alpha \leq 0.05$) of the interaction between metamemory skills and cognitive load on mindfulness among Taif University students.*

Materials and Methodology

Due to the nature of this quantitative study, the descriptive correlational approach was employed to examine the correlation between the study variables, determine the extent and direction of these relationships, and examine the impact of the interaction between metamemory skills and cognitive load on mindfulness among college students.

Participants

Participants of this study were 594 college students (age; $M = 20.84$ years, $SD = 2.09$) studying science ($n = 298$) and arts ($n = 296$); of them, 192 freshmen (32.32%), 196 juniors (33%), and 206 seniors (34.68%) at Taif University, Saudi Arabia. The sample was chosen randomly including 281 males (47.31%) and 313 females (52.69%).

Measures

Metamemory Skills Scale

The metamemory skills scale aimed to measure the metamemory skills of Taif University students. To develop the scale, the researcher reviewed many previous research studies on metamemory skills (e.g., Al-Jarrah, 2010; DeMarie & Ferron, 2003; Fadl, 2012; Magno, 2008; Pannu & Kaszniak, 2005; Zaitoon, 2011). The scale included three dimensions: awareness of metamemory (12 items), metamemory abilities (14 items), and metamemory strategies (10 items). The scale was based on a five-point Likert scale: Strongly Agree (5 points), Agree (4 points), Undecided (3 points), Disagree (2 points), and Strongly Disagree (1 point).

For validity, the scale was presented to (12) psychology professors in Saudi universities to check its face validity. The referees' agreement rate was 93.29%. The content validity was calculated using the Lawshe Content Validity Ratio (CVR) for each item in the scale (Johnston & Wilkinson, 2009). The (CVR) for Lawshe was (0.866) indicating that all items had acceptable content validity values.

In addition, the factorial validity was checked using the factorial analysis by applying the scale on a pilot sample ($n=93$). The analysis revealed that one factor explains (43.374%) of the variance in students' performance on the metamemory skills scale. The dimensions of the metamemory skills scale had saturations that exceeded (0.30) on the single factor. Therefore, they were statistically significant saturations, as the acceptable and statistically significant saturation value must not be less than (0.30). Moreover, the reliability of the metamemory skills scale was calculated using Cronbach's Alpha. The reliability of the current sample was 0.821.

Cognitive Load Scale

The cognitive load scale (Al-Feil, 2013) was adopted to measure the cognitive load among Taif University students. The original scale was developed upon previous cognitive load scales (Al-Feil, 2013). The scale included three traits of cognitive load: intrinsic (6 items), extraneous (5 items), and Germane cognitive load (5 items). The scale was based on a five-point Likert scale: Very High (5 points), High (4 points), Moderate (3 points), Low (2 points), and Very Low (1 point).

The factorial analysis of the original scale was performed and found that one factor explains (49.236%) of the variance in students' performance on the cognitive load scale. The dimensions of the cognitive load scale also showed saturations on the single factor, and its value exceeded (0.30). Cronbach's alpha calculated the reliability of the original scale, and it was (0.88).

The current study applied the scale to a pilot sample ($n=93$). The construct validity was calculated through internal consistency between the scale items and the scale's total score. The results showed that the scale was valid, and all correlation values were significant (0.01). Cronbach's alpha was calculated, and the reliability value was (0.796).

Mindfulness Scale

Many previous research studies related to mindfulness (e.g., Al-Behairy et al., 2014; Al-Dabee, 2016; Al-Dabee & Mahmoud, 2013; Al-Zubaidi, 2012; Giluk, 2009; Khader & Eliwi, 2015; Leinberger, 2012; Sauer et al., 2011; Hollis-Walker & Colosimo, 2011) were reviewed to develop the mindfulness scale. In addition, the researcher reviewed many mindfulness scales such as The Freiburg Mindfulness Inventory (FMI) (Walach et al., 2006), Mindful Attention Awareness Scale (MAAS) (Brown & Ryan, 2003), Kentucky Inventory of Mindfulness (KIMS)

(Baer et al., 2004), Toronto Mindfulness Scale (TMS) (Lau et al., 2006), and Southampton Mindfulness Questionnaire (SMQ), (Chadwick et al., 2008). Then, the mindfulness scale was developed and included three dimensions: mindfulness observation (11 items), describing (9 items), and acting with awareness (10 items). The scale was based on a five-point Likert scale: Strongly Agree (5 points), Agree (4 points), Undecided (3 points), Disagree (2 points), and Strongly Disagree (1 point).

To confirm the scale's validity, (12) psychology professors in Saudi universities checked its face validity. The referees' agreement rate was 91.94%. The content validity was calculated using the Lawshe Content Validity Ratio (CVR) for each item in the scale (Johnston & Wilkinson, 2009). The (CVR) for Lawshe was (0.839) indicating the content validity of the mindfulness scale.

In addition, the factorial analysis was performed to assert the factorial validity of the scale (n=93). The analysis revealed that one factor explains (54.13%) of the variance in students' performance on the mindfulness scale. The dimensions of the scale had saturations that exceeded (0.30), which were accepted values. In addition, the reliability of the mindfulness scale was calculated using Cronbach's Alpha. The reliability of the current sample was 0.810.

Data Analysis and Results

Statistical Package for Social Sciences was run to analyze the study's quantitative data. Before analyzing the data, the Shapiro-Wilk test was performed to test data normality, and the test values ensured normal data distribution. The relationships between each two variables were checked, and they were found to be linear.

Pearson's correlation coefficient was run to test the associations of metamemory skills and cognitive load to mindfulness. In addition, A Univariate Analysis of Variance was conducted to examine the impact of the interaction between metamemory skills and cognitive load on mindfulness among college students.

First hypothesis

To examine the first hypothesis, "There is a statistically significant relationship at ($\alpha \leq 0.05$) between metamemory skills and mindfulness among Taif University students", Pearson's correlation coefficient was used to calculate the correlation between metamemory skills and mindfulness among Taif University students as shown in Table 1.

Table 1: The Correlation Matrix between Metamemory Skills and Mindfulness among Taif University Students (N=594).

Total	Mindfulness			Variables
	Acting with awareness	Describing	Mindfulness observation	
0.45**	0.73**	0.36**	0.49**	Awareness of metamemory
0.52**	0.65**	0.46**	0.51**	Metamemory abilities
0.54**	0.58**	0.35**	0.38**	Metamemory strategies
0.49**	0.62**	0.42**	0.44**	Total

** Significant at (0.01).

Table 1 shows a moderate positive significant correlation at ($\alpha \leq 0.01$) between metamemory skills and mindfulness ($r=0.49$). The most robust relationships were seen between the dimensions of metamemory: awareness of metamemory, metamemory abilities, and

metamemory strategies and acting with awareness (0.73, 0.65, 0.58 respectively). Conversely, the weakest associations were noticed between the dimensions of metamemory and describing (0.36, 0.46, 0.35, respectively).

Second hypothesis

To examine the second hypothesis, "There is a statistically significant relationship at ($\alpha \leq 0.05$) between cognitive load and mindfulness among Taif University students", Pearson's correlation coefficient was used to calculate the correlation between cognitive load and mindfulness among Taif University students as shown in Table 2.

Table 2: The Correlation Matrix between Cognitive Load and Mindfulness among Taif University Students (N=594).

Total	Mindfulness			Variables
	Acting with awareness	Describing	Mindfulness observation	
-0.38**	-0.19*	-0.12	-0.42**	Intrinsic
-0.47**	-0.11	-0.62**	-0.32**	Extraneous
-0.41**	-0.42**	-0.32**	-0.11	Germane
-0.56**	-0.31**	-0.39**	-0.36**	Total

** Significant at (0.01), * Significant at (0.05).

Table 2 shows a moderate negative significant correlation at ($\alpha \leq 0.01$) between cognitive load and mindfulness ($r=0.56$). All dimensions of cognitive load were negatively and significantly correlated to the dimensions of mindfulness were between ($r=-0.19$ to $r=-0.62$) except Germane cognitive load to mindfulness observation ($r=-0.11$), intrinsic cognitive load to describing ($r=-0.12$), and extraneous cognitive load to acting with awareness ($r=-0.11$). The most vital relation was found between extraneous cognitive load and describing.

Third hypothesis

To examine the third hypothesis, "There is a statistically significant effect at ($\alpha \leq 0.05$) of the interaction between metamemory skills and cognitive load on mindfulness among Taif University students", Univariate Analysis of Variance was used to calculate the significance of the differences in the mean scores of mindfulness among Taif university students due to the differences in the levels of metamemory skills, cognitive load, and the interaction between them. The results are shown in Table 3.

Table (3): Results of Univariate Analysis of Variance for the Differences in the Mean Scores of Mindfulness among Taif University Students due to the Differences in the Levels of Metamemory Skills, Cognitive Load, and the Interaction between them (N = 594).

P value	F	Mean Square	df	Type III Sum of Squares	Source
0.18	2.341	174.544	1	174.544	Metamemory skills (A)
0.91	0.472	24.639	1	24.639	Cognitive load (B)
0.86	0.558	29.146	1	29.146	Interaction between (A*B)
		52.235	590	30818.77	Error
			594	65404.38	Total

Table 3 shows no statistically significant differences at ($\alpha \leq 0.05$) in the mean mindfulness scores among Taif University students due to their levels of metamemory skills, cognitive load, and

interaction. The p-values for the differences in the mean scores of mindfulness due to the differences in the levels of metamemory skills, cognitive load, and the interaction between metamemory skills and cognitive load were 0.18, 0.91, and 0.86, respectively.

Discussion

The findings showed a moderate positive significant correlation between metamemory skills and mindfulness. These findings are attributed to the fact that metamemory skills, including awareness of metamemory, metamemory abilities, and metamemory strategies, enabled a student to be aware of the limits and nature of his memory and the extent of his discomfort with the state of. They also enabled him to set limits to his memory, what he can remember, and what he cannot remember. They also included the student's ability to identify the strategies he used to help him remember, such as diaries and keywords. This, in turn, affected the student's ability to observe things from different angles and notice the connection between things that might seem to others to be unrelated. Metamemory skills also affected the student's ability to choose the word he was looking for and his ability to express what he wanted without losing his mind. Consequently, it is believed that the positive relationship between metamemory skills and mindfulness among Taif University students was logical.

These findings were consistent with the findings of Pannu and Kaszniak (2005), which revealed that many factors affected metamemory performance, such as contemplation tasks and future vision. These findings were also consistent with the findings of Al-Jarrah's study (2010), which revealed a significant correlation between metamemory and the internal locus of control if we accepted that contemplation, future vision, and locus of control had a strong relationship with mindfulness in terms of their nature. In addition, these findings agreed with the findings of Chua and Bliss-Moreau (2016), which revealed that participants' confidence in their memory predicted their use of the saved information.

Regarding the relationship of mindfulness to some variables, the study findings were consistent with Hollis-Walker and Colosimo (2011), which revealed that mindfulness was positively associated with happiness and positive personality traits such as openness to experience, extroversion, and agreeableness. They were also consistent with the result of Al-Zubaidi (2012), which revealed a positive significant relationship between psychological stability and mindfulness among middle school students.

The study's findings also indicated a moderate negative significant correlation between cognitive load and mindfulness. These findings were attributed to the fact that when the mental energy allocated from the working memory that the student exhausts in a specific time while performing a task increased or decreased, as well as the resources used by the working memory at a specific point of time, they affected the student's ability to notice the effects of the physical environment on his body and also affected the amount of his observation. They also affected the student's ability to identify feelings and choose appropriate words. They also affected the student's ability to be aware of what he is doing when he works spontaneously and not to be preoccupied with the past and future rather than the present and what he is experiencing now. In other words, when the cognitive load increases, there would be no free mental energy that enables the student's mental alertness because the working memory is busy, allocating all available cognitive resources to perform the students' cognitive task.

These findings were consistent partially with Bishara (2021, 2022), which revealed a significant association between cognitive load and mindfulness only in students without learning

disabilities, and psychological availability and mindfulness were associated with cognitive load among students with and without learning disabilities. These findings were also consistent with the study of Chen and Chang (2009), which revealed a negative correlation between cognitive load and performance and a positive relationship between perceived difficulty and cognitive load. They also agreed with Al-Abadi's study (2014), which revealed a negative significant correlation between cognitive load and ego resiliency. They also agreed with Al-Harthy's study (2015), which revealed a negative relationship between students' cognitive load and cognitive skills.

In terms of the relationship of mindfulness to some variables, this result was consistent with the study of Hollis-Walker and Colosimo (2011), which revealed that mindfulness was negatively related to neuroticism and isolation. It was also consistent with the result of the study of Al-Dabee and Mahmoud (2013), which revealed a negative correlation between mindfulness and depression.

Moreover, the study's findings indicated no statistically significant differences in mindfulness among Taif University students due to metamemory skills, cognitive load, and the interaction between them. These findings might be due to the fact that although there was a positive relationship between metamemory skills and mindfulness and a negative relationship between cognitive load and mindfulness among Taif University students, these relations revoked each other's influence over mindfulness when they interacted. Because one of them had a positive relationship and the other had a negative relationship, there might be a process of neutralization of their combined effect on mindfulness.

Implications and Limitations

The current study found that mindfulness was positively correlated with metamemory skills and negatively correlated with cognitive load. Also, it was evident that mindfulness was not affected by metamemory skills, cognitive load, or the interaction between them. These findings add to the literature that asserts the importance of developing metamemory skills and mindfulness and decreasing cognitive load among students. The findings suggest that improving mindfulness and metamemory skills among learners might benefit their academic achievement. In addition, decreasing students' cognitive load might benefit their mindfulness. Curriculum designers might benefit from these findings by applying the principles of cognitive load theory in designing educational programs at various academic levels. Teachers should prepare educational programs that develop metamemory skills and mindfulness among learners in various academic subjects. Moreover, training courses for teachers and mentors are needed to raise their awareness and provide them with essential educational theories to enable them to keep pace with developments in the field of education and psychology.

This study had several limitations. Firstly, the study was designed to explore the impact of metamemory skills and cognitive load on mindfulness among college students. Thus, studies at different educational levels, such as primary and secondary, are recommended. Secondly, the sample of this study included students from Taif University only. It only represented some university students throughout Saudi Arabia, which may limit the generalizability of the study findings. Finally, this study examined the association of metamemory skills and cognitive load with mindfulness. Thus, studies examining the variables mediating these relationships, such as gender, academic field, and age, are suggested.

Conclusion

The current study examined the relationships of metamemory skills and cognitive load to mindfulness and the impact of the interaction between metamemory skills and cognitive load on mindfulness among college students. The findings of this study not only extend the understanding of the relationships between these psychological traits but also confirm their influence on students' mindfulness. Amongst college students, their mindfulness became stronger as their metamemory skills and cognitive load improved. These findings will be helpful for students, organizations, universities, and professional researchers.

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