

Impact of Mindfulness Meditation on Cognitive Functions - An Experimental Study

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Mindfulness meditation has a strong impact on improving cognitive functions. Mindfulness meditation is a practice of paying attention and being present in the moment. A sample of 48 female first-generation students consented to attend the mindfulness meditation sessions after a brief overview of the intervention. The two cognitive tests, the Controlled Word Association Test (COWAT) and Symbol Digit Modalities Test (SDMT) were administered to the first-generation students who were randomly selected and assigned them into the experimental group and the control group, to measure cognitive ability, before and after the intervention. The findings indicate that the experimental group significantly showed improved cognitive ability scores, increased from the pre-test to post-test with effect size ($d=0.6064$) in COWAT and SDMT ($d=0.5355$), when compared to the control group, with no significant difference in both the pre-test and post-test scores.

Keywords: Mindfulness meditation, Cognitive ability, First-generation students

Mindfulness Meditation is a practice of paying attention and being present at the moment, using the power of breath as well, maintaining a relaxed state of mind, and noticing all the sensations that come across. During formal meditation practice, distractions will arise. The meditator is taught to acknowledge disturbing thoughts, and non-judgmentally return his/her attention to their breathing (Wallace, 2006). Mindfulness training brings awareness about the self and the environment (Wallace, 2006). And to the extent, it promotes meta-cognitive processing. (Austin, 1998).

Tenaciously, taming the attitudes of non-judging, patience, trust, beginner's mind, non-motivated, acceptance, and letting go will deeply gain and enhance the engagement with the meditation practices.

According to Sedlmeier et al. (2012), there are three primary types of meditation that are frequently performed: guided meditation, concentrative meditation, and

mindfulness meditation. Burke (2012) found that among the students, mindfulness meditation was the most favored method. It has been shown that the notion of mindfulness meditation, regardless of the kind used, has very little advantages. Mindfulness meditation has been shown in the literature to address a wide range of benefits, including the reduction of stress (Kabat-Zinn, Lipworth, Burncy, & Sellers, 1986) and the reduction of symptoms associated with mental illness (Coppola & Spector, 2009; Teasdale et al., 2000; William, Duggan, Crane, & Fennel, 2005). The therapeutic process has also benefited from the practice of mindfulness meditation. Wright (1999) discovered that practicing mindfulness meditation helps people develop the kind of life-altering skills that are essential to treatment. Mindfulness meditation addresses skills including improved concentration, improved self-control, and improved witness-building. (Wright, 1999)

Body Scan Meditation

The body scan aims to bring awareness through our breath and deeply investigates the different regions of our body. It allows oneself to experience how each part feels, without trying to change anything. Just being with what is there. Body scan meditation helps us to get in touch with our body and let go of the feelings that may be harsh on us. The body scan meditation, like other mindfulness meditation trains our focus and attention. During body scan meditation, one can experience a range of feelings such as pains, aches, tingles, itches, warmth, cold, lightness, heaviness, and firmness in the body parts. Hence, it is highly experiential.

Need for the Study:

In today's campuses, a growing population of students is the first-generation students, with their unique needs and expectations. (Sickles.R.A 2004). Almost 40% of college students who are enrolled are first-generation college students (Swail, p. B16). These students receive very little family support, as their parents may not be graduates to nourish the students' needs, guide, and support them.

If their cognitive abilities are pushed to a higher level, through certain psychological techniques, their cognitive abilities are increased and they perform their academics without any anxiety. Though there are many studies that support cognitive enhancement through extensive meditation, and other conventional methods like education, training in memory techniques, study skills, etc, they prove to be short-term effective for cognition enhancement. Thus, mindfulness meditation has been selected as an intervention for cognition enhancement which is result-oriented and has a long term effect to enhance cognition. Hence, the need for the study was recognized and further support for the study was established.

Research Questions

The following questions were raised to formulate the objective of the study.

- Is there a possibility of enhancing cognitive functions among first-generation students by mindfulness meditation?
- Will there be an effect of mindfulness meditation on first-generation students?

Review of related Literature

Some literature reviews to highlight the previous studies on mindfulness meditation on cognitive enhancement.

Benjamin.et.al (2018) proved that Mindfulness-based cognitive therapy (MBCT) has been effective in significant improvement in cognitive deficits which was associated with depressive symptoms. A closer look at the study, by Zanesco. A., &Saron.C., (2018), provides information on the gains in attention observed immediately after the retreat of meditation which were partly maintained even after seven years. This longitudinal study indicates that a more diligent meditation practice among older adults showed cognitive gains and no age-related decline such as sustained attention, compared to those who practiced less number of meditation sessions.Immink et al. (2017) emphasized on single sessions of focused attention meditation FAM and open monitoring meditation OMM,(as measured by a serial reaction time task SRT),which improved sequence performance and learning . Ten young, healthy participants in Kohler et al. (2017)'s study were given a concentrative type of yoga nidra meditation, which they performed before, after, and again after a rest or meditation session. The participants' attention performance was the focus of the study. Without taking a break, sustained attention improved and tiredness reduced after meditation.

Kurth et al. (2017), mentioned in his study that long-term, continuous meditation practice reduces the deleterious effects of ageing on cognition, including both aging-related and meditation-induced cognitive functions. Cristiano C. et al. (2017) examined the impact of mindfulness meditation on brain and cognition enhancement, as well as improvements in cognitive processing, such as executive functions and attention regulating abilities. MM encouraged these functions, which can result in alterations in brain anatomy. Also, it has been shown that meditating can help older people who rapidly avoid cognitive loss.

Rooks et al. (2017) identified short-form mindfulness training (MT) was more effective than relaxation training (RT) at improving sustained attention and emotional well-being among 100 collegiate football players. Hartkamp and Thornton's (2017) reported that there was no difference between the retreat group and a control group of participants who did not take part in the 6-day intensive Vipassana (mindfulness) retreat. The retreat was given before and after a series of behavioural measures assessing cognitive flexibility, such as Task Switching and Stroop. However, retreat participants reported higher levels of mindfulness and well-being after the 6-day retreat. Malinowski and Shalamanva (2017) developed a conceptual and theoretical framework for MM's neuroprotective benefits in cognitive ageing. They hypothesized that MM could be used to improve cognitive reserve capacity and retain cognitive skills in older people.

Malinowski, .P., and Shalamanova, .L. (2016) investigated how mindfulness-related meditation practices link several cognitive functions, particularly the ability to focus.

In light of the literature reviewed above, it is observed that mindfulness meditation

has been used as an intervention to investigate its effectiveness in improving cognitive functions such as attention sub-function, sustained attention, focused attention, and cognitive reappraisal. Thus, the previous studies have added solid evidence to proceed with the present study and also have been a source of sufficient body of knowledge to formulate the hypothesis.

Method

Objective of the Study

The main objective of the study was to enhance the cognitive ability of first-generation college students through mindfulness meditation particularly body scan and breathing exercises.

Hypothesis:

1. There will be a significant difference in the scores obtained in the controlled word association test among the experimental and control groups in the pre-test and the post-test
2. There will be a significant difference in the scores obtained in the symbol Digit modalities test among the experimental and control groups in the pre-test and the post-test

Research Design

An experimental, before and after control study design was adapted for this study. An experimental design is defined as a compilation of research designs that use manipulation and mandatory testing to value the causal processes. Usually, one or more variables are manipulated to investigate their effect on a dependent variable. The independent variable was the intervention-mindfulness meditation and the dependent variable was cognitive ability.

Operational Definitions

Cognitive Enhancement:

Cognitive enhancement may be defined as the strengthening or extension of core capabilities of the mind through the expansion or intensification of internal or external information processing systems. (Bostrom.N, 2009)

Mindfulness Meditation:

Mindfulness is defined as maintaining attention to the present moment whilst non-judgmentally noticing thoughts within the mind.(Kabat-Zinn, 2003)

Body Scan meditation:

Body scan meditation involves paying attention to parts of the *body* and bodily sensations in a gradual sequence from feet to head.

First generation College students:

The students whose parents have not completed a bachelor's degree are referred to as first-generation college students. It would be a very proud accomplishment to enroll oneself and complete the course in a college as a first-generation student without parental guidance.

Cognitive Functions:

Cognitive functioning is a collection of multiple mental abilities such as learning, thinking, reasoning, remembering, problem-solving, decision-making, and attention. (Gwenith G. Fisher, 2019)

Tools used for the Study

A series of tests were administered to the participants of this study. The description of each tool used for this study is a) Controlled Word Association Test (COWAT) and b) Symbol Digit Modalities Test (SDMT)

The Controlled Oral Word Association Test (COWAT) is an oral fluency task that evaluates the spontaneous production of

words under restricted search conditions. The test could be completed in 5–10 minutes. The reliability and validity scores for the Controlled Oral Word Association Test, were qualitatively verified as excellent inter-rater reliability (all indices at or above $r(icc)=0.9$. Benton, A. L., et al. (1983). The scoring system was developed by Troyer et al. (1997).

Recording and scoring

A sheet of numbered lines is provided to every participant to record or write the responses. If the participant's speed of word production is just too fast to allow verbatim recording, a "+" should be recorded to point to an accurate response. The sum of all correct answers is the score obtained by the individual.

The Symbol Digit Modalities Test (SDMT) is used to assess divided attention, visual scanning, tracking, and motor speed. The examinee has 90 seconds to pair specific numbers with given geometric figures, using the reference key. As the examinees can give either written or oral responses, the test is compatible to be used with individuals who have lower academic grades or any motor disabilities. Since it involves only geometric figures and numbers, the SDMT is comparatively culture-free and may be administered to individuals who don't speak English. It takes approximately 5 minutes to finish the whole test. The Test-retest reliability of SDMT is .80 for the written version and .76 for the oral version in normal adults with a mean retest interval of 29 days (Smith, 1991). Test-retest reliability is found to be .70 for a population with a sports group. (Echemendia et al., 1999). The Construct validity of SDMT scores indicates that the correlation between oral and written forms is .78 (Smith, 1991) suggesting the 2 forms aren't interchangeable.

Scoring

The entire sum of the number of correct substitutions within the 90-second interval (max = 110).

Intervention

In the mindfulness meditation body scan, participants gain an awareness that arises from paying attention on purpose, in the present moment, and non-judgementally. (Kabat-Zinn). The participants have to focus on their breath, cultivate attention, and focus on the body and mind, in the present moment to help with pain, both physical and emotional. This mindfulness meditation body scan was conducted for the experimental group for 8 sessions, spread over three weeks. Every week, two sessions were conducted and the participants were encouraged to attend the sessions with regular reminders. The participants were made to sit on the comfortable mats and asked to close their eyes to increase concentration of meditation. In a serene and peaceful environment, Jon Kabat-Zinn led a body scan meditation. Following the body scan meditation, the experimental group's participants were instructed to perform a breathing exercise that involved taking a deep breath, holding it for two seconds, and then exhaling it deeply through their lips for four seconds. To assist participants focus on the rise and fall of their chest or the sensation through their noses, they were told to simply observe each breath without attempting to modify it. They were informed that it was acceptable if, while they were doing this, their minds strayed and were preoccupied with ideas or physical sensations.

Sampling Technique and Procedure

A convenient sampling technique was adopted in this study. The students who consented to participate in the 8 sessions of intervention- mindfulness meditation body scan were allotted to the experimental group. A total of 42 students consented to attend the sessions. A brief overview of the benefits

of mindfulness meditation was given to them, after which the pre-test was conducted. The students who were not inclined to the sessions, due to their preoccupations with their academic pressures, were considered as a control group and were administered with a pre-test. After sufficient passage of time, with the experimental group, they were administered with the post-test. They did not undergo any sessions but were kept on the waitlist for the session. However, there were 6 students, who dropped out after two sessions, 4 students left after 3 sessions, and 2 students left after the 4th session due to academic pressures. At the end of the eighth session, there were 30 participants in the experimental group.

Administration of the Tools:

The first-generation learners who consented for the study were administered COWAT, and SDMT tests for both groups. Intervention (Mindfulness meditation body scan) was conducted on the experimental group for 8 sessions in the spread of three weeks. Two sessions per week were conducted and the participants were encouraged to attend the sessions with regular reminders. A guided body scan meditation by Jon Kabat-Zinn was used in the form of a video with attached speakers in a silent room. Each session lasted about 40 minutes which included body scan meditation and breathing exercises. After three weeks, the COWAT and SDMT tests were administered to both groups as the post-test.

Analysis and Discussion

The data collected were analyzed using paired and independent samples t-tests. The results were discussed as follows:

Significance of Difference between Means

The effect of mindfulness meditation on cognitive ability was assessed through the word association test, symbol digit modalities test, the paired samples t-test, and independent samples t-test.

Table 4.1 Paired t-test of Pre-Test and Post-test of Cognitive ability by COWAT of the Mindfulness group and control group

Variable	Group	Test	Mean(SD)	t-Value	p- Value	Effect Size
Cognitive ability by Controlled Word Association Test	Mindfulness	Pre-Test	23.27(11.7)	4.51**	0.0001	0.6064
		Post-Test	29.9(10.2)			
	Control group	Pre-Test	23.20(9.46)	1.7044	0.009NS	
		Post-Test	25.2(9.66)			

**- $p=0.0001$ NS- Not significant at $p<.05$

The findings show that the experimental group scored significantly higher in their cognitive functions, with mean scores of COWAT in the pre-test ($M=23.27, SD=11.7$), when compared to the mean scores of COWAT in the post-test ($M=29.9, SD=10.2$). In the control group, no significant changes were observed in the cognitive functions, with mean scores of COWAT in the pre-test ($M=23.2, SD=9.46$) and the mean scores of COWAT in the post-test ($M=25.2, SD=9.66$). A paired t-test was computed to find any significant difference in the pre-test and post-test of the experimental and control group.

Results show that the mean scores of COWAT of the experimental group in the pre-test ($M=23.27, SD=11.7$), and post-test ($M=29.9, SD=10.2$), was significantly higher, $t(29)= 4.51, p<.0001$, (see Table 4.1), when compared to the mean scores of the pre-test ($M=23.2, SD=9.46$) and mean scores of post-test ($M=25.2, SD=9.66$), of the control group $t(29)= 1.70, p<.05$. The Cohen's D effect size was found to be $d=0.6064$ and interpreted as above moderate, clearly reports that there was a significant effect of the mindfulness meditation on cognitive functions of the mindfulness group(see Table 4.1).

Table 4.2 Paired t-test of Pre-Test and Post-test of SDMT of the Mindfulness group and Control group

Variable	Group	Test	Mean(SD)	t-Value	p-Value	Effect Size
Symbol Digit Modalities Test	Mindfulness group	Pre-test	56.17(17.64)	3.134	0.0039*	0.5355
		Post-test	64.63(13.71)			
	Control group	Pre-test	53.23(18.14)	0.5783	0.5653NS	
		Post-test	50.70(15.70)			

* $p <.05$

NS Not significant at $p<.05$

The findings infer that the mean scores of SDMT which measure cognitive functions, in the post-test ($M=64.63, SD=13.71$), were significantly higher than the mean scores of the pre-test ($M=56.17, SD=17.64$) in the experimental group. No significant changes

were observed in the cognitive functions of the control group assessed by the mean scores of SDMT in the pre-test ($M=53.23, SD=18.14$) and the mean scores of SDMT in the post-test ($M=50.70, SD=15.70$). Paired t-test was computed and the results show an extremely significant difference between the mean scores of SDMT in the pre-test ($M=56.17, SD=17.64$), and the mean scores

of SDMT in the post-test ($M=64.63$, $SD=13.71$), of the experimental group, $t(29)= 3.13, p<.0039$, (see Table 4.4), when compared to the mean scores of SDMT in the pre-test ($M=53.23$, $SD=18.14$) and mean scores of SDMT in the post-test ($M=50.70$, $SD=15.70$), of the control group, $t(29)= .578$, $p<.05$. The Cohen's D effect size was found to be $d=0.5355$ and interpreted as moderate, clearly reported that there was a significant effect of the mindfulness meditation intervention on cognitive functions. (see Table 4.2)

Malinowski, P., & Shalamanova, L., (2016) studied that Mindfulness-related meditation practices engage various cognitive skills including the ability to focus and sustain attention, which in itself requires several interacting attention-related sub-functions.

Hence the Hypothesis which stated that there would be a significant difference in the cognitive functions between mindfulness and the control group assessed by SDMT in pre-test and post-test was failed to reject.

Table 4.3. Independent sample t-test of Post-Test of COWAT between Mindfulness group and control group

Variable	Group	Test	Mean(SD)	t-Value	Sig(2 tailed)
Controlled Word	Mindfulness	Post-Test	29.9(10.2)	1.826	0.0729 NS
Association Test	Control	Post Test	25.2(9.66).		

NS Not significant at $p<.05$

The independent sample two-tailed t-test was computed to identify if there was any significant difference in the COWAT scores of the experimental group and the control group in the post-test. The results indicate that there was no significant difference between the cognitive functions mean scores of COWAT of the experimental group ($M=29.9, SD=10.2$) and the mean scores of COWAT of the control group. ($M=25.2, SD=9.66$) have a difference, but not statistically significant ($t(29)= 1.826, p<.05$). (see Table 4.3)

The results support the previous research study by Benjamin & Schone, et.al(2018), who investigated that engaging mindfulness meditation results in improved performance on the range of cognitive tasks, and taps the core cognitive processes, namely sustained selective visual attention and spatial functioning memory. Hence the hypothesis states that there would be a significant difference in the cognitive functions between the mindfulness and control group assessed by COWAT in the pre-test and post-test was rejected..

Table 4.4 Independent sample t-test of Post-Test of SDMT between Mindfulness group and control group

Variable	Group	Test	Mean(SD)	t-Value	Sig(2 tailed)
Symbol Digit	Mindfulness	Post-Test	64.63(13.71)	3.6608	0.0005*
Modalities Test	Control	Post Test	50.70(15.70)		

* $p<0.01$

The independent sample two-tailed t-test was computed to identify if there was any significant difference in the SDMT scores of

the experimental group and the control group in the post-test. The results indicated that there was an extremely significant difference between the cognitive functions measured by

SDMT for the experimental group ($M=64.63$, $SD=13.71$) and the control group. ($M=50.70$, $SD=15.70$), in the post test, $t(29)=1.826$, $p<.05$). (see Table 4.4)

Conclusion

The results indicate that the effect of mindfulness meditation body scan and breathing exercises for 8 sessions of 40 minutes duration each, have shown significant improvement in the cognitive measures which include focused attention, and cognitive executive functions. The experimental group and control group displayed significant differences in their effect sizes. In addition, the results provide insight have improved the scope of mindfulness meditation; the individuals can practice mindfulness meditation in a setting where calmness prevails, not necessarily a clinical setting.

Limitations

- The study had a major limitation as it was conducted only with female participants
- Some level of distraction during the mindfulness practice, outside the laboratory was noted.
- Only 8 sessions were conducted.
- No follow-up study was conducted.

Implications and recommendation

This study implies the benefit of short term mindfulness meditation which shows a significant increase in the cognitive levels of people. It also enables the scope of meditation for any person who is his busy schedule can practice. This study further recommends future studies to examine the effect of app guided meditation and their effectiveness and to extend the investigation of web-based or internet-based short-term meditation. It will contribute to increasing

mindfulness practice's applicability and scalability.

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