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Research Article

Meditation and Pranayama as Educational Management Tools: Implications for Learning Achievement and Cognitive Abilities of Secondary School Students

Dr. Om Prakash Sharma [1*], Dr. Surendra Sisodia [2]
[1] Lecturer, Udaipur, Rajasthan, India
[2]Assistant Professor, Suresh Gyan Vihar University, Jaipur, Rajasthan, India

Corresponding Author: * Dr. Om Prakash Sharma

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Abstract

The ancient Indian system of yoga has gained significant attention in educational and psychological research for its potential role in improving students' mental health and cognitive performance. The present study examined the effect of meditation and pranayama interventions on learning achievement and cognitive abilities among secondary school students. Adopting an experimental pre-test–post-test control group design, the study was conducted on a sample of 200 students from Classes IX and X. The group of the sample (experimental group) received a structured intervention comprising selected daily meditation practices and pranayama exercises, over a period of 6–8 weeks, while the other group (control group) followed the regular school routine without any intervention. Pre-test and Post-test data were collected to get a 'Learning Achievement Score' and a 'Cognitive Abilities Score' derived from specifically designed tests assessing the general academic score, attention, concentration, memory and reasoning. The collected data were analysed using descriptive statistics and paired sample t-tests. The findings revealed no significant changes in learning achievement and cognitive abilities among the control group, whereas the experimental group demonstrated statistically significant improvements in academic scores and all measured cognitive dimensions. The results indicate that meditation and pranayama practices have a positive and significant effect on enhancing learning achievement and cognitive abilities among secondary school students. The study highlights the potential of integrating yogic practices into school routines to promote students' academic performance and cognitive development.

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1. INTRODUCTION

Education in the twenty-first century is no longer confined to the transmission of academic knowledge alone; it increasingly emphasises the holistic development of learners, encompassing cognitive, emotional, and psychological well-being. Secondary school students, in particular, experience a crucial developmental phase marked by rapid cognitive growth, academic pressure, emotional fluctuations, and heightened expectations from family and society. In India, the secondary stage of education coincides with board examinations, competitive environments, and performance-oriented evaluation systems, which often contribute to stress, reduced concentration, anxiety, and declining academic engagement among students. These challenges necessitate the exploration of effective and friendly interventions that can enhance learning achievement while simultaneously strengthening students' cognitive abilities. Learning achievement is closely linked with the level of academic growth, and cognitive abilities are defined with various functions such as attention, memory, concentration and reasoning. These altogether form the foundation for effective learning, problem-solving, and academic success. However, several studies have highlighted that contemporary adolescents face increasing difficulties in sustaining attention, retaining information, and applying reasoning skills due to factors such as academic overload, excessive screen time, lifestyle imbalances, and psychosocial stress. Traditional instructional strategies alone may not be sufficient to address these challenges, thereby creating a need for complementary approaches that support cognitive functioning and mental clarity.

Meditation and pranayama, integral components of the ancient Indian system of yoga, have gained growing recognition in educational and psychological research for their potential role in enhancing mental health and cognitive performance. Meditation involves practices that promote focused attention, mindfulness, and mental calmness, while pranayama refers to regulated breathing techniques aimed at balancing physiological and psychological processes. These practices are deeply rooted in Indian culture and philosophy and are increasingly being integrated into modern educational settings due to their simplicity, cost-effectiveness, and adaptability for different age groups. Meditation and pranayama are believed to influence cognitive functioning by improving attentional control and reducing stress responses. Regular practice has been associated with improvements in sustained attention, working memory, executive functioning, and reasoning abilities. Pranayama, through controlled breathing patterns, positively affects the autonomic nervous system, leading to better oxygenation of the brain, reduced physiological arousal, and improved mental alertness. Such mechanisms suggest that yoga-based interventions may create an optimal internal environment for learning and academic engagement. In recent years, empirical research has begun to examine the educational implications of meditation and pranayama among school-aged children. Several studies have reported a variety of effects on academic performance, concentration levels, memory retention, classroom behaviour, and emotional stability. In the recent past, the Indian education system has increasingly acknowledged the importance of integrating yoga, pranayama and meditation practices into school curricula. It is important to have a regular review of the effect of structured meditation and pranayama interventions on learning achievement and cognitive abilities among secondary school students. Simultaneously, it is vital to emphasise key cognitive domains to provide a comprehensive understanding of how mind–body practices influence students' learning achievement and cognitive abilities.

2. OBJECTIVES OF THE STUDY

The present study aims to assess the learning achievement and cognitive abilities of secondary school students and to examine the effect of meditation and pranayama interventions on key cognitive domains such as attention, concentration, memory and reasoning. It also seeks to compare the pre-test and post-test scores of students in the experimental and control groups in order to determine the effectiveness of meditation and pranayama practices in enhancing learning and cognitive outcomes among secondary school students.

Significance of the Study

The present study is significant as it provides empirical evidence on the effectiveness of meditation and pranayama interventions in enhancing learning achievement and cognitive abilities among secondary school students. By examining key cognitive domains such as attention, concentration, and memory, the study contributes to the field of educational psychology by highlighting the role of mind–body practices in supporting students' academic and cognitive development. The findings of the study may assist teachers and school administrators in adopting simple, cost-effective, and culturally relevant interventions to improve students' learning outcomes and classroom engagement. Furthermore, the study offers valuable insights for educational policymakers by supporting the integration of meditation and pranayama into school programmes as complementary strategies for promoting holistic education and students' mental well-being.

3. REVIEW OF LITERATURE

The literature provides substantial evidence on the effectiveness of yoga, pranayama, and meditation-based interventions in enhancing students' cognitive, academic, psychological, physical, and physiological outcomes, with each study contributing distinct insights. Shavan and Sadeghian (2023) demonstrated that yoga therapy significantly improved visual perception, memory, and attention among students with dyscalculia. Mahananda (2022) reported marked improvements in physiological parameters such as blood pressure, pulse rate, breath-holding time, and vital capacity, along with reductions in stress, anxiety, and depression, and enhanced self-confidence among adolescent girls following yoga asana and pranayama practice. Kesavan et al. (2021) found notable gains in attention, attentiveness, and memory among healthy adults after structured yoga practices. Dutta et al. (2020) established that

yogic training, either alone or combined with aerobic exercises, positively influenced physical fitness, mental health, mood, self-confidence, and stress management in pre-adolescent girls. Biradar (2020) confirmed a significant improvement in academic performance and psychological traits such as emotional intelligence, stress, and academic anxiety among secondary school students who underwent yoga training. Selvaraj and Arumugam (2018) observed significant improvements in resting heart rate and vital capacity among football players after yogic practices, while Johnbosco (2018) reported enhanced flexibility, muscular strength, cardiovascular endurance, and resting pulse rate among college girls due to yogasana and pranayama training. Kusuma (2016) emphasised that regular practice of yoga, pranayama, and meditation fosters mental peace, emotional stability, and overall mental well-being. Richter et al. (2016), though reporting limited effects on executive functions, noted changes in perceived movement speed and behavioural aspects among school children undergoing yoga training. Abdussalam (2015) highlighted significant improvements in speed, explosive strength, and cardiorespiratory endurance following pranayama practice. Bhanu et al. (2015) found that asanas, pranayama, and combined yogic practices significantly enhanced vital capacity in school-going children. Bhardwaj et al. (2015) reported significant improvements in self-adjustment levels among adolescents after yoga training. Ashtaputre (2015) observed a substantial reduction in academic anxiety among college students following yogic intervention. Ricarte et al. (2015) concluded that mindfulness-based interventions improved mood, attentiveness, and immediate auditory-verbal memory among primary school children. Wisner (2014) identified intrapersonal, psychological, and systemic benefits of mindfulness meditation among high school students, particularly in stress reduction and school climate improvement. Babu and Kulothugan (2011) confirmed significant enhancement in cardiorespiratory and cardiovascular endurance among male hockey players after asana and pranayama practice. Collectively, these studies strongly support the relevance of the present research in examining the impact of meditation and pranayama on learning achievement and cognitive abilities of secondary school students.

4. RESEARCH METHODOLOGY

The present study adopted an experimental research design to examine the effect of meditation and pranayama interventions on learning achievement and cognitive outcomes among secondary school students. The independent variable of the The study was the meditation and pranayama intervention**,** while the dependent variables included learning achievement and cognitive abilities, namely attention, concentration, memory and reasoning**.** The sample comprised 200 students of reputed schools of Udaipur, Rajasthan (boys and girls) studying in Classes IX and X (approximately 14–16 years of age), selected through random sampling. The sample was randomly assigned to two groups of equal size, i.e. an experimental group (n = 100) and a control group (n = 100). The experimental group received a structured intervention consisting of meditation practices (mindfulness breathing and Om chanting/silent focus) for 5–10 minutes and pranayama exercises (Anulom Vilom, Bhramari, and light Kapal-Bhati) for 10 minutes per session, conducted daily over a period of 6–8 weeks. The control group followed the regular school routine without any intervention. Data were collected to get a 'Learning Achievement Score' and a 'Cognitive Abilities Score' derived from specifically designed tests assessing the general academic score, attention, concentration, memory and reasoning. Pre-tests were administered to both groups before the intervention, and post-tests were conducted after its completion using the same tools. The collected data were analysed using descriptive statistics such as mean and standard deviation, and the paired t-test was employed to determine the significance of differences between pre-test and post-test scores, thereby assessing the effectiveness of meditation and pranayama interventions on learning achievement and cognitive abilities among secondary school students.

Data Analysis

The data collected from the experimental and control groups were systematically analysed to examine the effect of meditation and pranayama interventions on learning achievement and cognitive abilities of secondary school students. The analysis was carried out in accordance with the objectives of the study and was intended to test the following null hypothesis-

$H_0$1: Meditation and Pranayama interventions have no significant effect on the learning achievement and cognitive abilities of secondary school students.

Appropriate statistical techniques, including descriptive statistics and the paired t-test, were employed to compare pre-test and post-test scores and to determine whether the observed differences were statistically significant. The results of the analysis, given in Table 1, illustrate the basis for accepting or rejecting the stated null hypothesis.

Table 1: Pre Test Vs Post Test Mean Score

Pre Test Vs Post Test Mean Score								
	Control Group				**Experiment Group**			
	Pre Test Score	Post Test Score	Difference	Improvement	Pre Test Score	Post Test Score	Difference	Improvement
Learning Achievement								
Academic Scores	8.06	7.96	-0.09	No	8.06	8.21	0.15	Yes
Cognitive Abilities								
Attention	7.39	7.38	0.00	No	7.39	8.05	0.66	Yes
Concentration	7.88	7.41	-0.47	No	7.90	8.31	0.42	Yes
Memory	8.71	8.68	-0.04	No	8.71	8.78	0.07	Yes
Reasoning	8.64	8.61	-0.04	No	8.62	8.71	0.09	Yes

The results presented in Table 1 indicate a clear difference between the control group and the experimental group with respect to pre-test and post-test mean scores for learning achievement and cognitive abilities. In the control group, the mean academic score showed a slight decline from 8.06 in the pre-test to 7.96 in the post-test, indicating no improvement in learning achievement. Similarly, no noticeable improvement was observed in cognitive abilities, as the mean scores for attention (7.39 to 7.38), concentration (7.88 to 7.41), memory (8.71 to 8.68), and reasoning (8.64 to 8.61) either remained nearly unchanged or showed marginal decreases in the post-test. These findings suggest that the regular school routine without any intervention did not contribute to enhancement in learning or cognitive outcomes.

On the other hand, the experimental group demonstrated consistent improvement across all measured variables following the meditation and pranayama intervention. The mean academic score increased from 8.06 in the pre-test to 8.21 in the post-test, indicating an improvement in learning achievement. Substantial gains were also observed in cognitive abilities, with attention scores increasing from 7.39 to 8.05, concentration from 7.90 to 8.31, memory from 8.71 to 8.78, and reasoning from 8.62 to 8.71. The positive mean differences across all domains reflect the beneficial impact of meditation and pranayama practices on students' cognitive functioning and academic performance. Overall, the comparative analysis highlights that meaningful improvements were observed only in the experimental group, thereby indicating the effectiveness of the intervention.

Table 2- Paired Samples Test (Control Group)

Paired Samples Test (Control Group)					
		Paired Differences		t	Sig. (2-tailed)
		Mean	Std. Deviation		
Pair 1	Pre & Post Test Academic Score	.170	1.055	1.612	.110
Pair 2	Pre & Post Test Attention	.150	1.077	1.393	.167
Pair 3	Pre & Post Test Concentration	.170	1.776	.957	.341
Pair 4	Pre & Post Test Memory	.060	0.802	.748	.456
Pair 5	Pre & Post Test Reasoning	.060	1.033	.581	.563

The paired t-test results for the control group indicate that there were no statistically significant differences between pre-test and post-test scores across learning achievement and cognitive ability variables. As shown in the table, the difference in academic scores was not significant (t = 1.612, p = 0.110). Similarly, the pre-test and post-test differences in attention (t = 1.393, p = 0.167), concentration (t = 0.957, p = 0.341), memory (t = 0.748, p = 0.456), and reasoning ability (t = 0.581, p = 0.563) were all found to be statistically non-significant at the 0.05 level. These findings suggest that the regular school routine without any meditation or pranayama intervention did not lead to any significant improvement in learning achievement or cognitive abilities among the control group students.

Table 3: Paired Samples Test (Experiment Group)

Paired Samples Test (Experiment Group)					
		Paired Differences		t	Sig. (2-tailed)
		Mean	Std. Deviation		
Pair 1	Pre & Post Test Academic Score	-.45	1.250	-3.599	.001
Pair 2	Pre & Post Test Attention	-1.32	1.469	-8.983	.000
Pair 3	Pre & Post Test Concentration	-.97	1.507	-6.436	.000
Pair 4	Pre & Post Test Memory	-.19	0.692	-2.746	.007
Pair 5	Pre & Post Test Reasoning	-.23	0.993	-2.315	.023

On the contrary, the paired t-test results for the experimental group revealed statistically significant improvements in both learning achievement and cognitive abilities. A significant difference was observed in academic scores between pre-test and post-test (t = −3.599, p = 0.001), indicating an improvement in learning achievement. Highly significant improvements were also found in attention (t = −8.983, p = 0.000) and concentration (t = −6.436, p = 0.000). Further, the differences in memory (t = −2.746, p = 0.007) and reasoning ability (t = −2.315, p = 0.023) were also statistically significant. These results clearly prove that the meditation and pranayama interventions had a positive and significant effect on the learning achievement and cognitive abilities of secondary school students. So far as the hypothesis is

concerned, the paired t-test analysis indicates that significant improvements were observed only in the experimental group and not in the control group, thereby providing empirical support for rejecting the null hypothesis H_01 and confirming the effectiveness of meditation and pranayama interventions in enhancing learning and cognitive outcomes among secondary school students.

5. FINDINGS AND CONCLUSION

The findings of the present study reveal that meditation and pranayama interventions had a significant and positive influence on the learning achievement and cognitive abilities of secondary school students. The analysis of pre-test and post-test scores of the control group showed no statistically significant improvement in academic performance or cognitive abilities such as attention, concentration, memory, and reasoning, indicating that the regular school routine without any intervention did not contribute to measurable cognitive or learning gains. In contrast, the experimental group demonstrated statistically significant improvements across all assessed domains following the meditation and pranayama intervention. A significant increase was observed in learning achievement, as reflected by improved academic scores, along with highly significant gains in attention and concentration. Furthermore, meaningful improvements were also recorded in memory and reasoning abilities. The paired t-test results clearly indicated that the observed improvements in the experimental group were not due to chance, thereby establishing the effectiveness of meditation and pranayama practices as educational interventions. Overall, the comparative findings confirm that structured meditation and pranayama interventions contribute significantly to enhanced learning outcomes and cognitive functioning among secondary school students, leading to the rejection of the null hypothesis and reinforcing the value of incorporating such practices within the school setting.

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