

CHAPTER 6

6.0 RESULTS

The one-way ANOVA at the baseline indicated statistically significant differences in the mean scores of the groups for all the research variables, except for test anxiety ($p = .010$). The findings indicated that, in general, the selected groups exhibit similarities in terms of the majority of the variables important for the study. After the intervention, the findings of the one-way ANOVA on the difference in mean scores before and after the intervention for different groups and subsequent post-hoc analysis are separately provided in the **Table 11**. Findings of the analysis of variances, multiple-regression analysis, and correlational analysis are presented in the following sub-sections.

Academic performance

Statistically significant differences were observed in the mean difference scores of academic performances among the three groups: Group A (hatha yoga), group B (combination of hatha and jnana yoga), and group C (physical exercise), with $F_{(2, 276)} = 22.54, p < .001$. Post-hoc analysis revealed that Group B outperformed Group A ($p < .001$) and Group C ($p < .001$) separately in terms of academic performance. Incorporating academic intervention emphasizing reading, reflective contemplation, and writing practice with hatha yoga enhanced group B's academic performance.

Minimum muscular fitness

Muscle fitness assessed through the Krauss-Weber test shows statistically significant group differences between the groups with $F_{(2, 276)} = 5.57, p = .004$. The post-hoc test revealed non-significant differences between group A and group C, indicating similarities between hatha yoga and physical exercise in terms of muscular fitness. Nonetheless, results for the combined

practices of hatha and jnana yoga indicated statistically significant improvements compared to group A ($p = .018$) and group C ($p = .010$). Group B's improvements resulted from aligned physical postures with the Krauss-Weber test and prolonged holding positions, enhancing core muscle endurance and strength. The practices of jnana yoga introduced a cognitive dimension, promoting focused attention and awareness, potentially amplifying physical benefits.

General intelligence

General intelligence results showed statistically significant differences between all groups, $F_{(2,276)} = 14.40, p < .001$. Post-hoc adjustment reveals a statistically significant improvement in group B compared to group A ($p < .001$) and group C ($p < .001$). There was statistically non-significant difference between group A and group C ($p = .833$). The results suggested that incorporating the principles of jnana yoga had a notable positive impact on general intelligence, emphasizing intellectual pursuits through cognitive engagement in reflection and inquiry.

Attention and Verbal short-term memory

Between-group results for digit span forward show a statistically significant difference, $F_{(2, 276)} = 12.59, p < .001$. Furthermore, the post-hoc test demonstrates statistically significant improvement in group A ($p = .007$) and group B ($p < .001$) compared to physical exercise scores. However, there was no statistical significance between group A and group C ($p = .202$). The observed improvements in attention and working memory in the yoga groups can be attributed to the integration of physical postures, breath control, and cognitive engagement, thereby creating a comprehensive cognitive training environment. These enhancements are crucial for cognitive functions in academic performance.

Working memory

The group differences test for the digit-span backward test to assess working memory shows statistically significant differences between groups, $F_{(2, 276)} = 6.68, p = .001$. In addition, the combined hatha and jnana yoga participants show statistically significant improvement compared to separate cases of hatha yoga ($p = .034$) and physical exercise groups ($p = .001$). Nevertheless, no significant difference was found between hatha yoga and physical exercise. The inclusion of academic interventions played a crucial role in the observed improvement in digit-span backward performance. These cognitive activities may stimulate working memory, leading to enhanced performance in recalling information in reverse order.

Verbal and Working memory

One-way ANOVA for the total score of verbal short-term memory and working memory displays statistically significant group differences, $F_{(2, 276)} = 17.86, p < .001$. The results from post-hoc analysis indicated a significant difference between group B compared to group A ($p = .007$) and group C ($p < .001$). The findings can be explained through jnana yoga's process of contemplation, which, when combined with hatha yoga, can enhance both verbal short-term memory and working memory.

Comprehension skills

The group comparison for the comprehension test shows a statistically significant difference between groups, $F_{(2, 276)} = 3.32, p = .038$. There was no statistically significant difference between group A and group B ($p = 1$) or between group A and group C ($p = .256$). However, there was a significant difference between group B and group C ($p = .036$). Comprehension skills develop over time, influenced by factors such as reading, attention, and vocabulary. The significant impact suggests that integrating jnana yoga into educational practices

may enhance cognitive functions, particularly those related to understanding and processing information.

Numeracy skills

The between-groups numeracy skill scores were statistically non-significant, $F(2, 276) = 2.81, p = .062$. There were statistically non-significant differences between group A and group B ($p = .661$), group A and group C ($p = .761$), and group B and group C ($p = .055$). Numeracy skills, which involve performing mathematical operations within certain time constraints require processing speed and a foundational level of proficiency. The potential increase in cognitive load during tasks highlights the complexity of numeracy skills. This complexity might not have been fully addressed within the timeframe of the intervention, resulting in only marginal improvements.

Creative writing skills

Creative writing scores differed significantly between the groups, $F(2, 276) = 4.95, p = .008$. No significant difference existed between group A and group B ($p = .168$), nor between group A and group C ($p = .693$). However, a statistical difference emerged between group B and group C ($p = .006$). In the ancient yoga sutra text, focus is achieved through yoga practice followed by deep relaxation. Unlike rote learning, creativity often involves a dynamic interaction between attention and relaxation. Therefore, integrating relaxation periods can develop the emergence of innovative ideas.

Reading skills

Statistically significant differences existed for reading skill scores between the groups, $F(2, 276) = 11.66, p < .001$. Additionally, a significant difference was found between group B and group A ($p = .043$), as well as between group B and group C ($p < .001$). These findings suggest

that the observed reading skill performance stemmed from academic training. This training involved attentive listening, reading aloud, and implementing corrective measures to improve pronunciation, punctuation, and reading pace, aligning with fundamental reading principles and contributing to the enhanced performance observed in group B.

Academic skills

The summations of the scores from all academic skill domains were used to calculate total academic skills scores. The analysis revealed statistically significant differences between the groups for the total academic skills score, $F(2, 276) = 14.89, p < .001$. There was a significant difference observed in the comparison between the group A and group C ($p = .008$). Furthermore, a highly significant difference was found in the comparison between participants in group B and group C ($p < .001$).

Academic self-efficacy

Statistically significant differences were found between the groups for the academic self-efficacy scores, $F(2, 276) = 19.78, p < .001$. Yoga groups A and B exhibited improvement compared to the group C, but the difference was not statistically significant between group A and group C ($p = .101$). However, the difference between the combined hatha and jnana yoga group and the physical exercise group was statistically significant ($p < .001$). Yoga facilitated an interplay between the body and mind, enhancing awareness and regulating psycho-emotional distress. This improvement could enhance learning motivation and self-efficacy as students recognized their strengths and weaknesses.

Test anxiety

Performance anxiety exhibited statistically significant differences between the groups, $F(2, 276) = 5.58, p = .004$. Statistical significance was observed between group A and group C (p

= .015), as well as between groups B and C ($p = .010$). However, no statistically significant difference was found between the group A and group B ($p = 1$). These findings can be attributed to the stress-regulating effects of yoga practices, which modulate mental processes, enhance awareness, and positively impact emotional well-being. This could result in reduced test anxiety, offering students a more conducive mental state for optimal performance during academic assessments.

Emotional symptoms

Emotional symptoms measured across groups showed a statistically significant difference, $F(2, 276) = 4.46, p = .012$. The emotional symptom scores of group B significantly reduced compared to group C students ($p = .010$). No significant differences were observed between group A and group B ($p = .296$), and between group and A group C ($p = .559$).

Conduct problem

Conduct problem scores showed statistically significant differences between groups, $F(2, 276) = 6.29, p = .002$. The reduction in conduct problem scores in group B was statistically significant compared to group A ($p = .027$) and group C ($p = .003$). There was no statistically significant difference between group A and group C ($p = 1$).

Hyperactivity

Hyperactivity scores indicated statistically significant differences between groups, $F(2, 276) = 9.15, p < .001$. The improvement in hyperactivity scores in group B was statistically significant compared to group A ($p = .002$) and group C ($p < .001$). Statistically non-significant differences were observed between group A and group C ($p = 1$).

Peer problem

Peer problem scores showed statistically significant differences between groups, $F(2, 276) = 10.16, p < .001$. Significant reduction in scores was observed for group B when compared

to group A ($p = .022$) and group C ($p < .001$). The differences between group A and group C were statistically non-significant ($p = .229$).

Pro-social behavior

The between-group differences for pro-social behavior were statistically non-significant, $F(2, 276) = 0.716, p = .490$. There were no significant differences between group A and group B scores ($p = 1$), group A and group C scores ($p = .731$), and group B and group C scores ($p = 1$).

Strength and difficulty

The total score, which is the summation of the four domains assessing emotional and behavioral problems, showed statistically significant differences, $F(2, 276) = 13.05, p < .001$. Significant differences were observed for group B compared to group A ($p = .002$) and group C ($p < .001$). The difference between group A and group C was statistically non-significant ($p = .426$).

Impact score

The levels of difficulties faced by students and their impact on day-to-day activities, classroom learning, friendship, and interactions showed statistically non-significant differences between groups, $F(2, 276) = 0.373, p = .689$.

Internalizing factor

The summation of emotional symptoms and peer problems scores, called the internalizing factor, showed statistically significant differences between groups, $F(2, 276) = 10.04, p < .001$. Post-hoc analysis revealed that group B performed better than group A ($p = .028$) and group C ($p < .001$). There was no statistically significant difference between group A and group C ($p = .199$).

Externalizing factor

The summation of scores of conduct problem and hyperactivity, known as the externalizing factor, indicated statistically significant differences between the groups, $F(2, 276) = 9.95, p < .001$. Post-hoc analysis further revealed that the intervention of group B was more impactful compared to group A intervention ($p = .002$) and group C ($p < .001$). The group differences analysis between group A and group C was statistically non-significant ($p = 1$).

Adverse Effects

The report analyzed data from both the fidelity and feasibility report (**refer Table 7 and 8**), along with subjective feedback gathered from student interviews. Students reported experiencing discomfort such as headaches, body aches, and fatigue. While physical activity could induce symptoms like pain and fatigue, the slower movements in yoga typically resulted in less discomfort. Trainers effectively managed adverse effects arising from physical activities and yoga through established protocols and clear communication. The team promptly addressed concerns, with trainers advising students against practices that could pose risks. Female participants were encouraged to engage in gentle loosening exercises during menstruation if discomfort occurred. Trainers and staff were adequately equipped to address any complaints.

Interview Summary

Twenty students, 10 from each yoga group (13 females, 7 males), participated in interviews. Overall, the students rated the yoga protocols as 'Very Good'. They valued specific practices such as spinal movement, positive affirmations in Yoga Nidra, balancing postures, and exploring new connections between mind and body, all of which contributed to their learning experience. The students observed academic improvements with jnana yoga principles and expressed interest in further learning, motivated by physical benefits like improved flexibility,

digestion, weight reduction, and reduced menstrual pain. They also reported psychological benefits, including decreased levels of anger, fear, anxiety, sadness, hatred, overthinking, excessive talking, and headaches. Additionally, they noticed enhancements in mood, behavior, thought clarity, calmness, and sleep quality. Furthermore, they demonstrated increased engagement in school activities and improved task efficiency. All students expressed enthusiasm to continue practicing yoga, eager to explore pranayama, meditation, and jnana yoga for further academic enhancement.

Findings of Multiple Regression

Hatha yoga (Group A)

In the pre-intervention data of the hatha yoga group, numeracy skill was the significant predictor of academic score with $F_{(2, 90)} = 7.73, p < .001, R^2 = .14, R^2_{Adjusted} = .13, S_e = .933$, with standardized coefficients of numeracy skill with $\beta = .24, p = .017$. In the post-intervention data reading skills and academic self-efficacy were the significant predictors of the academic score with $F_{(2, 90)} = 7.98, p < .001, R^2 = .15, R^2_{Adjusted} = .13, se = .931$, standardized coefficients for reading skills and academic self-efficacy represented as $\beta = .32, p = .002$ and $\beta = .29, p = .006$, respectively.

Hatha and jnana yoga (Group B)

In the pre-intervention data of the hatha and jnana yoga group, reading and self-efficacy were the significant predictors of academic scores ($F_{(2, 94)} = 13.30, p < .001, R^2 = .22, R^2_{Adjusted} = .20, S_e = .892$), with ($\beta = .361, p < .001$) and ($\beta = .260, p = .006$) as standardized coefficients for reading and academic self-efficacy, respectively. In the post-intervention data, general intelligence, creative writing, and academic self-efficacy were the significant predictors with $F_{(2, 94)} = 9.95, p < .001, R^2 = .24, R^2_{Adjusted} = .25, S_e = .884$. The regression coefficients for general intelligence, creative writing and academic self-efficacy are $\beta = .210, p = .026, \beta = .271, p = .004$, and $\beta =$

.342, $p < .001$, respectively.

Physical exercise (Group C)

In the physical exercise group, pre-data showed general intelligence as predictor of academic score with $F_{(2, 86)} = 10.38$, $p < .001$, $R^2 = .19$, $R^2_{Adjusted} = .17$, $Se = .907$ and standardized coefficient with $\beta = .35$, $p = .001$. In the post-intervention data, apart from general intelligence, digit span backward which represents working memory was a significant predictor of academic score with $F_{(2, 86)} = 11.81$, $p < .001$, $R^2 = .25$, $R^2_{Adjusted} = .19$, $Se = .895$. Working memory emerged as a significant predictor with $\beta = .26$, $p = .008$ along with general intelligence with $\beta = .37$, $p < .001$.

Findings of Correlation Analysis

Authoritative parenting

A statistically non-significant relationship was found between authoritative parenting style and students' academic scores, $r(238) = .05$, $p = .419$, indicating that authoritative parenting were not associated with academic performance. Additionally, there was a significant negative correlation between authoritative parenting style and peer problems, $r(238) = -.29$, $p < .001$, as well as between authoritative parenting style and total difficulties, $r(238) = -.33$, $p < .001$. Also, there was a significant positive relationship between authoritative parenting and pro-social behavior of adolescents, $r(238) = .21$, $p = .001$ suggesting that authoritative parenting is linked to fewer peer problems and overall difficulties, it further promotes pro-social behavior among adolescent students. However, there was no statistically significant relationship between the socio-economic scores of parents who preferred an authoritative parenting style and the academic scores of the adolescents, $r(238) = .06$, $p = .359$.

Authoritarian parenting

There was a statistically significant positive relationship between authoritarian parenting style and academic scores, $r(62) = .27, p = .028$. Additionally, there was a significant negative correlation between authoritarian parenting style and peer problems, $r(62) = -.34, p = .007$, as well as between authoritarian parenting style and total difficulties, $r(62) = -.27, p = .033$.

However, there was no statistically significant relationship between the socio-economic scores of parents who preferred an authoritarian parenting style and the academic scores of the adolescents, $r(62) = -.06, p = .646$.

Permissive parenting

The correlation between permissive parenting and academic performance was not statistically significant, $r(23) = -.21, p = .309$. Similarly, there was no significant relationship between the socio-economic status of permissive parents and academic scores, $r(23) = -.12, p = .579$.

However, a noteworthy positive correlation emerged between permissive parenting and pro-social behavior, $r(23) = .42, p = .035$. Additionally, a significant positive relationship was found between permissive parenting and conduct problems, $r(23) = .43, p = .032$. These findings suggest that while permissive parenting does not impact academic performance, it is associated with both enhanced pro-social behavior and increased conduct problems.

Socio-economic status

Upper lower

A statistically non-significant relationship was observed between the socio-economic status of the upper-lower category and students' academic performance, $r(93) = -.036, p = .729$. However, a significant negative relationship was found between the socio-economic status of the upper-lower category and emotional symptoms, $r(93) = -.225, p = .028$.

Furthermore, a statistically significant negative relationship was observed between the socio-economic status of the upper-lower category and strength and difficulty scores, $r(93) = -.212, p = .039$. These findings highlight the detrimental impact of socio-economic status within the upper-lower category on emotional well-being and overall psychological functioning among students.

Lower middle

There was no statistically significant relationship emerged between the lower-middle socio-economic status and students' academic scores, $r(134) = -.152, p = .078$. However, a notable finding emerged regarding pro-social behavior. A statistically significant negative relationship was discovered between the lower-middle socio-economic category and pro-social behavior, $r(134) = -.174, p = .043$. This suggests that despite academic performance showing no significant association, socio-economic status may play a crucial role in shaping students' social interactions and behaviors.

Upper middle

The relationship found between the socio-economic score of the upper-middle category and students' academic scores was statistically non-significant, $r(90) = -.092, p = .383$. However, a significant negative correlation was discovered between academic performance and peer problems, $r(90) = -.255, p = .014$, suggesting that academic struggles may coincide with difficulties in peer relationships. Additionally, a positive correlation was found between the socio-economic score of the upper-middle category and conduct problems, $r(90) = .206, p = .049$, indicating a potential link between socio-economic status and behavioral challenges. Moreover, a statistically significant negative correlation was observed between pro-social behavior and peer problems among students from the upper-middle category, $r(90) = -.253, p =$

.015, highlighting the complex interplay between social behavior and peer interactions within this socio-economic group.

Findings of Sub-group Analysis

A sub-group analysis was conducted based on the categories of scores for all three groups. The categories were defined as follows: less than 35% was classified as Fail, between 35% and 59% as Second Division, 60% to 74% as First Division, and above 75% as Distinction.

Fail Category

Group A exhibited a significant improvement in AP scores from pre-intervention to post-intervention, $t(6) = -3.95$, $p = .008$, with a large effect size ($d = -1.49$). Group B also demonstrated a significant difference in AP scores, moving from pre-intervention to post-intervention, $t(3) = -4.16$, $p = .025$, with a large effect size ($d = -2.08$). Group C similarly showed a significant improvement, with scores shifting from pre-intervention to post-intervention, $t(4) = -4.32$, $p = .012$, and a large effect size ($d = -1.93$).

Second Division

Group A's AP scores significantly improved from pre-intervention to post-intervention, $t(42) = -4.43$, $p < .001$, with a medium effect size ($d = -0.67$). Group B also showed significant improvement from pre-intervention to post-intervention, $t(47) = -8.59$, $p < .001$, with a large effect size ($d = -1.24$). Conversely, Group C did not show a significant change, with AP scores from pre-intervention to post-intervention yielding $t(43) = -1.31$, $p = .198$, and a small effect size ($d = -0.20$).

First Division

Group A demonstrated no significant change in AP scores, with pre-intervention compared to post-intervention yielding $t(30) = -1.10$, $p = .281$, and a small effect size ($d = -0.20$). For Group B, a significant difference was observed in AP scores, moving from pre-intervention to post-intervention, $t(36) = -6.55$, $p < .001$, with a large effect size ($d = -1.08$). In contrast, Group C

showed no significant change, with AP scores from pre-intervention to post-intervention yielding $t(28) = 1.11$, $p = .277$, and a small effect size ($d = 0.21$).

Distinction Category

A paired-samples t-test for Group A revealed no significant difference in academic performance (AP) scores from pre-intervention to post-intervention, $t(11) = 0.22$, $p = .831$, with a negligible effect size ($d = 0.06$). For Group B, the t-test indicated no significant difference in AP scores from pre-intervention to post-intervention, $t(7) = -1.52$, $p = .172$, although a moderate effect size was observed ($d = -0.54$). Similarly, Group C showed no significant difference in AP scores from pre-intervention to post-intervention, $t(9) = 0.89$, $p = .399$, with a small effect size ($d = 0.28$).

The findings indicate that in the Fail Category, all groups (A, B, and C) showed significant enhancements in academic performance. Notably, Group B (combined hatha and jnana yoga) achieved the largest improvement, indicating that this integrated intervention was particularly effective for lower-performing students. Groups A (hatha yoga) and C (physical exercise) also demonstrated substantial gains. In the Second Division, both Groups A and B experienced significant improvements in academic performance, with Group B showing the most pronounced effect. In contrast, Group C (physical exercise) did not exhibit a significant change.

For the First Division, Group B again recorded a significant improvement in academic performance, while Groups A and C showed no significant changes. In the Distinction Category, none of the groups demonstrated statistically significant improvements in academic performance following the interventions. However, Group B, which participated in combined Hatha yoga and academic instruction based on jnana yoga, exhibited a moderate improvement, though this was not statistically significant.

Overall, the results indicate that the combined hatha yoga and jnana yoga-based academic instructions (Group B) was the most effective across various categories, especially for students with lower academic performance. Conversely, hatha yoga alone and physical exercise had limited effects on high-performing students.

Findings from a Delphi Study

In response to the research question, “*What are the most important concepts, methodologies, and applications that should be included to develop a comprehensive learning strategy for academically low-performing students?*”, a Delphi study was conducted. Out of 109 experts invited, 57 responded, and five key themes were identified: experience-based learning, self-regulated learning, study environment, teaching methods, and additional activities/support. In the second round of the study, 25 experts rated important methods, concepts, and applications on a scale from 1 to 4. Strategies that achieved a mean score of ≥ 3.25 , a median score of 4, and a quartile deviation (Q) of 1 were deemed highly recommended, with those scoring above the 81.25 percentile having a high probability of effectiveness. The termination criterion was set such that 75% of the strategies needed to fall within the first quartile.

In the second round, 25 experts evaluated 38 strategies across the five identified themes, of which 21 were rated as highly effective and strongly recommended. For experience-based learning, reflective learning, real-life examples, and learning by doing emerged as key strategies, with 3 out of 7 items receiving high ratings. Under self-regulated learning, methods such as reading aloud, self-motivation, and independent thinking were rated highly, with 3 out of 7 items endorsed. For the study environment, a democratic, interactive, and motivating environment was strongly recommended (2 out of 5). Teaching methods that focused on student-centric learning, the use of local language, remedial teaching, counseling, and a balance between theory and practice were particularly valued (6 out of 9). In the additional support category, strategies like collaborative learning, technological aids, physical activity, positive reinforcement, rest periods, and proper nutrition were highlighted (7 out of 10).

In a third and independent round, 50 new experts with teaching experience provided insights into the practical implementation of these strategies for low-performing adolescents in

schools. Despite strong theoretical support, strategies such as experiential learning, reading aloud, independent thinking, democratic learning environments, student-centric and remedial teaching were not widely implemented in practice. However, only nine strategies were found to be currently implemented by educators across different states in India. These strategies were organized into five key themes: using day-to-day examples and learning by doing (Theme I), fostering self-motivation (Theme II), promoting interactive learning (Theme III), teaching in local languages while balancing students' strengths and weaknesses (Theme IV), and encouraging physical activity alongside proper diet and nutrition (Theme V).

In conclusion, while a range of effective strategies have been identified for enhancing learning among academically low-performing students, there remains a gap between theoretical recommendations and actual implementation in educational practice. Addressing this gap will require focused efforts to integrate these highly recommended strategies into the everyday learning environments of students, particularly in underperforming schools.

Findings from Mediation Analysis

The following results depict two models showing intrinsic goal orientation and task value as mediators between critical thinking (independent variable) and self-efficacy for learning and performance (dependent variable). These models analyze how yoga influences these mediating factors and their effect on the outcome variable as illustrated in **Figure 2**.

Intrinsic Goal Orientation as the mediator

The direct effect of critical thinking on self-efficacy for learning and performance without the mediator resulted in $\beta (S_e) = 0.813 (0.077)$, $p < .05$ with 95% CI of [0.659, 0.966]. Additionally, the effect of critical thinking, represented as path 'a' on intrinsic goal orientation (mediating

variable) resulted in $\beta (S_e) = 0.640 (0.101)$, $p < .05$ with 95% CI of [0.439, 0.842]. Furthermore, the effect of intrinsic goal orientation on self-efficacy for learning and performance, controlling for critical thinking effect, represented as path 'b', resulted in $\beta (S_e) = 0.386 (0.087)$, $p < .05$ with 95% CI of [0.213, 0.559]. The inclusion of the mediating variable resulted in the effect of critical thinking on self-efficacy for learning and performance, represented as path 'c' as $\beta (S_e) = 0.565 (0.087)$, $p < .05$ with 95% CI of [0.392, 0.739]. The indirect effect calculated as $a \times b = 0.640 \times 0.386 = 0.25$. Whereas, the total effect (c) was calculated by adding the effect of critical thinking on self-efficacy including the mediating (c') to the indirect effect ($a \times b$) variable, which is $c' + a \times b$, implying $0.813 + 0.25 = 1.06$. The percentage of the total effect that is mediated by intrinsic goal orientation was calculated using the mediation percentage formula; $(\text{Indirect effect} / \text{Total effect}) \times 100 = (0.25 / 1.06) \times 100 = \sim 24\%$.

Task Value as the mediator

The direct effect of critical thinking on self-efficacy for learning without task value as mediator resulted in $\beta (S_e) = 0.813 (0.077)$, $p < .05$ with 95% CI of [0.659, 0.966]. Path 'a' defined the effect of critical thinking on task value (mediating variable) resulted in $\beta (S_e) = 0.714 (0.092)$, $p < .05$ with 95% CI of [0.530, 0.898]. Similarly, path 'b' defined the effect of task value on self-efficacy for learning after controlling the effect of critical thinking resulted in $\beta (S_e) = 0.450 (0.093)$, $p < .05$ with 95% CI of [0.265, 0.636]. The path c' which represented the effect of critical thinking on self-efficacy for learning after including task value as mediating variable resulted in $\beta (S_e) = 0.491 (0.093)$, $p < .05$ with 95% CI of [0.305, 0.677]. The indirect effect calculated as $a \times b = 0.714 \times 0.450 = 0.32$. Furthermore, the total effect (c) was calculated as $c = c' + a \times b = 1.13$. Also, the percentage of the total effect contributed by task value using mediation percentage $(0.32/1.13) \times 100 = 28\%$.

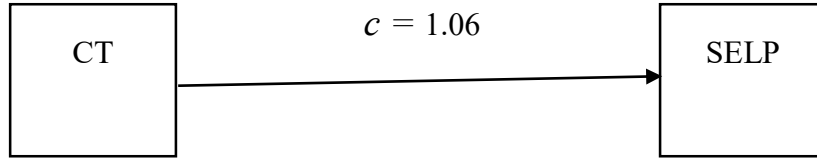


Figure 2a: The total effect of critical thinking (CT) on self-efficacy for learning and performance measured as 'c'.

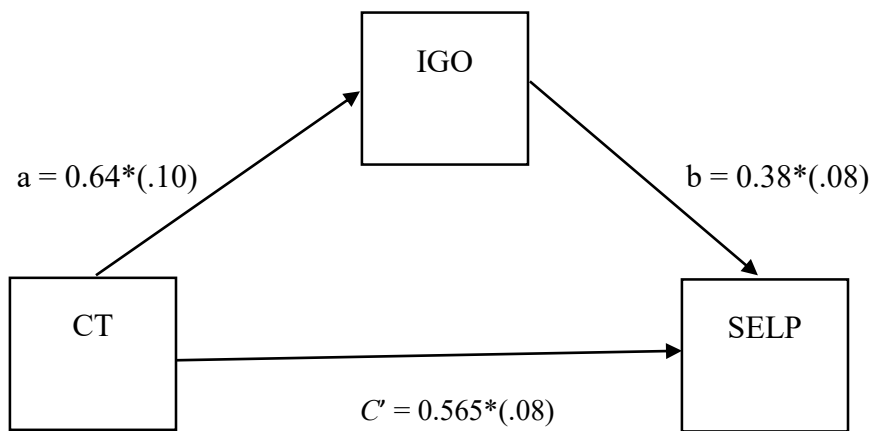


Figure 2b: Path diagram for indirect effect of critical thinking (CT) on self-efficacy for learning and performance (SELP) through intrinsic goal orientation (IGO). The values of path a, b, and c' represent path coefficients (with standard error of estimates) β (S_e)

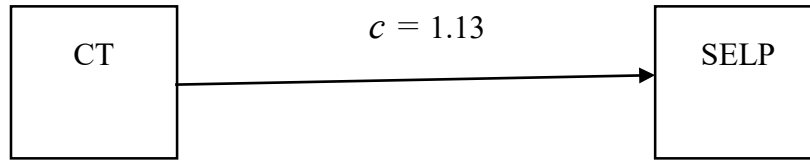


Figure 2c: The total effect of critical thinking (CT) on self-efficacy for learning and performance measure as 'c'.

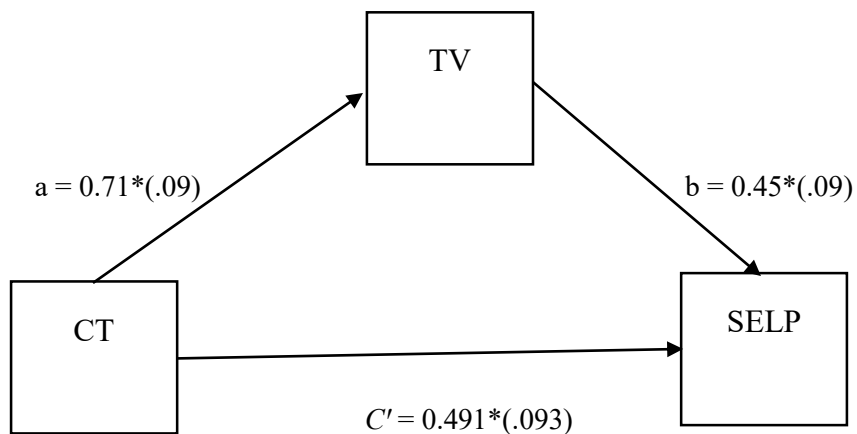


Figure 2d: Path diagrams for indirect effect of critical thinking (CT) on self-efficacy for learning and performance (SELP) through task value (TV). The values of path a, b, and c' represent path coefficients (with standard error of estimates) β (S_e).

Effect of Mindfulness on Emotional and Behavior Problem with Self-esteem as mediator

The following results depict two models showing self-esteem as a mediator between mindfulness (independent variable) and emotional and behavioral problems (dependent variable) and self-esteem as a mediator between mindfulness (independent variable) and pro-social behavior (dependent variable). These models analyze how yoga influences these mediating factors and their effect on the outcome variable.

The effect of mindfulness, represented as path 'a' on self-esteem (mediating variable) resulted in $\beta (S_e) = 0.349 (0.100)$, $p < .001$ with 95% CI of [0.151, 0.548]. The effect of self-esteem on difficulty score, represented as path 'b', resulted in $\beta (S_e) = -0.560 (0.088)$, $p < .001$ with 95% CI of [-0.735, -0.384]. The direct effect of mindfulness on difficulty score, represented as path 'c' as $\beta (S_e) = -0.416 (0.097)$, $p < .001$ with 95% CI of [-0.608, -0.223].

The indirect effect calculated as $a \times b = 0.349 \times (-0.560) = \beta (S_e) = -0.195 (0.063)$. The calculation based on Sobel's statistics yielded a z -value of (-3.06) which is significant at $p < .001$ level, indicating a statistically significant mediation effect. Additionally, the total effect (c) was calculated following the summation of direct effect (c') and the indirect effect (a x b). Using the equation ($c = c' + (a \times b)$); which equals to $(-0.416 + (-0.195)) = \beta (S_e) = -0.611 (0.116)$. The percentage of the total effect that is mediated by self-esteem was calculated using the mediation percentage formula: $(\text{Indirect effect} / \text{Total effect}) \times 100 = (-0.195 / -0.611) \times 100 = 31.96\%$. It implies that approximately 32% of the effect of mindfulness on difficulty score is mediated through self-esteem.

Effect of Mindfulness on Pro-Social Behavior with Self-Esteem as Mediator

The effect of mindfulness (independent variable) on self-esteem (mediating variable), represented as path 'a' resulted in $\beta (S_e) = 0.349 (0.100)$, $p < .001$ with 95% CI of [0.151, 0.548].

The effect of self-esteem on pro-social behavior, represented as path 'b', resulted in $\beta (S_e) = 0.358 (0.100)$, $p < .001$ with 95% CI of [0.160, 0.556]. The direct effect of mindfulness on pro-social behavior, represented as path 'c' as $\beta (S_e) = 0.287 (0.102)$, $p = .006$ with 95% CI of [0.084, 0.490/].

The indirect effect calculated as $a \times b = 0.349 \times (0.358) = \beta (S_e) = 0.124 (0.050)$. The calculation based on Sobel's statistics yielded a z -value of (2.49) with significance level ($p = .012$), indicating a statistically significant mediation effect. Additionally, the total effect (c) was calculated following the summation of direct effect (c') and the indirect effect (a x b). Using the equation ($c = c' + (a \times b)$); which equals to $(0.287 + 0.125) = \beta (S_e) = 0.412 (0.113)$. The percentage of the total effect that is mediated by self-esteem was calculated using the mediation percentage formula: $(\text{Indirect effect} / \text{Total effect}) \times 100 = (0.125 / 0.412) \times 100 = 30.34\%$. It implies that approximately 30% of the effect of mindfulness on pro-social behavior is mediated through self-esteem. The diagrammatic representation along with path coefficients of both the analysis are provided in **Figure 3**.

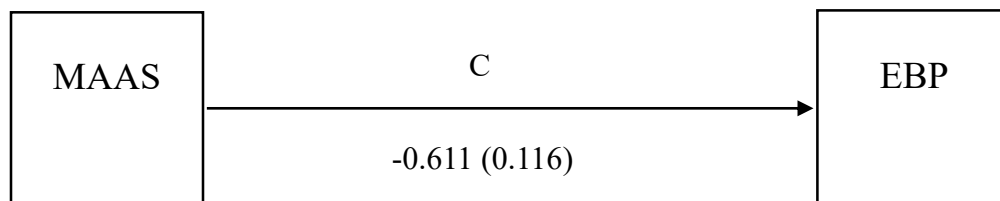


Figure 3a: Total Effect (c) of Mindfulness on Emotional and Behavior Problem representing Coefficient and Standard Error Values

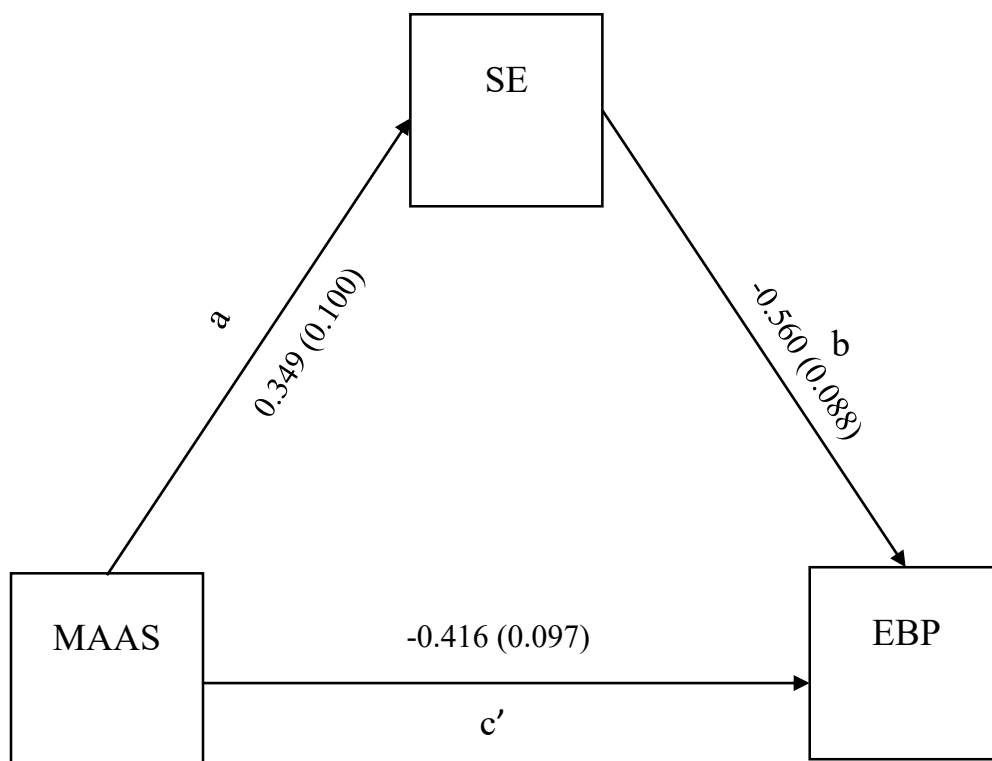


Figure 3b: Direct (c') and Indirect Effect Total Effect (axb) of Mindfulness on Emotional and Behavior Problem with Self-Esteem as Mediating Variable

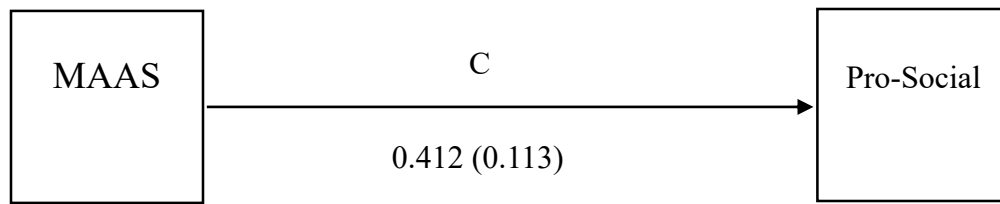


Figure 3c: Total Effect (c) of Mindfulness on Pro-Social Behavior representing Coefficient and Standard Error Values.

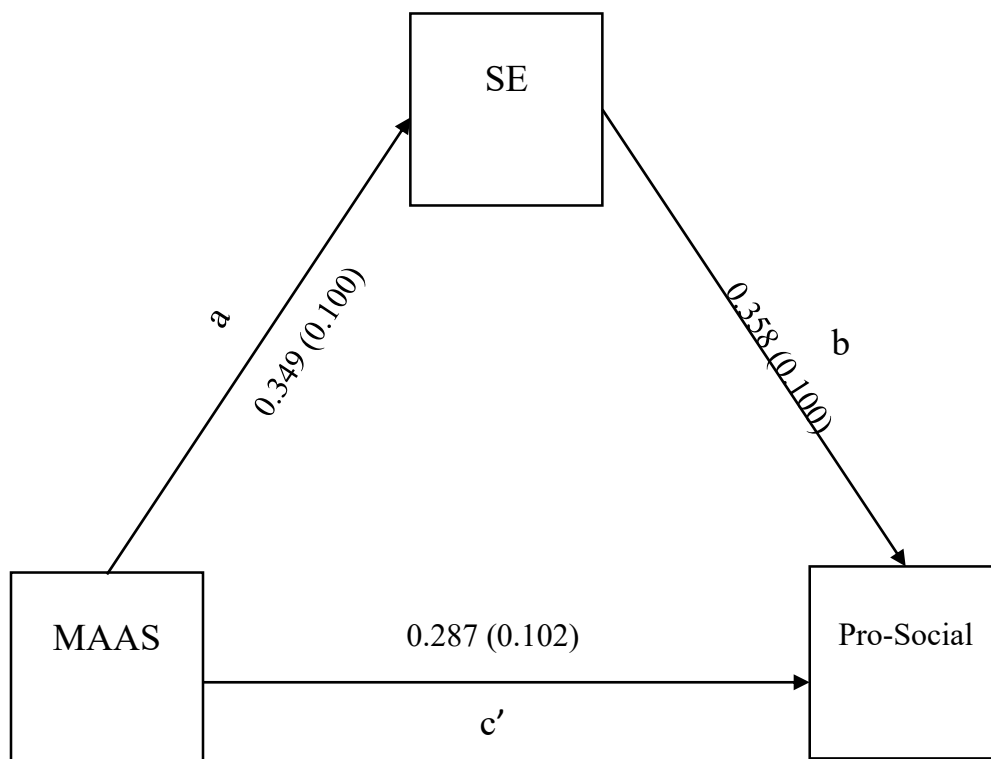


Figure 3d: Direct (c') and Indirect Effect Total Effect (axb) of Mindfulness on Pro-Social Behavior with Self-Esteem as Mediating Variable.

Recapitulation

The research employed a three-arm trial to compare the effects of hatha yoga, the combined effects of hatha and jnana yoga, and physical exercise on academic performance and related factors such as physical fitness, emotional well-being, cognitive functions, self-efficacy,

and performance anxiety. Conducted at two different locations in India, the study aimed to determine whether a learning approach based on yogic principles could enhance students' learning abilities and academic performance. Data were collected using standard assessment tools both before and after the intervention, along with one-time data for other factors that influence academic learning, such as parenting styles and socio-economic status. The analyses incorporated one-way ANOVA for group comparisons, regression analysis to uncover predictors of academic performance within each group, and correlation analysis to explore the relationships of parenting style, socio-economic status, and emotional and behavioral problems with academic performance. The study findings suggest that initially, there were no significant differences among the groups across most of the variables studied, indicating a level of homogeneity in baseline levels of the study variables. However, after the intervention, significant improvements were observed in several key variables.

Academic performance showed marked enhancements, with the group undergoing combined hatha and jnana yoga demonstrating superior performance compared to both hatha yoga and physical exercise alone. This improvement underscores the potential benefits of integrating learning principles, such as reflective contemplation and inquiry, with physical culturing, enhancing focus and awareness, leading to more holistic academic development. Furthermore, improvements were noted in muscle fitness, general intelligence, attention, verbal and working memory, comprehension skills, creative writing skills, and reading skills. These enhancements can be attributed to the comprehensive nature of yoga practices, which involve physical postures, breath control, and cognitive engagement, thereby creating an environment conducive to learning and academic skill development.

Additionally, significant improvements were observed in academic self-efficacy,

indicating that yoga interventions can enhance students' belief in their ability to succeed academically. This improvement in self-efficacy could be attributed to yoga's ability to promote self-awareness, regulate emotions, and reduce stress, ultimately cultivating a more positive mindset towards learning and academic challenges. Moreover, reductions in test anxiety, emotional symptoms, conduct problems, hyperactivity, and peer problems were noted, particularly in the group undergoing hatha and jnana yoga. These findings suggest that yoga interventions may contribute to improvements in emotional regulation, social interactions, and behavioral conduct, thereby creating a conducive learning environment and enhancing overall well-being among adolescents. However, it's important to note that some variables, such as numeracy skills and pro-social behavior, did not show significant differences among the groups post-intervention. These results highlight the multifaceted nature of skill development, indicating that certain skills may require more targeted or prolonged interventions to yield significant improvements.

The results of the multiple regression analysis indicate significant predictors of academic performance across the intervention groups. In the pre-intervention phase, numeracy skills were found to significantly predict academic scores in the hatha yoga group, while reading skills and academic self-efficacy emerged as significant predictors post-intervention. For the hatha and jnana yoga group, pre-intervention predictors included reading and self-efficacy, whereas post-intervention predictors comprised general intelligence, creative writing, and academic self-efficacy. In the physical exercise group, general intelligence was a significant predictor of academic score pre-intervention, with working memory also emerging as a significant predictor post-intervention.

Additionally, correlation analysis revealed interesting insights into parenting styles and

socio-economic status. Both authoritative and authoritarian parenting styles positively correlated with academic performance while negatively correlating with peer problems and overall difficulties. Permissive parenting, although not significantly impacting academic performance, was associated with enhanced pro-social behavior and increased conduct problems. Socio-economic status exhibited varying relationships, with the upper-lower category negatively impacting emotional well-being and psychological functioning, and the lower-middle category negatively correlating with pro-social behavior. The upper-middle category showed complex interplays between academic performance, behavioral challenges, and social behavior, emphasizing the nuanced influence of socio-economic status on students' academic and social outcomes.

The mediation analysis was performed to explore the influence of intrinsic goal orientation, task value, and self-esteem in explaining the relationship between critical thinking and self-efficacy, as well as mindfulness and emotional/behavioral outcomes. The results indicated significant mediation effects, particularly highlighting the roles of intrinsic goal orientation and task value in self-efficacy for learning, and self-esteem in emotional and behavioral regulation. These findings are critical in understanding how psychological and cognitive factors influence student outcomes and behavior.

Overall, the study underscores the potential of school-based yoga interventions, particularly those incorporating cognitive and non-cognitive principles, to positively impact various aspects of academic performance and emotional and behavioral outcomes among adolescents.

Table 11: Statistical Significance Analysis of Study Variables: Within Group, Between Groups, and Post-Hoc Comparisons

Variables	Group	Within Group Analysis					Between Groups		Post-Hoc Analysis		
		Pre	Post	N	<i>p</i>	ES	<i>F</i> (2, 276)	<i>p</i>	A Vs B	B Vs C	A Vs C
		Mean ± SD	Mean ± SD						<i>p</i> -value	<i>p</i> -value	<i>p</i> -value
Academic performance	A	57.27 ± 14.79	59.48 ± 13.35	93	0.000	0.44	22.54	0.000	0.000	0.000	0.190
	B	57.09 ± 12.92	63.32 ± 12.38	96	0.000	1.13					
	C	57.45 ± 14.18	58.01 ± 12.66	89	0.466	0.08					
Muscular Fitness	A	4.08 ± 1.78	5.22 ± 0.92	93	0.000	0.70	5.58	0.004	0.018	0.010	1.000
	B	3.45 ± 1.99	5.33 ± 0.73	96	0.000	0.96					
	C	3.79 ± 1.96	4.87 ± 1.17	89	0.000	0.57					
General Intelligence	A	29.78 ± 8.55	32.73 ± 8.51	93	0.000	0.71	14.41	0.000	0.000	0.000	0.833
	B	29.55 ± 8.38	35.22 ± 7.13	96	0.000	1.07					
	C	28.91 ± 9.50	31.10 ± 10.40	89	0.000	0.49					
Digit Span Forward	A	8.08 ± 2.21	9.20 ± 2.29	93	0.000	0.68	12.26	0.000	0.202	0.000	0.007
	B	8.18 ± 2.01	9.74 ± 1.96	96	0.000	1.22					
	C	8.06 ± 2.19	8.50 ± 2.28	89	0.030	0.24					
Digit Span Backward	A	4.75 ± 1.94	5.12 ± 2.17	92	0.033	0.23	6.68	0.001	0.034	0.001	0.958
	B	4.66 ± 1.71	5.54 ± 1.89	96	0.000	0.61					
	C	4.39 ± 1.75	4.49 ± 1.76	89	0.478	0.08					
Verbal Working Memory	A	12.82 ± 3.56	14.27 ± 3.84	93	0.000	0.62	17.86	0.000	0.007	0.000	0.011

	B	12.84 ± 3.18	15.28 ± 3.36	96	0.000	1.24					
	C	12.42 ± 3.24	12.90 ± 3.34	89	0.061	0.20					
Comprehension	A	3.95 ± 2.27	4.87 ± 2.10	92	0.000	0.44	3.32	0.037	1.000	0.036	0.256
	B	4.29 ± 2.53	5.42 ± 2.20	96	0.000	0.54					
	C	4.30 ± 2.68	4.61 ± 2.65	89	0.297	0.11					
Numeracy skill	A	2.16 ± 2.24	3.28 ± 2.11	93	0.000	0.69	2.81	0.065	0.661	0.055	0.761
	B	2.07 ± 2.37	3.52 ± 2.03	96	0.000	0.87					
	C	2.18 ± 2.15	3.00 ± 2.64	89	0.001	0.38					
Creative Writing	A	1.32 ± 1.35	2.58 ± 1.66	93	0.000	1.03	4.94	0.007	0.168	0.006	0.693
	B	1.30 ± 1.41	3.04 ± 1.79	96	0.000	0.95					
	C	1.46 ± 1.43	2.43 ± 2.07	89	0.000	0.49					
Reading skill	A	4.16 ± 1.82	4.93 ± 2.04	92	0.000	0.56	11.66	0.000	0.043	0.000	0.056
	B	4.04 ± 1.82	5.28 ± 1.73	96	0.000	1.21					
	C	4.25 ± 1.92	4.49 ± 2.02	89	0.095	0.18					
Academic skills	A	15.30 ± 7.10	21.95 ± 7.80	93	0.000	1.20	14.89	0.000	0.050	0.000	0.008
	B	15.81 ± 7.38	24.43 ± 7.01	96	0.000	1.67					
	C	16.10 ± 7.74	20.21 ± 9.77	89	0.000	0.67					
Academic Self-Efficacy	A	82.83 ± 10.59	86.72 ± 11.65	93	0.000	0.42	19.78	0.000	0.000	0.000	0.101
	B	81.89 ± 10.34	90.31 ± 9.21	96	0.000	1.43					
	C	84.94 ± 11.89	86.40 ± 11.40	89	0.079	0.19					
Test Anxiety	A	3.17 ± 0.59	2.70 ± 0.68	91	0.000	0.64	5.59	0.004	1.000	0.010	0.015
	B	3.27 ± 0.66	2.78 ± 0.62	96	0.000	0.72					

	C	2.99 ± 0.60	2.83 ± 0.59	89	0.035	0.23					
Emotional Symptoms	A	5.03±2.12	4.01 ±2.58	93	0.001	0.35	4.46	0.012	0.296	0.010	0.559
	B	5.14 ± 2.07	3.51 ± 1.88	97	0.001	0.66					
	C	4.84 ± 2.11	4.33 ± 2.14	89	0.033	0.23					
Conduct Problem	A	3.42 ± 1.91	2.98 ± 2.28	93	0.139	0.15	6.29	0.002	0.027	0.003	1.000
	B	4.06 ± 1.92	2.67 ± 1.58	97	0.001	0.58					
	C	3.70 ± 1.96	3.53 ± 2.00	89	0.460	0.07					
Hyperactivity	A	4.25 ± 1.74	3.35±1.82	93	0.001	0.39	9.15	0.000	0.002	0.001	1.000
	B	4.70 ± 1.85	2.69 ± 1.55	97	0.001	1.01					
	C	4.51 ± 2.21	3.78 ± 1.79	89	0.006	0.29					
Peer Problem	A	4.02 ± 1.88	3.33 ± 1.91	93	0.007	0.28	10.16	0.000	0.022	0.000	0.229
	B	4.45 ± 1.66	2.88 ± 1.71	97	0.000	0.74					
	C	3.69 ± 1.88	3.60 ± 1.77	89	0.705	0.04					
Pro-Social	A	7.71 ± 2.03	7.86 ± 2.23	93	0.604	0.05	0.716	0.490	1.000	1.000	0.731
	B	7.86 ± 1.88	7.88 ± 1.94	97	0.933	0.01					
	C	7.74 ± 1.86	7.46 ± 1.98	89	0.233	0.127					
Strength and Difficulty	A	16.72 ± 5.48	13.68 ± 6.94	93	0.000	0.36	13.046	0.000	0.002	0.000	0.426
	B	18.36 ± 4.98	11.74 ± 4.63	97	0.000	1.05					
	C	16.73 ± 5.38	15.22 ± 5.37	89	0.028	0.24					
Internalizing Factor	A	9.05 ± 3.00	7.35 ± 3.84	93	0.000	0.37	10.039	0.000	0.028	0.000	0.199
	B	9.60 ± 2.89	6.38 ± 3.07	97	0.000	0.85					
	C	8.53 ± 3.25	7.92 ± 3.20	89	0.120	0.16					

Externalizing Factor	A	7.67 ± 3.09	6.39 ± 3.72	93	0.007	0.28	9.952	0.000	0.002	0.000	1.000
	B	8.68 ± 3.15	5.36 ± 2.59	97	0.000	0.90					
	C	8.20 ± 3.31	7.30 ± 3.22	89	0.027	0.23					

Legend: A: Hatha yoga group; B: Hatha and Jnana yoga; C: Physical exercise group; Academic performance scores calculated in percentage; Minimum muscular fitness: score range 0 to 6: measured through Krauss-Weber test; General intelligence measured through Raven's progressive matrix: total score out of 60; Digit span forward: score range 0 to 16; Digit span backward: score range 0 to 16; Verbal working memory: score range 0 to 32; DSF, DSB, and VWM were measured through Weschler intelligence scale; Academic self-efficacy: score range 19 to 111; Test Anxiety: score range 1 to 5; Emotional Symptoms: score range 0 to 10; Conduct Problems: score range 0 to 10; Hyperactivity: score range 0 to 10; Peer Problem: score range 0 to 10; Pro-Social: score range 0 to 10; Strength and Difficulty; score range 0 to 10; Internalizing Factor: score range 0 to 20; Externalizing Factor: score range 0 to 20; N: Sample size for final analysis; *p*: probability to obtain the observed results if the null hypothesis is correct; *F*: ratio of mean square between groups to the mean square within groups; ES: Effect size (Cohen's *d*).