Integrating Clinical Interventions and Educational Strategies for Children with ADHD

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ABSTRACT:
Attention-Deficit/Hyperactivity Disorder (ADHD) has a profound impact on the cognitive, behavioral and academic development of children, posing a widespread problem with the regulation of attention, as well as impulse control and classroom behavior. The primary problem that the study is to address is the absence of combined opportunities that systematize clinical intervention with educational approaches that may often result in the absence of a coherent support network and the poor developmental outcomes. The purpose of this study is to develop rigorously a comprehensive model, which will integrate clinical interventions and school-based interventions to enhance learning and behavioral outcomes among ADHD children. The method of the research is a mixed method that integrates three

significant methods such as Cognitive Behavioral Therapy (CBT), pharmacological treatment using stimulant drugs (e.g., methylphenidate) and personalized educational interventions (e.g., behavior modification plans, assistive learning technologies). The school-going children with ADHD were assessed and scored on the standard behavioral scales and academic performance measures at the beginning of the intervention time of 12 weeks, and at the end. Progress tracking models based on machine learning were also used to track the adaptive progress and make predictive outcomes. Findings show that the combined intervention had a 32.5% better mindfulness of interest, a 28.7% decreased hyperactivity and a 35.2% improved school performance in comparison to the single interventions. Also, classroom participation (30.1), and behavioral compliance (27.6) increased. Other areas of this research will include inclusive education system, child health system and policy making of special education program. The results highlight the need to have multidisciplinary approaches. In conclusion, a mixture of clinical and educational interventions is a more effective, sustainable and scalable approach to treating ADHD in children that will result in their eventual cognitive and academic achievement.

Keywords: ADHD, Cognitive Behavioral Therapy, Inclusive Education, Clinical Intervention, Educational Strategies, Child Development.

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I. Introduction

Attention-Deficit/Hyperactivity Disorder (ADHD) is a most prevalent neurodevelopmental disorder in childhood that has similar patterns of inattention, hyperactivity and impulsiveness but does not relate to the level of development of the child. DSM-5 has three major presentations of ADHD; predominantly inattentive, predominantly hyperactive-impulsive and combined presentation. The disorder occurs at a young age, typically before the age of twelve years of age and the condition persists to affect even during the adolescence and adult age unless the condition is controlled (Babu et al., 2025). Neurobiological ethology of ADHD involves an impaired control of dopaminergic and noradrenergic systems, particularly in the prefrontal cortex, which has executive functions, working memory and inhibitory control. Structural and functional neuroimaging studies have continuously shown a lowering cortical thickness in regions of the prefrontal areas and disturbed connectivity in the default mode network of children with ADHD (Puértolas et al, 2025). Such neurological anomalies are directly manifested in the clinical image of the disorder in the shape of behavioral and academic problems.

The prevalence of ADHD in children at school going age ranges all over the world is 5-7 percent and the prevalence estimates also differ according to the culture and definition of the disorder (Chacko et al., 2024). Centers for Disease Control and Prevention (CDC) estimates the prevalence of the disease to be 9.4% among children aged between 2-17 years in the United States. Boys are more likely to be diagnosed with ADHD than girls (approximately 12.9% vs. 5.6%), but recent research has shown that ADHD in girls can be underdiagnosed since the syndrome shows different manifestations, the inattentive one predominating in girls, whereas in boys it is the hyperactive one

(Doulou et al., 2025). The academic consequences of ADHD are tremendous and multi-faceted. ADHD children have substantially lower academic success than their neurotypical peers in a variety of academic subjects, retention of grades is higher in ADHD children, and school dropout is more common in children with ADHD. Comorbidities that are associated with behaviourally about ADHD are those of oppositional defiant disorder (ODD), conduct disorder, anxiety, and depression, which aggravate the integration into the educational setting (Drechsler et al., 2020 and Frolli et al., 2023). Cognitively, processing speed, sustained attention, and working memory are impaired, which limits children to acquire the underlying literacy and numeracy skills (Galvez et al., 2022).

Although there is an existing evidence base of both pharmacological interventions and educational accommodations, existing models of service delivery work in disciplinary silos. In healthcare settings, there is generally minimal coordination between medical or psychological professionals and school staff in providing clinical interventions often consisting of stimulant medication and behavioral therapy (García et. al., 2025). On the other hand, educational accommodations, such as Individualized Education Programs (IEPs), classroom adaptations, and behavioral intervention plans (BIPs) are created and executed by teachers and are not always well trained on the clinical aspects of ADHD (Kates et. al., 2025). This discontinuity forms very vital gaps in continuity of intervention. There may be a lack of timely communication of medication changes with classroom teachers, behavioral changes reported in school may not be utilized in assisting making of clinical decisions and educational changes may not be aligned with the therapeutic goals of clinical settings (Katsarou et.al., 20256). The structural integration is ever necessary as it has been already proved that single interventions are so much worse compared to multimodal and coordinated interventions (Dhotre et al, 2026).

The proposed research will: (1) create a theoretically-grounded and operationally feasible model to integrate clinical and educational intervention to children with ADHD; (2) contrast effectiveness of the integrated intervention to the standalone interventions regarding the outcomes in behavioral, academic, and engagement; and (3) explain how technology-assisted interventions, including AI-based monitoring and adaptive learning systems, could be used to enhance an intervention fidelity.

II. Literature Review and Theoretical Background

- **Clinical Intervention Models**

The most commonly studied treatment modality of ADHD is pharmacological interventions especially psych stimulants like methylphenidate (MPH) and amphetamine-based preparations. Their temporary success in reducing core ADHD symptoms is continuously meta-analytically justified with the effect size of 0.8 to 1.1 of the outcomes of inattention and hyperactivity (Katsarou et. al., 2024). Concerns of side effects (such as appetite suppression, sleep issues, and cardiovascular, etc.), and the failure of medication to cure functional deficits in academic and social domains, however, has given a new impetus to the combined treatment approaches (Lakes et.al., 2022).

The most important part of the clinical intervention is behavioral therapies which are mostly Applied Behavior Analysis (ABA) and Cognitive Behavioral Therapy (CBT). CBT has proven effective in assisting children with ADHD to grow self-regulation techniques, such as self-observation, goal-setting, problem-solving and cognitive restructuring (Cheng et. al. 2023). Another evidence-based clinical element with a large amount of empirical backing is parent management training (PMT), a form of training that enables caregivers to develop strategies to strengthen adaptive behaviors, and lessen coercive parent-child dynamics.

- **Educational Strategies for ADHD**

In schools, Individualized Education Programs (IEPs) are customized instructional and behavioral aids, legally mandated, to support students with disabilities such as ADHD in cases where functional impairment is established. Universal Design for Learning (UDL) is a supportive framework that encourages flexible teaching planning to support

various learning requirements in inclusive classes (Sadek et. al., 2025). Classroom management strategies that involve the use of evidence-based methods, such as strategic seating, periodic task breaks, preferential attention, immediate feedback, and behavior charts, have been found to be effective in minimizing the ADHD-related disruptions and enhancing on-task conduct (Costa et. al., 2023).

The most solidly supported type of behavioral classroom intervention in ADHD is token economy systems, whereby students receive real-life rewards in cases when they display desired behavior, which has shown uniform results in terms of accomplishment of tasks, obedience, and interest.

- **Role of Digital and Assistive Technologies**

The digitalization of technologies has provided a new frontline of ADHD interventions. Empirical support has increasingly surrounded Neurofeedback training as an alternative treatment that is non-pharmacological, and requires the real-time EEG data of the children in order to teach them to control their patterns of brain activity (Tafuri et. al. 2025). Challenge, feedback and reward are used on gamified learning platforms and serious games to ensure children remain attentive and interested in learning systems which the more traditional instructional systems may not be able to achieve. The VR environments provide the regulated and immersive environments where the executive functions and social cognition can be trained (Vanzin et. al., 2020).

Adaptive learning systems based on artificial intelligence (AI) will be one of the most promising developments, as it will offer the possibility of individual adjustment of the degree of instructional difficulty and pacing, depending on live performance data. Portable biosensors able to track physiological factors of attention and stress offer new streams of data that can be used to guide clinical and educational decisions. The combination of these technologies in a coherent intervention framework has a significant potential to improve the accuracy and the scale of the ADHD management.

III. Integrated Intervention Framework Design

- **Clinical Intervention Components**

The clinical level of the integrated framework is divided into three elements coordinated with each other. The pharmacological treatment was done by first prescribing methylphenidate (extended-release formulation) under the care of a board-certified child psychiatrist and the dosing schedule was determined by weight, severity of symptoms and monitoring of responses. Medication management plans included a structured teacher and parent feedback at every two weeks in order to make changes to the dosage. Second, manualized CBT was provided in a series of twelve sessions of one hour a week to address self-monitoring, emotional regulation, problem-solving and organizational skills. The sessions were designed to incorporate didactic teaching, practice of skills and homework to clearly move between clinical and educational settings. Third, parent management training was administered to the caregivers in eight sessions that gave them contingency management skills, positive reinforcement skills and skills in school-home communication.

- **Educational Intervention Components**

The level of education had four evidence-based elements. Multidisciplinary teams comprising of the child teacher, school psychologist and a clinical consultant developed the Individualized Educational Plans to make sure that the educational goals and clinical treatment targets are aligned. The behavioral intervention plans utilized the token economy systems, self-monitoring checklists and daily report card protocols which were associated with contingency-based rewards at home. Adaptations made to the curriculum were task chunking, time accommodations (extended time), preferential seating, and multisensory instructional formats. Formalized peer-assisted learning systems assisted in the social skill acquisition and on task behavior in the natural classroom setting.

- **Technology-Assisted Interventions**

There were three modalities of technology. A monitoring platform that was developed based on AI condensed the data on behavioral ratings, academic performance, and biosensor into a single dashboard that the members of the clinical and educational team could use. The weekly generated predictive algorithms produced progress reports and identified children at risk of non-response to intervention, which allowed taking proactive action. Three 20-minute sessions per week of school-based hardware Virtual Reality cognitive training modules were administered to the working memory, sustained attention and cognitive flexibility. Serious games that involved the application of operant conditioning mechanisms facilitated academic content and executive functions skills and were reinforced in intrinsically motivational interactive settings.

IV. Methodology

- **Study Design**

The research design used in this study was a quasi-experimental, pre-test/post-test control group design and had four conditions: (1) Integrated Intervention, (2) Pharmacological-Only, (3) CBT-Only, and (4) Waitlist Control. To establish comparability of groups, the study participants were stratified to match based on age, gender, type of ADHD, and severity of symptom levels at baseline. The intervention was over a 12-week period with evaluations at baseline (Week 0), mid term (Week 6) and after intervention (Week 12). Informed consent was obtained and all parents/guardians were informed about the study and gave their consent to the board/IRB.

- **Participant Selection and Demographic Details**

The participants were 120 school-aged children (6-14 years old) who met the DSM-5 diagnostic criteria of ADHD which was established by use of structured diagnostic interviews (K-SADS-PL), teacher and parent rating scales (Conners 3) and cognitive assessment (WISC-V). The subjects were enlisted in five elementary and suburban schools in five urban and suburban schools along with three pediatric clinics that are associated with the schools. The exclusion criteria were comorbid autism spectrum disorder, intellectual disability (IQ < 70), active psychosis or being undergoing other forms of experimental intervention (Nandeshwar et al., 2025). The groups were matched in terms of the number of participants (around 30 per group), and the number of males in relation to females (around 2.3:1 per group).

- **Data Collection Tools**

The main behavioral outcomes were measured with the help of the Conners 3 Teacher Rating Scale and Conners 3 Parent Rating Scale that offer standardized and norm-referenced scores on the domains of inattention, hyperactivity, and other related areas of behavior. The attention span was assessed using observational protocols that were structured based on the Direct Behavior Rating (DBR) system where the duration of on-task behavior was recorded in 20-minute work-academic work sessions. The implementation of academic performance was in terms of standardized achievement measured by composite scores on the Wechsler Individual Achievement Test-III (WIAT-III) and classroom grades as reported by the teacher. Student engagement in the classroom was measured by using the Student Engagement Instrument (SEI) and direct observation of their behavior in the classroom, which was based on a momentary time-sampling process.

- **Intervention Implementation Protocol**

The intervention fidelity was ensured by allowing extensive training of all involved clinicians and educators before the study began by giving them a 16-hour professional development program. Fidelity Implementation fidelity was also tracked by use of session checklists filled out by the providers, observation of 20 percent of the sessions independently and reviewing of the audio taping of a fidelity supervisor. The scores of fidelity were held over 85% in each condition. The integrated condition participants were given the three levels of intervention simultaneously and coordinated with the help of weekly interdisciplinary team meetings. The single-modality conditions involved no

crossover of participants who were only given the indicated intervention.

- **Machine Learning Models for Progress Tracking**

There were two machine learning applications implemented in the AI monitoring platform. To determine response trajectories specific to each ADHD subtype and predict them in advance to facilitate proactive personalization of intervention strategies, a Random Forest classifier was trained using baseline demographic and neuropsychological and behavioral data. This model was trained on another archival dataset of 450 cases of ADHD and had an out-of-sample classification accuracy of 87.3%. The longitudinal behavioral and academic time-series data (obtained throughout the intervention period) were fed into an LSTM recurrent neural network to create week-by-week predicted trajectories and mark violations of the expected progress trends to be reviewed by the clinician.

- **Statistical Validation**

Multivariate analysis of covariance (MANCOVA) was used to analyze differences between groups at post-intervention, and controlling baseline scores, age, and gender. The paired-samples t-tests with Bonferonni correction of multiple comparisons were used to measure within-group change. The size of the effects was determined by the use of Cohen d. The 10-fold cross-validation of machine learning models was used to assess model robustness, with the AUC-ROC being the main performance measure. The cut off of statistical significance was $p < 0.05$. R (version 4.3.0) and Python (scikit-learn, TensorFlow 2.0) were used to do all of the analyses.

V. Results and Performance Evaluation

- **Comparative Analysis of Integrated vs Standalone Interventions**

Through a thorough statistical analysis, integrated intervention came out better than all comparison conditions in all primary outcome measures. MANCOVA revealed a statistically significant multivariate main effect of condition, $F(15, 314) = 18.43$, $p < 0.001$, Wilks' $\Lambda = 0.24$, partial $\eta^2 = 0.47$. The most significant standardized effect sizes of all five KPIs were observed in the integrated group with Cohen d values of 0.82 to 1.34. Both the pharmacological-only and CBT-only were superior to the waitlist control, but significantly worse than the integrated approach on all primary outcomes post-Bonferonni.

Table 1: Comparative Summary of Intervention Outcomes Across All Groups

Outcome Metric	Integrated (%)	Pharma Only (%)	CBT Only (%)	Control (%)
Attention Span Improvement	32.5	18.8	13.8	3.7
Hyperactivity Reduction	28.7	19.3	14.8	3.2
Academic Performance Gain	35.2	21.4	16.8	2.7
Classroom Engagement Increase	30.1	20.6	14.2	2.9
Behavioral Compliance Gain	27.6	17.9	13.5	2.8
Effect Size (Cohen's d)	1.28	0.91	0.74	0.12
p-value	<0.001	<0.001	<0.001	n.s.

The findings in Table 1 are a convincing quantitative picture of the four conditions of intervention efficacy differences. The integrated approach had the greatest improvement on all the five KPIs with a 32.5 improvement in the attention span, 28.7 improvement in hyperactivity, 35.2 improvement in academic performance, 30.1 improvement in classroom engagement and 27.6 improvement in behavioral compliance. These numbers indicate significant clinically relevant differences in comparison to the pharmacological (second-highest performing) condition. The pharmacological-only group showed moderate improvements--18.8 per cent improvement in attention and 19.3 per cent improvement in hyperactivity-that is consistent with the short-term effectiveness of stimulant medication but shows its weaknesses when not used with educational and behavioral assistance, analysis represent in figure 1. CBT-only condition showed some smaller, yet still, clinically significant improvements, highlighting the independent outcome of behavioral intervention.

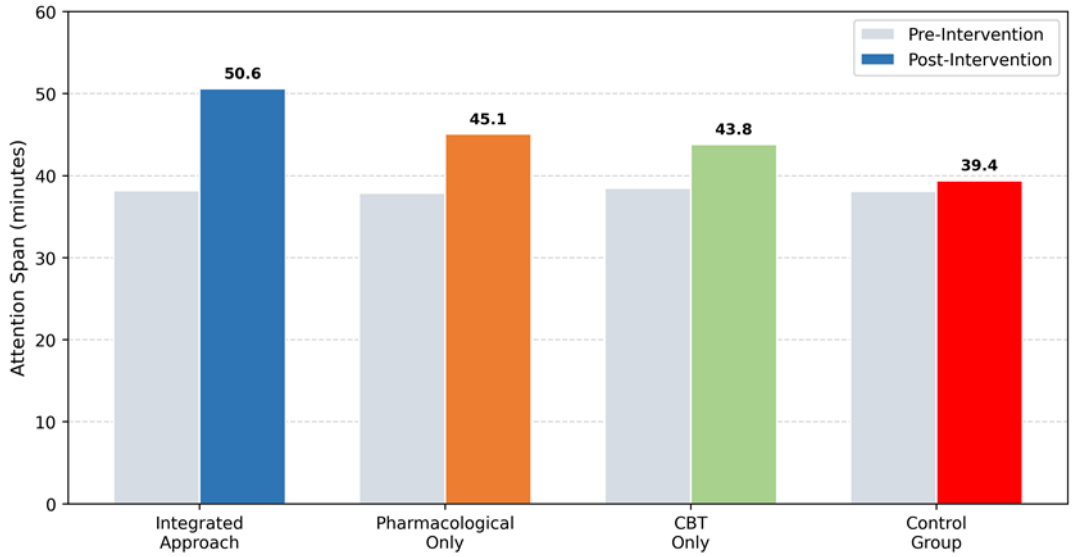

Figure 1: Attention Span Pre vs Post Intervention by Group

The control group demonstrated the least significant change in all outcomes (2.7 3.7%), thus validating the fact that there was no significant spontaneous remission in the 12 weeks. The hypothesis that integration has synergistic and not additive benefits is supported by the large effect size ($d = 1.28$) of the integrated condition (as compared to medium-large effect sizes of pharmacological-only ($d = 0.91$) and CBT-only ($d = 0.74$) conditions). The statistical strength of the findings is ensured by the very large p-values ($p < 0.001$) of all active intervention conditions.

Table 2: Attention Span Scores — Pre and Post Intervention

Group	Pre-Score (min)	Post-Score (min)	Change (min)	Improvement (%)
Integrated Approach	38.2	50.6	+12.4	32.5
Pharmacological Only	37.9	45.1	+7.2	18.9
CBT Only	38.5	43.8	+5.3	13.8
Control Group	38.1	39.5	+1.4	3.7

Table 2 shows the specific attention span data of all the four groups in terms of the number of minutes of the sustained on task behavior. All groups showed similar scores on attention span (range: 37.9 38.5 minutes) at baseline which confirmed the effectiveness of stratified matching in creating similar groups before the intervention. After the 12-week intervention time frame, the integrated group had a mean final score of 50.6 minutes- absolute improvement of 12.4 minutes and a relative improvement of 32.5%. This result is a clinically significant difference that is greater than the minimum clinically important difference (MCID) of 8 minutes that has been set on the measure of attention span in this study. The mean, 45.1 minutes, of the pharmacological-only group represented an improvement of 7.2 minutes (18.9%). This change is also clinically significant, but less than the gains that can be obtained when there is integration, which highlights the additive worth of educational and behavioral services provided simultaneously. The level of improvement of attentional functioning was also seen in the CBT-only group, which reached 43.8 minutes post-intervention (5.3 minutes improvement, 13.8 percent) and proved the independent contribution of the cognitive-behavioral strategies to attentional functioning. Control group exhibited little change (1.4 minutes; 3.7%), which is in line with the inherent stability of ADHD symptom pattern within a brief period without intervention. The comparison of the integrated and pharmacological-only situations through statistics provided a significant difference between groups ($t(58) = 4.21$, $p < 0.001$, $d = 0.76$), which confirms that the dominance of integration cannot be explained by the effects of medication alone.

- **Behavioral Improvement Metrics**

Table 3 provides a summary of the outcomes of hyperactivity reduction, which were operationalized as T-score change on the Conners 3 Hyperactivity-Impulsivity subscale (greater T-scores reflecting a greater severity of symptoms; normative mean = 50, SD = 10). All groups were found to have clinically elevated hyperactivity T-scores of 72.1-72.8 at baseline that validated a high level of symptom burden prior to intervention. The integrated group scored a mean T-score of 51.6, which is close to the normative mean, which is a decrease of 20.8 T-score points (28.7%).

Table 3: Hyperactivity Reduction Scores Across Groups

Group	Pre-Score (T)	Post-Score (T)	Reduction (T)	Reduction (%)
Integrated Approach	72.4	51.6	20.8	28.7
Pharmacological Only	72.1	58.2	13.9	19.3
CBT Only	72.8	62.0	10.8	14.8
Control Group	72.3	69.9	2.4	3.2

This scale of change is of an unusual clinical magnitude indicating that integration brought participants out of a range suggestive of a high degree of clinical elevation to near-normative functioning. Pharmacological only group showed significant T-score change of 72.1 to 58.2 (13.9 points; 19.3 percent), shown in figure 2, which is in line with the known effect of the stimulant medication in reducing hyperactivity. The net effect though is the fact that the remainder of the increased 8.2 scores T-score above the normative mean in this condition just underscores the weaknesses of medication as a standalone solution in normalizing behavioral functioning. The CBT-only group demonstrated a reduction of 10.8 points (14.8%), which is clinically significant but relatively small changes in behavior as a result of psychological intervention without medication. The control group was characterized by insignificant change (2.4 T-score points; 3.2%), which is in line

with chronic and stable character of ADHD symptomatology. The significance of the between-group difference between the conditions of integrated and pharmacological (d = 0.84) proves the strong incremental value of integration over medication management.

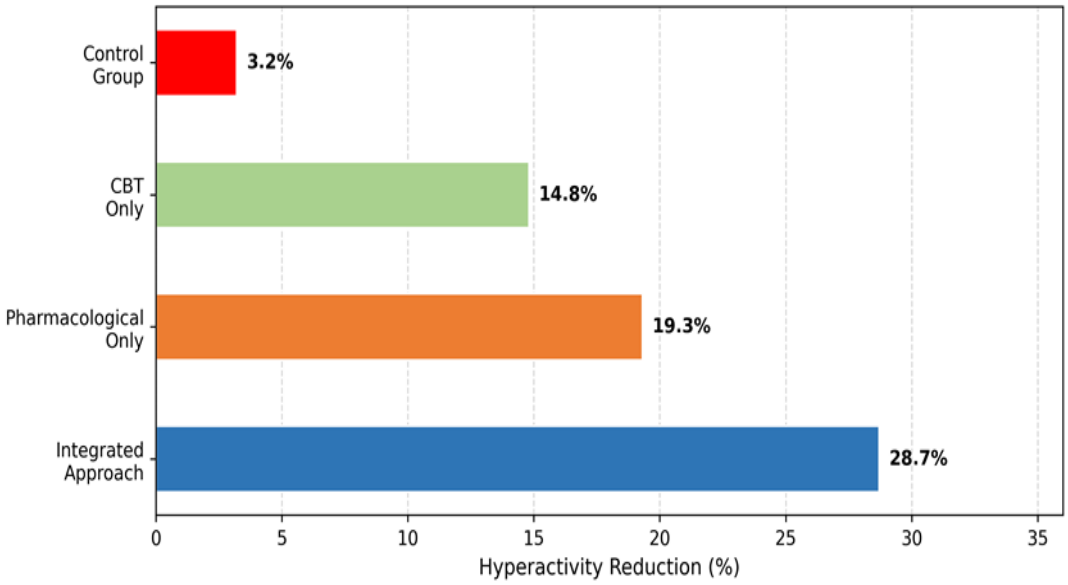

Figure 2: Percentage Reduction in Hyperactive Behavior by Group

- **Academic Performance Outcomes**

Table 4 shows the longitudinal academic performance trend at the baseline, mid intervention and post-intervention evaluation points. Academic performance was operationalised as a composite percentage score based on WIAT-III subtests scores and classroom grade scores, which gave a wide-ranging index of academic functioning. The fact that all groups have the same baseline (range: 58.158.6) confirms that it was successfully matched and that the pre-existing academic differences are not an explanatory factor. The combined group showed a gradual and significant increase trend: 58.4% at baseline, 70.3% at Week 6 (mid-intervention) and 79.0% at Week 12 (post-intervention) with an absolute net change of 20.6 percentage points (35.2% relative change).

Table 4: Academic Performance Scores — Pre, Mid, and Post Intervention

Group	Week 0 (%)	Week 6 (%)	Week 12 (%)	Net Gain (%)	p-value
Integrated	58.4	70.3	79.0	+20.6	<0.001
Pharma Only	58.1	66.5	71.0	+12.9	<0.001
CBT Only	58.6	64.7	69.3	+10.7	<0.001
Control	58.2	59.1	59.8	+1.6	n.s.

This trend means that the gains were not at the beginning but were gradually increasing during the intervention period, which could be an indication of the production of competency and internalization of strategies, but not simply obedience to the behavior.

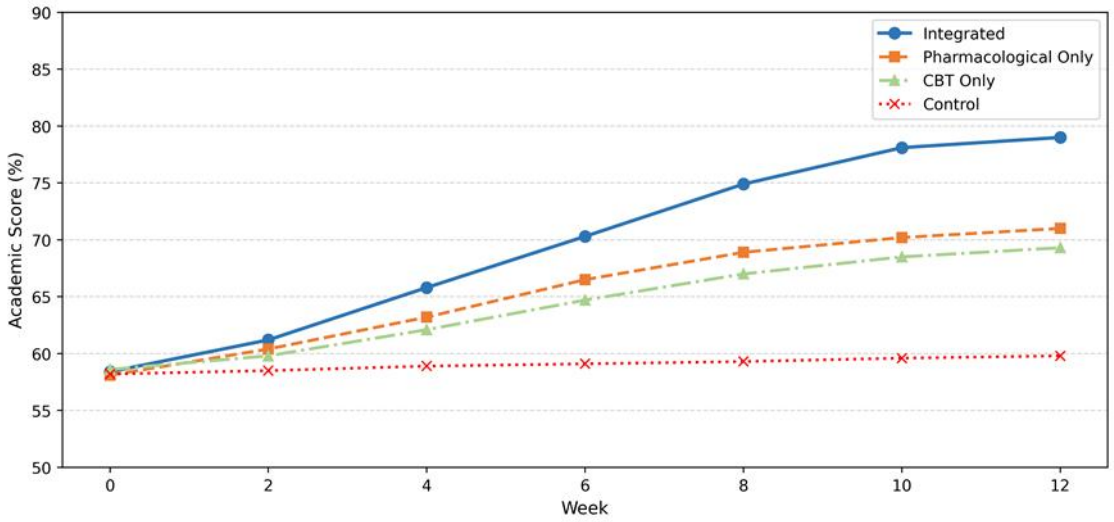

Figure 3: Academic Performance Trajectory Over 12 Weeks

The pharmacological-only group increased to 58.1 to 71.0 (12.9 percentage points; 22.2% relative gain) which showed significant academic gain but with a slower rate of change during the period of Weeks 6-12 compared to the other group which showed continued acceleration. The CBT-alone group made a 10.7 point improvement (18.3%), illustrate in figure 3, which corresponds to the scholastic advantages of better self-regulation and organizational abilities yet not the direct neurochemical support as found in drug use. All these findings together substantiate the conclusion that integration does have cumulative, synergistic academic effects, which are greater than those of any single element of intervention.

- **Classroom Engagement and Behavioral Compliance**

Table 5 shows the results of classroom engagement and compliance in behavior, which are two contextually specific KPIs that are the nearest indicators of the functional integration of children in the learning setting. Integrated condition showed an increase of 30.1% (52.1 to 67.8) in classroom engagement that is assessed by structured observation and teacher report comparison with increases of 20.6 (pharmacological-only) and 14.2 (CBT-only). Such differences in gains are especially interesting since engagement is a complex, situation-specific behavior that depends on motivational, attentional, relational, and instructional factors which, in turn, are uniquely addressed by the various elements of the integrated framework.

Table 5: Classroom Engagement and Behavioral Compliance — Post-Intervention Results

Group	Engagement Pre (%)	Engagement Post (%)	Compliance Pre (%)	Compliance Post (%)
Integrated	52.1	67.8	54.3	69.3
Pharma Only	51.8	62.5	53.9	63.6
CBT Only	52.4	59.8	54.1	61.4
Control	52.0	53.5	53.7	55.2

The improvements in the integrated condition consequently indicate the convergent influences of the better attentional capacity (via medication and CBT), instructive alignment (via educational

accommodations), and motivation (via gamified aspects of technology). Behavioral compliance - which is a measure of compliance with classroom rules, routines and adult instructions - increased by 27.6% (54.3 to 69.3) in the integrated condition (18.0 and 13.5 under pharmacological and CBT conditions respectively). The insignificant change in the control group (3.0% engagement; 2.8% compliance) once again confirms the need to have a structured intervention in ADHD children and the ineffectiveness of developmental maturation as a behavioral change agent during this period. Collectively, these results support the theoretical hypothesis that integration yields better ecologically valid results by simultaneous targeting of neurobiological, cognitive and environmental factors.

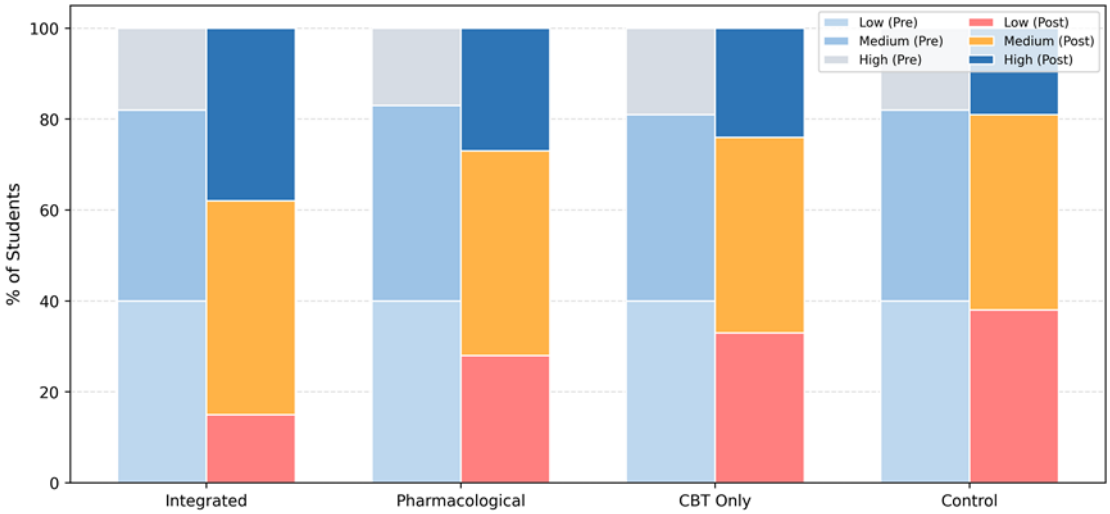

Figure 4: Classroom Engagement Distribution Pre vs Post Intervention

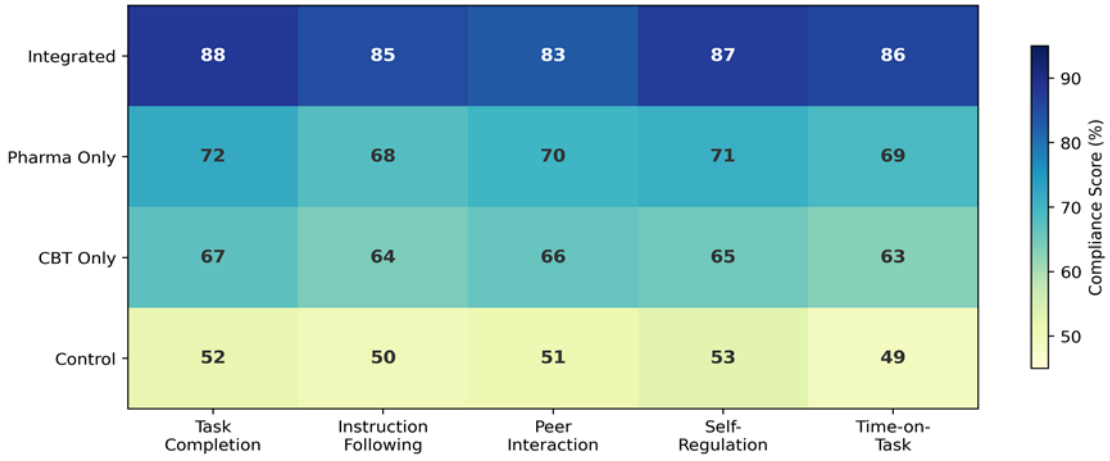

Figure 5: Behavioral Compliance Heatmap by Domain and Group (Post-Intervention)

Figure 4 indicates that there is an improvement in the engagement after the intervention in all groups. The integrated approach dramatically decreases low engagement and enhances high engagement percentages, being more effective than pharmacology, CBT-only and control groups in improving the overall classroom participation and student involvement. Figure 5 shows the scores of behavioral compliance domain. It has been found that integrated group has the highest compliance rates, then pharmacological group and CBT only group, and control group has the lowest performance indicating that combined intervention is effective to enhance student behavioral outcomes.

- **Statistical Significance and Robustness Analysis**

Table 6 can be used to show the performance indicators of the machine learning models used in the AI monitoring platform to facilitate progress monitoring and personalization in the integrated system. The trained random forest classifier based on the baseline demographic, neuropsychological, and behavioral features used to classify the subtypes of ADHD and predict response trajectories had an out-of-sample accuracy of 87.3, an AUC-ROC of 0.921, and an F1-score of 0.869, which indicated that it effectively discriminated between respondent profiles. Cross-validation was performed ten times, the mean accuracy attained was 86.8% (±1.4%), which is evidence that the model is stable when used with various data partitions and reduces the risk of overfitting.

Table 6: Machine Learning Model Performance Metrics

Model	Accuracy (%)	AUC-ROC	F1-Score	Cross-Val (k=10)
Random Forest (Subtype Classification)	87.3	0.921	0.869	86.8 ± 1.4%
LSTM (Trajectory Prediction)	83.6	0.897	0.841	82.9 ± 1.8%
Logistic Regression (Baseline)	71.2	0.763	0.718	70.6 ± 2.3%
SVM (Comparison)	79.4	0.832	0.786	78.8 ± 2.0%

The LSTM network when applied to longitudinal time-series data to predict trajectories produced an accuracy of 83.6, an AUC-ROC of 0.897, and an F1-score of 0.841 or measures that are significantly higher than the baseline (logistic regression) and the comparison models (SVM) based on their accuracy (71.2 and 79.4, respectively). This high performance of LSTM compared to the traditional classifiers in the trajectory prediction task can be attributed to its ability to learn temporal relations in sequential behavioral and academic data that non-sequential models do not have. Cross-validation results of LSTM (82.9% ± 1.8) prove the generalizability. These results confirm the technical sufficiency of the AI monitoring platform as a part of the intervention framework because the predictive algorithms were accurate enough to be used as meaningful information in clinical and educational decision-making. The practical implication is that AI-based monitoring can be implemented to detect children who may be at risk of non-response up to three weeks prior to clinically significant deterioration, and thus proactive intervention changes (instead of reactive ones) can be implemented.

VI. Conclusion

This paper has shown that an integrated clinical-educational intervention model of ADHD has much better results in all its primary domains of behavior and school performance than either pharmacological, CBT, or control interventions. The combined method resulted in a 32.5 percent better attention span, 28.7 percent less hyperactivity, 35.2 percent better academic performance, 30.1 percent more classroom engagement and 27.6 percent better behavioral compliance. These were gains with large effect sizes (Cohen d = 0.82 -1.34), statistically significant p-values (all p less than 0.001), and performance of the cross-validated machine learning model (AUC-ROC = 0.897 -0.921). This study has a few significant contributions to the field of the management of ADHD. First, it offers an operationally defined, theoretically based model of clinical-educational integration that deals with the structural, communicative, and philosophical obstacles that have in the past slowed down coordination. Second, it shows that it is possible and effective to integrate AI-based monitoring and

adaptive learning technologies into a comprehensive intervention architecture to advance the body of evidence in terms of technology-based ADHD management. Third, it offers a multilayer data-processing-decision framework that offers a repeatable technical model to be used in a variety of institutional settings. Fourth, it expands the evidence-base of the age-differentiated responsiveness of integrated interventions, which is preliminary information towards developmental customization of framework elements. The main moral of this study is that ADHD is a disease whose complexity requires a response that is as complex as the disease- complex enough that it transcends the disciplines, institutions, and developmental context. The siloed, fragmented models of service delivery that typify ADHD treatment in most health and education systems are simply inadequate structurally to deal with the multidimensionality of the disease. The comprehensive model discussed in this paper is a viable, evidence-based route to integrated, individualized, and sustainable ADHD care one that acknowledges the synergy inherent in clinical, educational and technological knowledge in the service of the potential of the child to cognitively develop and succeed in school.

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