Empowering Independent and Critical Learning in High School Students with Learning Disabilities and ADHD: A Mixed-Methods Study on the Impact of Artificial Intelligence

Eitan Ben Itzhak Klutch [1,*]

[1]PUIE, Paris University of International Education, University, Paris, France
Email: eitan@makshivim.com (E.B.I.K.)
*Corresponding author

***Abstract* — Students with learning disabilities and attention-deficit/hyperactivity disorder (ADHD) often struggle with executive functioning, independent learning, and critical thinking within traditional instructional settings based on uniform pacing and standardized content. Following the growing integration of Artificial Intelligence (AI) into educational settings, this study examines the perceived contribution of AI tools to independent and critical learning among high school students with learning disabilities and ADHD. A mixed-methods design was employed with 105 students in grades 9–12, combining pre–post questionnaires across four dimensions - self-confidence, concentration, organization and time management, and critical thinking—with thematic analysis of open-ended responses describing students' experiences. The findings suggest that AI's contribution was reflected primarily in the emotional and motivational aspects of learning, particularly self-confidence and autonomous engagement with learning material. Quantitative changes were modest: self-confidence showed a slight non-significant increase; organization and time management showed a moderate non-significant decrease; and concentration remained generally stable, although a significant decrease was found among younger students. Qualitative findings indicated that students experienced AI as helpful in accessing, simplifying, and organizing academic content, but also revealed a risk of over-reliance on AI-generated responses without sufficient critical evaluation. The study underscores the importance of guided, age-appropriate, and pedagogically mediated AI use in inclusive educational settings.**

***Keywords*— Artificial intelligence, learning disabilities, ADHD, independent learning, critical thinking, self-confidence**

I. Introduction

Students with learning disabilities and ADHD face significant challenges in executive functioning — including attention regulation, organization, time management, and self-regulation — that traditional "one-size-fits-all" instructional methods often fail to address [4]. AI-based tools offer a promising alternative by providing personalized, adaptive learning experiences, real-time feedback, and structured support tailored to individual needs [12].

Despite growing adoption of AI in educational settings, its specific contribution to learning processes among students with learning disabilities remains insufficiently understood. Questions persist regarding whether AI improves cognitive functions such as concentration and critical thinking, or whether its contribution is primarily emotional and motivational. This study addresses that gap by examining the contribution of AI use to four dimensions: self-confidence, concentration, organization and time management, and critical thinking, among 105 high school students with learning disabilities and ADHD in Israel. The study examines AI's contribution to executive-function-related learning outcomes in this population using a mixed-methods empirical approach.

II. Literature Review

Artificial Intelligence (AI) has become increasingly central to educational technology, appearing in adaptive learning platforms, conversational agents, automated feedback systems, and personalized learning environments [1], [12]. While these tools are relevant for a wide range of learners, they hold particular promise for students who depend on flexible explanations, repeated practice, immediate feedback, and help in organizing what they study [3], [5]. This is especially true for students with learning disabilities and attention-deficit/hyperactivity disorder (ADHD). Conventional instruction, built around uniform pacing and standardized content, may be poorly aligned with the needs of learners who struggle with attention regulation, working memory, organization, time management, and self-regulation [4], [8].

A. AI, Learning Disabilities, and Executive Functioning

Executive functioning is a persistent difficulty for many students with learning disabilities and ADHD, surfacing in planning, task initiation, time management, organization, and the effort of sustaining attention over time [4], [8]. These are precisely the skills independent learning demands: students must interpret tasks, track their own progress, keep materials in order, and finish work without continuous external support. Longitudinal evidence shows that weaker executive functioning and more pronounced ADHD symptoms predict lower educational functioning over time [13].

AI-based tools can ease some of these pressures by segmenting complex tasks, issuing reminders, generating explanations, and tuning content to the learner's level [3], [5]. Adaptive platforms and gamified task managers, in particular, supply the external structure that students with ADHD often need to stay engaged and see tasks through [3]. This is particularly relevant for high school students with ADHD, who have been found to experience substantial difficulties in time management and task organization, both of which directly hinder effective independent learning [9]. None of this follows automatically, however. What a tool delivers depends less on the technology itself than on how it is used, how the surrounding task is designed, and whether students are guided in using it well [17].

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B. AI and Independent Learning

Independent learning is more than finishing assignments. It asks students to understand material, organize information, plan their work, monitor their progress, and judge their own understanding — and critical thinking runs through all of it, since learners must weigh information and build meaning that goes beyond what they were directly taught [10], [14].

In day-to-day use, students may turn to AI to request explanations and examples, condense long texts, simplify or translate difficult passages, and see a topic framed in more than one way [1], [2]. For students with learning disabilities, this can loosen their reliance on the teacher as the sole source of clarification and widen the sense that a task is theirs to take on. At a broader level, intelligent tutoring systems have produced significant gains in student achievement across a range of subjects [15]. AI-supported tools, including chatbot-based learning environments, have also been associated with increased motivation and learning confidence, particularly when students receive structured support during learning [6].

Easier access to answers, though, is not the same as stronger independent learning. A student may rely on AI to complete a task more quickly while leaving planning, prioritization, and self-regulation no better developed than before. Efficient, AI-assisted completion cannot simply be read as evidence of deeper independence [17] — a distinction that sits at the heart of the present study, which asks not whether students use AI but how that use is reflected across different dimensions of learning.

C. AI and Critical Thinking

Critical thinking requires students to evaluate information, weigh sources against one another, detect errors, and arrive at reasoned judgments [10]. This capacity becomes especially consequential in AI-supported learning, where the answers students receive are often fluent and confidently phrased yet may remain incomplete, inaccurate, or insufficiently justified.

The evidence here is mixed. AI can strengthen reflective thinking when learners are prompted to interrogate its outputs, compare competing explanations, and articulate their own reasoning [17]. The same tools, however, can just as easily encourage passivity: when generated responses are accepted at face value, students' tendency to verify information independently may be weakened. Generative AI use has been linked to a decline in self-initiated critical reflection during writing tasks [16], and broader evidence indicates that AI tends to raise performance while exerting only a moderate influence on higher-order thinking [21].

For students with learning disabilities and ADHD, this tension carries particular weight. They stand to gain from the structure, simplified explanations, and immediate feedback AI provides, yet they may also need explicit instruction in judging the quality of what AI returns [5], [17]. The relevant question, then, is not merely whether AI helps these students learn, but whether it helps them learn to think for themselves.

D. Teacher Mediation and Guided AI Use

AI is best understood as a complement to human instruction rather than a substitute for it. In inclusive and special education settings especially, teacher mediation remains important: helping students use AI responsibly, interpret what it generates, and distinguish genuine support from dependency [17].

Explainable feedback systems can reinforce self-regulation when students grasp the guidance they are given and act on it [2]. Yet students with learning disabilities and ADHD usually need more than technical feedback. They benefit from encouragement, emotional support, help in structuring tasks, and assistance in building durable learning routines [5], [20]. Used with guidance, AI can offer accessibility, personalization, and on-demand help while reducing risks such as passive use, uncritical acceptance of answers, and disengagement from genuine problem-solving [16], [21].

E. Research GAP

The literature makes a strong case for AI's potential in personalized learning, accessibility, and self-regulation. Far less is settled about how high school students with learning disabilities and ADHD actually experience AI in real educational settings. Most existing work centers on particular tools or structured interventions, leaving the more naturalistic texture of classroom and home-based use comparatively unexamined [3], [5].

Wider reviews of AI in education reinforce the point, calling for research that is more pedagogically grounded and more attentive to the educator's role in how AI is implemented [22]. Direct evidence remains scarce regarding how AI use is reflected in cognitive dimensions such as concentration, organization, time management, and critical thinking, and how it relates to emotional and motivational dimensions such as self-confidence and autonomy [6], [7], [19]. The present study addresses this gap through a mixed-methods examination of AI use among high school students with learning disabilities and ADHD in Israel.

III. Materials and Methods

A. Research Design

The study employed a mixed-methods design combining quantitative pre–post questionnaires with qualitative thematic analysis of open-ended responses, enabling examination of both measurable changes and students' subjective experiences of AI use.

B. Participants

A total of 111 high school students in grades 9–12, enrolled in specialized educational frameworks for students with learning disabilities across Israel, participated in the study. After listwise deletion of incomplete responses, the final analytical sample comprised 105 students. The analyzed sample included 72 boys (68.6%) and 24 girls (22.9%); the remaining 9 participants were not included in gender-based comparisons, as they either reported "Other/Prefer not to say" or did not provide gender data. Ages ranged across the high school years. In terms of disability status, the sample included 29 students with ADHD (27.6%), 39 students with other learning disabilities (37.1%), and 37 students with no reported disability (35.2%). Of the participants with no reported disability, a subgroup of 18 students served as the comparison group in selected between-group analyses where complete data were available.

C. Instruments

A shortened, custom-adapted questionnaire was developed for the purposes of the present study. The questionnaire was informed by theoretical constructs and content domains derived from validated instruments, including the Conners-3 for ADHD and associated executive-function difficulties and the BRIEF-A for executive functioning. The full Conners-3 and BRIEF-A instruments were not administered as standardized diagnostic tools. Rather, selected domains from these instruments were used to guide the construction of age-appropriate items relevant to high school students' learning experiences.

Items were organized into four subscales: self-confidence in learning (Q1, Q3, Q6; α=0.79), organization and time management (Q2, Q5; α=0.71), concentration (Q4; single item), and critical thinking (Q16–Q20; α=0.594). All items used a 5-point Likert scale (1=Strongly disagree; 5=Strongly agree). Open-ended questions were analyzed using Thematic Analysis (Braun and Clarke, 2006). Because the questionnaire was shortened and adapted for this study, it should not be interpreted as a standardized clinical assessment. This limitation is acknowledged in the interpretation of the findings.

D. Procedure

Questionnaires were distributed online via Google Forms by classroom teachers during regular classes. Data were collected at the end of the 2025 academic year, following the Israeli Ministry of Education's encouragement of AI integration in teaching and learning processes. This study employed a naturalistic, self-report mixed-methods design rather than a controlled experimental design. In the broader Israeli school context, students from grade 8 onward were permitted to independently use approved AI tools listed in the Ministry of Education's digital tools catalogue, including ChatGPT, Copilot, Gemini, and NotebookLM [23]. However, the present study examined students' naturalistic use of AI tools in their own learning. The specific tool, context, and frequency of use were determined by the students themselves and were not systematically recorded. This limitation is acknowledged in the interpretation of the findings. Responses were exported to Excel and analyzed using SPSS and JASP.

E. Data Analysis

Quantitative analyses included paired samples t-tests, Wilcoxon Signed-Rank tests (where normality was violated), repeated measures ANOVA, independent samples t-tests, and Spearman correlations. Qualitative responses were analyzed using Thematic Analysis: systematic coding, category grouping, and theme formulation.

F. Ethical Considerations

The study followed the Declaration of Helsinki principles. Participation was voluntary and fully anonymous; no identifying information was collected. Since the study was anonymous and risk-free, formal IRB approval was not required. Approval was obtained from teachers responsible for participating educational frameworks.

IV. Result and Discussion

Table 1. Summary of Pre- and Post-Intervention Quantitative Results

Measure	Pre M	Pre SD	Post M	Post SD	Test	p-value
Self-confidence in learning	3.36	0.78	3.49	0.82	t(104)=1.27	.208
Organization and time management	3.11	0.99	2.92	1.00	t(104)=1.45	.151
Concentration - ADHD group	2.90	1.32	2.79	0.90	n.s.	>.05
Concentration - non-ADHD group	3.26	1.16	2.74	0.99	n.s.	>.05
Critical thinking	—	—	—	—	Not tested	—

Note. Critical thinking was not compared pre–post because the subscale showed borderline internal reliability (α=0.594, ω=0.605). n.s. = non-significant.

A. Self-Confidence in Learning

Self-confidence showed a slight non-significant increase: overall mean from 3.36 (SD=0.78) to 3.49 (SD=0.82), t(104)=1.27, p=.208. Pre-intervention differences among items (F(2,208)=5.47, p=.005) leveled post-intervention (F(2,208)=1.21, p=.302). A significant pre-intervention gap between students with and without learning disabilities (t=2.00, p=.048) disappeared completely after the intervention (p=.871), indicating that shared AI-based learning contributed to reducing emotional gaps between groups.

Qualitative findings reinforced this pattern: students described reductions in test anxiety and increased confidence in independent learning ("I was sick before the matriculation and understood thanks to it"). This aligns with Chiu et al. (2023), who found AI-based chatbot support improved intrinsic motivation [6].

B. Concentration

Overall concentration remained stable (p>.05). An age-related effect was observed: younger students (age ≤16) showed a statistically significant decrease in concentration scores (p<.05), while older students (age ≥17) demonstrated stability or slight improvement. Among students with ADHD, the mean decreased from 2.90 (SD=1.32) to 2.79 (SD=0.90); among non-ADHD students, the mean decreased from 3.26 (SD=1.16) to 2.74 (SD=0.99). Both changes were non-significant.

This pattern is consistent with literature on developmental trajectories in executive functioning. Jensen et al. (2023) found that executive function trajectories predict academic outcomes [13], and Cortese et al. (2020) reported differential effects by developmental stage in ADHD cognitive training [7].

C. Organization and Time Management

Organization and time management showed a moderate non-significant decrease, as illustrated in Fig. 1: overall mean from 3.11 (SD=0.99) to 2.92 (SD=1.00), t(104)=1.45, p=.151. Item-level: time management decreased from 3.16 to 3.00, while organization decreased from 3.07 to 2.84. No gender differences were observed (boys: z=0.689, p=.488; girls: z=1.207, p=.227).

Qualitative data revealed an important distinction: students

reported that AI supported task efficiency and information organization ("it prepared a 10-minute podcast for me that helped with all the material"), but did not improve independent planning or prioritization. This aligns with Noroozi et al. (2023), who found that AI supports meta-cognitive self-regulation but requires pedagogical guidance to affect planning behaviors [17].

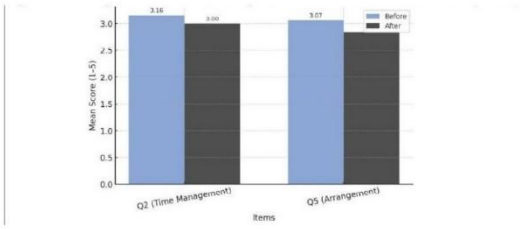


Fig. 1. Mean organization and time management scores before and after AI intervention (N=105).

D. Critical Thinking

The critical thinking subscale showed borderline internal reliability (α=0.594, ω=0.605), below the conventional 0.70 threshold. Due to this psychometric limitation, a before–after quantitative comparison was not conducted; findings are presented as preliminary descriptive indications only. A significant gender difference was found descriptively: female students (M=3.64, SD=0.70) reported higher critical thinking than male students (M=3.19, SD=0.82), t(89)=2.55, p=.012.

Qualitative findings indicated emerging reflective processes — self-checking, comparing information, and asking follow-up questions. However, a significant proportion of students tended to accept AI-generated responses without verification. This over-reliance pattern corresponds with Liu et al. (2024) [16] and Wang and Fan (2025) [19], who cautioned that passive AI use reduces self-initiated critical reflection.

E. Correlations Between Variables

Spearman correlations revealed significant relationships among dimensions, as shown in Fig. 2.

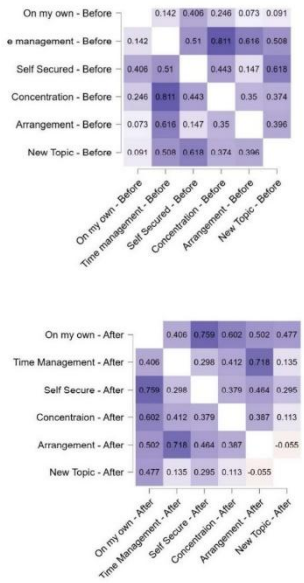


Fig. 2. Spearman Correlation Heatmaps Before (top) and After (bottom) AI Intervention (Control Group, N=18)

Pre-intervention: time management–concentration (r=0.811, p<.001), time management–organization (r=0.616, p=.007), self-confidence–concentration (r=0.510, p=.031). Post-intervention, relationships strengthened: self-confidence–independent learning (r=0.759, p<.001), independent learning–concentration (r=0.602, p=.008), time management–organization (r=0.718, p<.001). The strengthening of inter-variable relationships post-intervention suggests that AI-mediated learning was associated with greater integration between emotional and cognitive components of self-regulated learning.

F. Qualitative Themes

Thematic analysis of 51 open-ended responses yielded five themes: (A) Breaking down complex exercises (27%) — step-by-step explanation in mathematics and sciences; (B) Time saving and organizing material (20%) — converting large material into accessible formats; (C) Anxiety reduction and efficacy (18%) — emotional security and learning empowerment; (D) Support in writing and formulation (14%); (E) General use not related to learning (10%). The qualitative patterns corresponded with quantitative findings: gains described in themes A–C align with the self-confidence improvement, while the organization theme reflects the efficiency-without-planning pattern found quantitatively.

V. Conclusion

This study provides empirical evidence that AI use contributes primarily at the emotional-motivational level among high school students with learning disabilities and ADHD. A slight non-significant increase in self-confidence was found (t(104)=1.27, p=.208), with a significant pre-intervention gap between disability groups (p=.048) eliminated post-intervention (p=.871). Concentration showed an age-dependent effect, with a significant decrease among younger students (≤16, p<.05). Organization and time management decreased moderately (p=.151), with AI supporting efficiency but not independent planning. Critical thinking remains a limitation both methodologically (α=0.594) and practically, with evidence of uncritical AI acceptance.

Several implications may be considered in light of the findings. First, the age-related differences in concentration suggest that AI use among younger students (≤16) may warrant additional attention, although establishing the optimal form of support would require further comparative research, such as designs contrasting different modes of teacher guidance. Second, the observed tendency toward uncritical acceptance of AI-generated responses points to the importance of explicit guidance in evaluating AI outputs — a direction consistent with prior literature on AI mediation in education [6], [17]. Third, AI tools appeared more beneficial for students with learning disabilities than for students without, suggesting their potential as equity-supporting tools when integrated thoughtfully into instruction. Future research should employ longitudinal designs, integrate behavioral measures, and examine teacher mediation as a moderating variable.

Conflict of Interest

The authors declare no conflict of interest.

Author Contributions

E.B.I. Klutch conceived and designed the study, developed the research instruments, conducted data collection and analysis, and wrote the manuscript.

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