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The Effectiveness of Computerized Cognitive Rehabilitation on Academic Engagement among Students with Academic Underachievement: A Quasi-Experimental Study

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A B S T R A C T

This quasi-experimental study examined the effectiveness of computerized cognitive rehabilitation in improving academic engagement among lower-secondary students experiencing academic underachievement. The study used a pre-test/post-test design with an experimental group and a control group. The statistical population consisted of lower-secondary students with academic underachievement in Tehran during the first semester of the 2023-2024 academic year. Thirty students were selected through convenience sampling and randomly assigned to an experimental group (n = 15) and a control group (n = 15). Academic engagement was measured using the Zarang Academic Engagement Questionnaire, which assesses cognitive, motivational, and behavioral engagement. The experimental group completed a 12-session computerized cognitive rehabilitation program using Captain's Log version 14, delivered twice weekly and designed to train 22 foundational and higher-order cognitive skills, including focused and sustained attention, divided and selective attention, working memory, auditory and visual processing speed, response inhibition, problem solving, and logical reasoning. The control group did not receive the computerized intervention during the study period. Data were analyzed with analysis of covariance after checking the main statistical assumptions. The experimental group showed a marked increase in academic engagement from pre-test (M = 80.86, SD = 9.87) to post-test (M = 103.26, SD = 11.10), whereas the control group showed only a small descriptive increase from pre-test (M = 86.46, SD = 11.36) to post-test (M = 88.80, SD = 10.00). ANCOVA indicated a statistically significant group effect after controlling for pre-test scores, F(1, 27) = 7.11, p = .013, partial eta squared = .208. These findings suggest that computerized cognitive rehabilitation may be a useful school-based adjunct intervention for strengthening academic engagement among students with academic underachievement, although future studies with larger samples, active control conditions, and follow-up assessments are needed.

Keywords: *Computerized Cognitive Rehabilitation; Academic Engagement; Academic Underachievement; Executive Functions; Students; Q-Experimental Study*

1. Introduction

Academic underachievement remains one of the persistent concerns of school systems because it affects students' learning trajectories, motivation, educational identity, and long-term participation in social and occupational life. Underachievement is not simply a low grade or temporary performance fluctuation; it often reflects a broader pattern in which students fail to use their learning potential, lose confidence in school tasks, and gradually withdraw from academic activities. In lower-secondary education, this issue is particularly important because early adolescence is a developmental period in which students face increased academic demands, more complex classroom expectations, changing peer relationships, and growing responsibility for self-regulated learning. When academic difficulties are not addressed at this stage, students may move from temporary performance problems toward chronic disengagement, learned helplessness, and negative beliefs about their own learning capacity.

One of the key constructs for understanding academic underachievement is academic engagement. Engagement has been widely described as a multidimensional construct that includes behavioral, emotional or motivational, and cognitive components (Fredricks et al., 2004; Lam et al., 2014). Behavioral engagement refers to participation in learning activities, completion of tasks, persistence, attendance, and compliance with classroom expectations. Motivational or emotional engagement involves interest, value, positive feelings toward learning, and affective connection with school. Cognitive engagement refers to strategic learning, mental investment, use of self-regulation, and willingness to exert the effort needed to understand complex material. These dimensions are related but not identical. A student may attend class but remain mentally passive, or may show cognitive interest while lacking the behavioral structure needed to complete assignments. Therefore, academic engagement is especially useful in intervention studies because it captures more than achievement outcomes alone.

The literature has emphasized that engagement is malleable and responsive to educational, relational, and individual factors (Finn & Zimmer, 2012; Kahu & Nelson, 2018). In practical terms, this means that students who experience academic failure are not inevitably disengaged; rather, engagement can potentially be strengthened through targeted interventions. Classroom support, autonomy-supportive teaching, meaningful tasks, feedback, positive teacher-student relationships, and opportunities for successful participation have all been linked to better engagement. However, for many students with academic underachievement, motivational support may not be sufficient if underlying cognitive processes limit their ability to follow instructions, sustain attention, retain information, inhibit distractions, organize tasks, and regulate learning behavior. For these students, cognitive processes are not separate from engagement; they form part of the functional pathway through which students can participate more successfully in academic tasks.

Academic engagement is also an important target because it is closer to daily school functioning than distal outcomes such as final grades. Grades are influenced by many factors, including teacher assessment practices, curriculum difficulty, family support, prior learning gaps, and school resources. Engagement, by contrast, captures how students approach learning tasks in the present. A student who becomes more attentive, persistent, strategic, and motivated is better positioned to benefit from instruction, even if grade improvement requires more time. For intervention research, this distinction is useful: changes in engagement can indicate that students are beginning to reconnect with learning before large achievement changes become visible.

Executive functions and other cognitive skills are central to learning. Core executive functions include working memory, inhibitory control, and cognitive flexibility, which support goal-directed behavior, planning, monitoring, and adaptation to changing task demands (Diamond, 2013). Working memory allows students to hold and manipulate information while solving problems or following multi-step instructions. Inhibitory control helps them resist distractions, delay impulsive responses, and remain focused on learning goals. Cognitive flexibility allows students to shift strategies when one method is ineffective. These functions are closely related to classroom behaviors that appear as engagement: paying attention, completing homework, persisting during difficult tasks, organizing learning materials, and using strategies rather than guessing. Theoretical and empirical work has shown that working memory and executive functions are strongly associated with academic performance and can predict learning outcomes beyond general ability in some contexts (Alloway & Alloway, 2010; Titz & Karbach, 2014).

Computerized cognitive rehabilitation is a structured intervention approach that uses computer-based tasks to train cognitive processes through repeated practice, graded difficulty, immediate feedback, and adaptive progression.

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Unlike ordinary educational software, cognitive rehabilitation programs are designed to target underlying cognitive skills such as attention, processing speed, memory, reasoning, response inhibition, and problem solving. The theoretical basis of such programs is partly grounded in neuroplasticity: repeated activation and practice may improve the efficiency of cognitive processes, particularly when tasks are challenging but achievable and when performance feedback supports motivation. Programs such as Captain's Log provide a large set of exercises targeting multiple cognitive domains and allow tasks to be matched to the learner's performance level. In the school context, this adaptiveness is important because students with underachievement are heterogeneous: some may struggle primarily with sustained attention, others with working memory, inhibition, processing speed, or strategy use.

The computerized format may offer specific advantages for students with a history of academic setbacks. First, tasks can be presented in small, repeated units, reducing the burden of complex classroom instructions. Second, task difficulty can be increased gradually, allowing students to experience success before facing more demanding levels. Third, immediate feedback can make progress visible and concrete. Fourth, computer-based practice can standardize the intervention and reduce variation in delivery. These features are relevant because students with underachievement may be sensitive to failure experiences and may avoid tasks that they expect to be difficult. A structured digital environment can provide repeated opportunities for effortful practice without the social pressure that sometimes accompanies classroom failure.

The evidence on computerized cognitive training is promising but should be interpreted carefully. Several studies have shown that training can improve performance on trained or closely related cognitive tasks, particularly working memory and attention tasks (Klingberg et al., 2005; Zelinski et al., 2011). Other reviews have argued that far transfer to broad intelligence, everyday functioning, or academic achievement is less consistent and depends on the quality of the training, the match between trained skills and outcome measures, the control condition, and the learner's characteristics (Melby-Lervag & Hulme, 2013; Sala & Gobet, 2019; Simons et al., 2016). For this reason, computerized cognitive rehabilitation should not be presented as a universal solution for academic problems. It is better conceptualized as an adjunct intervention that may support students when the selected outcomes are functionally related to the trained skills. Academic engagement is one such outcome because attention, working memory, inhibition, self-monitoring, and task persistence are embedded in engaged learning behavior.

In the Iranian school context, academic underachievement is often addressed through tutoring, counseling, or general motivational advice, while fewer interventions directly target cognitive processes that may contribute to learning disengagement. The present study responds to this gap by evaluating whether a structured computerized cognitive rehabilitation program can improve academic engagement among lower-secondary students with academic underachievement. The study focuses on academic engagement rather than grades alone because engagement is a proximal psychological and behavioral indicator of students' readiness to participate in learning. Based on the cognitive and motivational rationale of computerized rehabilitation, it was hypothesized that students who received the intervention would show higher post-test academic engagement than students in the control group after controlling for pre-test scores.

2. Methods and Materials

2.1. Study design and participants

This study used a quasi-experimental pre-test/post-test design with an experimental group and a control group. The independent variable was participation in the computerized cognitive rehabilitation program, and the dependent variable was academic engagement. The design was selected because the study aimed to examine the effect of a structured intervention under applied school conditions while controlling for baseline differences through analysis of covariance. The source data specified that the study was conducted during the first semester of the 2023-2024 academic year among lower-secondary students with academic underachievement in Tehran.

The population included all lower-secondary students with academic underachievement in Tehran during the target academic semester. Thirty students were selected using convenience sampling and were then randomly assigned to two equal groups: an experimental group (n = 15) and a control group (n = 15). Inclusion criteria were academic underachievement, informed consent to participate, and regular attendance in the rehabilitation sessions. Exclusion criteria were incomplete questionnaire responses and absence from more than one intervention session. The use of random assignment after recruitment helped reduce systematic group differences, although the sampling method and modest sample size should be considered when interpreting the generalizability of the findings.

2.2. Measure

Academic engagement was measured using the Zarang Academic Engagement Questionnaire. This questionnaire includes 38 items and assesses three dimensions: cognitive engagement, motivational engagement, and behavioral engagement. The cognitive dimension includes items related to learning strategies, mental investment, and the use of understanding-oriented study behaviors. The motivational dimension reflects interest, value, and willingness to remain involved in academic tasks. The behavioral dimension reflects participation, task completion, effort, and persistence. Previous Iranian research has reported acceptable internal consistency for the total scale and its subscales, and the instrument has been used in studies of student engagement in Persian-speaking educational contexts. The present study used the total academic engagement score as the primary outcome variable.

2.3. Intervention

The computerized cognitive rehabilitation program was implemented with Captain's Log version 14. The program was described in the study protocol as a comprehensive computer-based cognitive rehabilitation package designed to train a wide range of foundational and higher-order cognitive skills. It includes exercises targeting working memory, perceptual memory, auditory memory, numerical-conceptual memory, focused attention, sustained attention, divided attention, selective attention, visual and auditory processing speed, problem solving, response inhibition, logical reasoning, and other cognitive processes involved in learning. The rationale of the program is that adaptive and repeated practice can challenge cognitive processes at an appropriate level and provide feedback that supports progress and self-efficacy. The intervention was delivered to the experimental group over 12 sessions, with two sessions per week. The structure of the computerized cognitive rehabilitation sessions is summarized in Table 1.

Table 1

Structure of the computerized cognitive rehabilitation program

Session	Focus	Content
1	Introduction and initial assessment	Orientation to Captain's Log, explanation of targeted cognitive skills, program goals, and baseline assessment.
2	Attention and concentration	Focused-attention and sustained-attention exercises.
3	Divided and selective attention	Exercises targeting divided attention and selective attention.
4	Working and perceptual memory	Exercises for working memory and perceptual memory.
5	Auditory and numerical-conceptual memory	Exercises to strengthen auditory memory and numerical-conceptual memory.
6	Processing speed	Visual and auditory processing-speed exercises.
7	Problem solving and logical reasoning	Exercises to strengthen problem solving and logical reasoning.
8	Response inhibition	Exercises to improve inhibition of impulsive responses.
9	Advanced attention	Advanced selective-attention and multiple-attention exercises.
10	Advanced memory	Long-term memory and memorization-strategy exercises.
11	Advanced reasoning	Exercises for deductive and inductive reasoning.
12	Review and final assessment	Review of all skills, final evaluation, and guidance for individual practice.

The first session introduced the software, explained the cognitive skills targeted by the program, clarified the goals of training, and included an initial assessment of strengths and weaknesses. Sessions 2 and 3 focused on attention, beginning with focused and sustained attention and then progressing to divided and selective attention. Sessions 4 and 5 addressed working memory, perceptual memory, auditory memory, and numerical-conceptual memory. Session 6 targeted visual and auditory processing speed. Session 7 focused on problem solving and logical reasoning, while Session 8 targeted response inhibition. Sessions 9 to 11 involved more advanced tasks in attention, memory,

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problem solving, and reasoning. The final session reviewed the skills practiced during the program and included final evaluation and guidance for continued individual practice. The control group did not receive the computerized cognitive rehabilitation program during the study period.

2.4. Statistical analysis

The procedure followed a pre-test, intervention, and post-test sequence. After eligible students were identified and assigned to groups, both groups completed the academic engagement measure at baseline. The experimental group then participated in the 12-session computerized rehabilitation program, while the control group continued their ordinary educational activities without the computerized cognitive intervention. After completion of the intervention period, both groups completed the same academic engagement measure again. This procedure allowed the study to examine whether changes in engagement were greater for students who received the cognitive rehabilitation program than for those who did not.

3. Findings and Results

Preliminary assumption testing indicated that the data met the main requirements for ANCOVA. The Shapiro-Wilk test for academic engagement was not statistically significant, supporting the normality assumption. Levene's test indicated no statistically significant difference in error variances between the experimental and control groups. Box's test was also non-significant, Box's M = 14.154, $F = 1.733$, $p = .083$, indicating that the assumption of equality of covariance matrices was not rejected. These results supported proceeding with covariance analysis.

Descriptive statistics for academic engagement are presented in Table 2. At pre-test, the experimental group had a mean score of 80.86 (SD = 9.87), whereas the control group had a mean score of 86.46 (SD = 11.36). At post-test, the experimental group mean increased to 103.26 (SD = 11.10), while the control group mean increased only slightly to 88.80 (SD = 10.00). The raw gain score for the experimental group was 22.40 points, compared with 2.34 points for the control group. Although these gain scores are descriptive and do not replace the adjusted analysis, they show a clear pattern in favor of the computerized cognitive rehabilitation program.

Table 2

Descriptive statistics for academic engagement by group

Group	Pre-test M	Pre-test SD	Post-test M	Post-test SD	Raw gain
Experimental	80.86	9.87	103.26	11.10	+22.40
Control	86.46	11.36	88.80	10.00	+2.34

The pre-test and post-test pattern is displayed in Figure 1. The figure shows that the experimental group began with a lower mean academic engagement score than the control group but exceeded the control group at post-test after completing the computerized cognitive rehabilitation program. This visual pattern is consistent with the ANCOVA results and supports the interpretation that the intervention was associated with an improvement in academic engagement.

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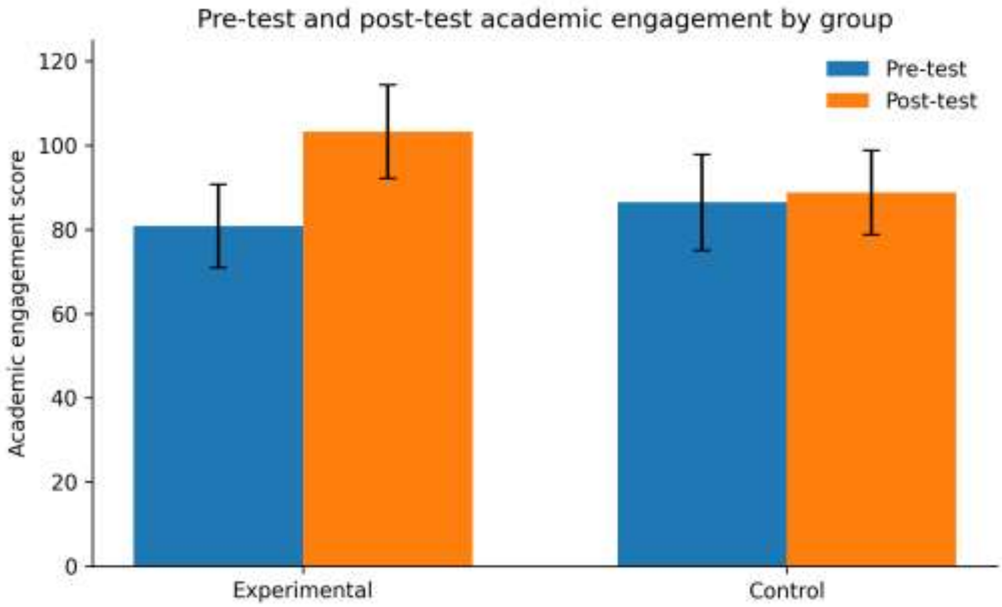
Figure 1

Pre-test and post-test academic engagement scores in the experimental and control groups. Error bars indicate standard deviations.



The ANCOVA results are reported in Table 3. The pre-test effect was statistically significant, F(1, 27) = 15.473, p = .001, partial eta squared = .364, indicating that baseline academic engagement was a meaningful covariate. After controlling for the pre-test score, the group effect was also statistically significant, F(1, 27) = 7.111, p = .013, partial eta squared = .208. The effect size indicates that approximately 20.8% of the adjusted variance in post-test academic engagement was associated with group membership. Therefore, the hypothesis of the study was supported: students who participated in computerized cognitive rehabilitation showed significantly higher academic engagement at post-test than students in the control group, after adjusting for baseline engagement.

Table 3

Analysis of covariance for post-test academic engagement controlling for pre-test scores

Source	SS	df	MS	F	p	Partial eta squared
Pre-test academic engagement	5005.214	1	5005.214	15.473	.001	.364
Group	2300.440	1	2300.440	7.111	.013	.208
Error	8734.119	27	323.486			
Total	291981.000	30				

Because the experimental group had a lower baseline mean than the control group, the use of ANCOVA was important. The adjusted analysis reduced the risk of interpreting simple post-test differences without considering initial scores. The significant covariate effect shows that baseline engagement contributed to post-test engagement, while the significant group effect shows that the intervention was associated with additional improvement beyond baseline differences. Thus, the result is not merely a descriptive increase but an adjusted statistical effect in favor of the computerized rehabilitation condition.

4. Discussion and Conclusion

The present study examined whether computerized cognitive rehabilitation could improve academic engagement among lower-secondary students with academic underachievement. The findings showed that students who received the intervention demonstrated a substantial increase in academic engagement compared with students in the control group. After controlling for baseline scores, the group effect was statistically significant and the partial eta squared value indicated a meaningful intervention effect. These findings suggest that a structured program targeting attention, working memory, processing speed, inhibition, reasoning, and problem solving may strengthen students' participation in academic learning.

The result is theoretically plausible because academic engagement requires cognitive resources as well as motivation. Engaged learning is not limited to wanting to succeed; it also involves the ability to remain focused, remember instructions, organize information, monitor progress, inhibit distractions, and persist when tasks are difficult. Students with academic underachievement may show disengagement partly because repeated failure reduces motivation, but they may also disengage because cognitive demands exceed their current self-regulatory capacity. When cognitive rehabilitation helps students experience successful performance on progressively challenging tasks, it may improve both cognitive efficiency and perceived competence. This combination can make academic tasks feel more manageable and may encourage greater behavioral and motivational engagement.

The intervention used in this study was broad rather than narrowly focused on a single cognitive skill. This is important because school engagement is supported by multiple processes. Focused and sustained attention help students remain connected to classroom tasks. Divided and selective attention help them manage competing stimuli and follow relevant information. Working memory supports reading comprehension, mathematics, note taking, and multi-step problem solving. Response inhibition helps students delay impulsive reactions and remain task-oriented. Processing speed may help students keep pace with classroom demands, and reasoning exercises can support more strategic thinking. By training a range of cognitive functions, the program may have influenced the functional skills that students use during academic participation.

The findings are consistent with research showing that computerized cognitive interventions can improve trained cognitive processes and, in some cases, related functional outcomes (Klingberg et al., 2005; Titz & Karbach, 2014). However, the results should not be overgeneralized. Major reviews of cognitive training have cautioned that improvements often remain strongest for trained or closely related tasks, while broad far transfer is less reliable (Melby-Lervag & Hulme, 2013; Sala & Gobet, 2019; Simons et al., 2016). The present study did not measure broad intelligence or general academic achievement; it measured academic engagement, a construct more proximal to the self-regulatory and attentional processes targeted in the intervention. For this reason, the positive finding is credible but should be interpreted as evidence for improvement in engagement, not as proof that computerized rehabilitation alone can solve academic failure or replace instructional support.

Another important interpretation is motivational. Computerized cognitive rehabilitation programs often provide immediate feedback, graded task difficulty, and visible indicators of progress. These features can increase students' sense of mastery and self-efficacy, especially for students who have experienced repeated academic setbacks. A student who succeeds in attention or memory tasks may begin to reinterpret learning difficulties as changeable rather than fixed. This shift can support motivational engagement and persistence. In addition, computer-based tasks can reduce some of the social embarrassment that underachieving students may feel in traditional classroom settings, allowing them to practice skills privately and receive individualized feedback.

The improvement observed in the experimental group may also reflect increased self-regulation. Academic engagement depends on students' ability to manage effort over time. Executive functions support this process by helping learners set goals, monitor errors, suppress distractions, and adjust strategies. Diamond (2013) emphasized that executive functions are essential for goal-directed behavior and classroom learning. When rehabilitation exercises repeatedly challenge these processes, students may become better able to regulate their learning behavior (Diamond, 2013). This could explain why an intervention primarily designed around cognitive skills produced improvement in a broader educational outcome such as academic engagement.

The size of the observed group effect is also educationally meaningful. A partial eta squared of .208 suggests that group membership accounted for about one-fifth of the adjusted variance in post-test engagement. In small school-based intervention studies, such an effect should be taken seriously, particularly when the target population consists of students already showing academic risk. At the same time, the effect should not be treated as definitive evidence of broad transfer. It indicates that the intervention was associated with improved engagement in this sample and at this time point. Replication with stronger controls is needed before making broad policy recommendations.

The study has several practical implications. First, schools and counseling centers may consider computerized

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cognitive rehabilitation as a supportive intervention for students with academic underachievement, particularly when disengagement is accompanied by attention, memory, inhibition, or processing difficulties. Second, the intervention should be integrated with educational and psychological support rather than used in isolation. A student who gains cognitive skills still needs supportive teachers, meaningful assignments, family encouragement, and academic guidance. Third, implementation should include careful screening, goal setting, and monitoring so that the selected cognitive tasks match the student's needs. Fourth, practitioners should explain realistic expectations to students and parents: the goal is to support learning engagement and self-regulation, not to promise rapid or universal academic transformation.

For school implementation, the findings suggest that computerized cognitive rehabilitation can be positioned as part of a multi-tiered support system. It may be most useful for students whose academic underachievement is accompanied by poor attention, weak working memory, slow processing, impulsive responding, or difficulty organizing learning behavior. However, implementation should be supervised by trained professionals who can interpret performance data, prevent excessive screen fatigue, and link cognitive exercises to real classroom strategies. Students should be helped to understand how attention, memory, inhibition, and reasoning skills apply to homework, reading, mathematics, and classroom participation. Without this bridge to academic routines, digital training may remain isolated from school learning.

The study also has limitations. The sample size was small, and participants were selected through convenience sampling from Tehran, which limits generalizability. The study used a passive control group rather than an active control condition, so some of the observed effect may be related to attention, novelty, or structured contact rather than the specific cognitive content of the program. The study did not include a follow-up assessment, so the durability of the effect is unknown. The outcome was based on a self-report questionnaire, which may be influenced by response style or social desirability. Finally, the provided results included only the total academic engagement score, preventing analysis of whether cognitive, motivational, or behavioral engagement was most affected.

Future research should use larger and more diverse samples, include active control groups, and examine follow-up outcomes to determine whether gains are maintained. It would also be useful to report subscale-level outcomes for cognitive, motivational, and behavioral engagement. Studies could test whether improvements in working memory, attention, inhibition, or processing speed mediate changes in academic engagement. Combining computerized cognitive rehabilitation with teacher feedback, study-skills instruction, or motivational interventions may produce stronger and more sustainable effects. Qualitative data from students, parents, and teachers could also clarify how students experience the intervention and how changes appear in everyday classroom behavior.

In conclusion, the present study provides evidence that computerized cognitive rehabilitation can improve academic engagement among students with academic underachievement in the short term. The intervention was associated with a clear increase in engagement scores and a statistically significant adjusted group effect. These findings support the use of cognitive rehabilitation as a promising adjunctive approach in educational and counseling settings, while also highlighting the need for careful implementation, realistic interpretation, and further controlled research.

Authors' Contributions

Hamideh Ariasefat contributed to conceptualization, data collection, intervention coordination, and original manuscript drafting. Hosein Khedmatgozar contributed to supervision, methodology, statistical interpretation, manuscript review, and final approval of the manuscript. Both authors reviewed and approved the final version for submission.

Declaration

Artificial intelligence tools were used only to support English-language editing, organization, and formatting of the manuscript. The authors remain responsible for the study design, data, interpretation, references, and final scholarly content.

Transparency Statement

Data are available for research purposes upon reasonable request to the corresponding author.

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Declaration of Interest

The authors report no conflict of interest.

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Ethics Considerations

The study was conducted in accordance with ethical principles for research with human participants. Participation was voluntary, informed consent/assent was obtained before data collection, and participants were informed that they could withdraw from the study without penalty. Confidentiality and anonymity were respected during data collection, analysis, and reporting.

References

Alloway, T. P., & Alloway, R. G. (2010). Investigating the predictive roles of working memory and IQ in academic attainment. *Journal of Experimental Child Psychology*, *106*(1), 20-29. https://doi.org/10.1016/j.jecp.2009.11.003

Diamond, A. (2013). Executive functions. *Annual Review of Psychology*, *64*, 135-168. https://doi.org/10.1146/annurev-psych-113011-143750

Finn, J. D., & Zimmer, K. S. (2012). Student engagement: What is it? Why does it matter? In S. L. Christenson, A. L. Reschly, & C. Wylie (Eds.), *Handbook of research on student engagement* (pp. 97-131). Springer. https://doi.org/10.1007/978-1-4614-2018-7_5

Fredricks, J. A., Blumenfeld, P. C., & Paris, A. H. (2004). School engagement: Potential of the concept, state of the evidence. *Review of Educational Research*, *74*(1), 59-109. https://doi.org/10.3102/00346543074001059

Kahu, E. R., & Nelson, K. (2018). Student engagement in the educational interface: Understanding the mechanisms of student success. *Higher Education Research & Development*, *37*(1), 58-71. https://doi.org/10.1080/07294360.2017.1344197

Klingberg, T., Fernell, E., Olesen, P. J., Johnson, M., Gustafsson, P., Dahlstrom, K., Gillberg, C. G., Forssberg, H., & Westerberg, H. (2005). Computerized training of working memory in children with ADHD: A randomized, controlled trial. *Journal of the American Academy of Child & Adolescent Psychiatry*, *44*(2), 177-186. https://doi.org/10.1097/00004583-200502000-00010

Lam, S. F., Jimerson, S., Wong, B. P. H., Kikas, E., Shin, H., Veiga, F. H., Hatzichristou, C., Polychroni, F., Cefai, C., Negovan, V., Stanculescu, E., Yang, H., Liu, Y., Basnett, J., Duck, R., Farrell, P., Nelson, B., & Zollneritsch, J. (2014). Understanding and measuring student engagement in school: The results of an international study from 12 countries. *School Psychology Quarterly*, *29*(2), 213-232. https://doi.org/10.1037/spq0000057

Melby-Lervag, M., & Hulme, C. (2013). Is working memory training effective? A meta-analytic review. *Developmental Psychology*, *49*(2), 270-291. https://doi.org/10.1037/a0028228

Sala, G., & Gobet, F. (2019). Cognitive training does not enhance general cognition. *Trends in Cognitive Sciences*, *23*(1), 9-20. https://doi.org/10.1016/j.tics.2018.10.004

Simons, D. J., Boot, W. R., Charness, N., Gathercole, S. E., Chabris, C. F., Hambrick, D. Z., & Stine-Morrow, E. A. L. (2016). Do brain-training programs work? *Psychological Science in the Public Interest*, *17*(3), 103-186. https://doi.org/10.1177/1529100616661983

Titz, C., & Karbach, J. (2014). Working memory and executive functions: Effects of training on academic achievement. *Psychological Research*, *78*(6), 852-868. https://doi.org/10.1007/s00426-013-0537-1

Zelinski, E. M., Spina, L. M., Yaffe, K., Ruff, R., Kennison, R. F., Mahncke, H. W., & Smith, G. E. (2011). Improvement in memory with plasticity-based adaptive cognitive training: Results of the 3-month follow-up. *Journal of the American Geriatrics Society*, *59*(2), 258-265. https://doi.org/10.1111/j.1532-5415.2010.03277.x