*International Journal of Instruction*
*e-ISSN: 1308-1470 ● www.e-iji.net*

*April 2026 ● Vol.19, No.2*
*p-ISSN: 1694-609X*
*pp. 427-442*

Article submission code: 20250813121719
Received: 13/08/2025
Revision: 30/10/2025
Accepted: 07/11/2025
OnlineFirst: 05/01/2026

# Enhancing Cognitive Skills: The Impact of logic games on Memory and Self-Efficacy in Adults

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This study examined the cognitive benefits of regular logical game play by comparing long-term memory performance and self-efficacy levels between experienced players who regularly play logic games and the general population. The research employed a quantitative approach with N = 60 participants, equally divided into a regular playing group (N = 30), who regularly play logic games and a general population comparison group (N = 30). Data collection involved both a production experiment to assess long-term memory capabilities and standardized self-efficacy measurement using the General Self-Efficacy Scale (GSES). Statistical analysis revealed a significant difference (p = 0.000) favoring the logic game players in terms of long-term memory performance, while no significant differences emerged between groups regarding self-efficacy levels. These findings suggest that incorporating logic games into educational frameworks as play-based learning, or utilizing it as a preventive intervention against cognitive impairment in adults, offers measurable cognitive benefits and supports healthy aging initiatives.

Keywords: long-term memory, self-efficacy, logic games, adult, cognitive enhancement

## INTRODUCTION

An individual's ability to perform and achieve desired outcomes in every environment depends on their learning ability. Cognitive skills such as creativity, memory, and abstract thinking can be improved and are developed through the process of learning or engaging in various activities. Lifelong learning represents a continuous process that enables individuals to acquire knowledge, skills, and competencies through different educational pathways throughout their entire lives, tailored to each person's individual

**Citation:** Doktorová, D., Šolcová, J., & Tokovská, M. (2026). Enhancing cognitive skills: The impact of logic games on memory and self-efficacy in adults. *International Journal of Instruction*, *19*(2), 427-442.

needs and interests (Šolcová, et al., 2023). These skills are of use in everyday life but can be progressively impaired with age (Tucker-Brod et al. 2019). Various cognitive activities, generally called cognitive training, can be used to develop or maintain memory, attention and thinking skills in adults (Gates et al. 2020). These activities include playing cards, working with texts, calculating, doing mathematics puzzles, and word creation. Cognitive training engages the brain in activities that are not normally used at the level required during daily routines, helping to keep the brain in a state of high performance. In educational contexts, brain-based teaching approaches that align with the brain's natural learning processes have shown promise in enhancing attention, understanding, meaning, and memory through authentic, real-world applications (Yatim et al., 2022).

Cognitive psychologists describe basic memory processes as three operations: encoding is the transfer of physical sensory information input into a representation that can be stored in memory; storage refers to the retention of coded information in memory; and retrieval is the process of gaining access to stored information (Cowan, 2019). Long-term memory appears to be primarily semantically coded and based on word meaning, although there is also evidence that vision and visual coding is present. The transfer of information from short-term to long-term memory is crucial for storage, and repetition plays a significant role in this process. Various processes are involved in the entry of data into long-term memory, including focussing on understanding the information and creating connections and associations with existing knowledge. Other processes are consolidation, referring to the new data being stored in pre-existing schemas, and repetition, a technique used to maintain information in an active state. The temporal organisation of repetition is crucial for effective memorisation (Sternberg, 2002). Bahrick and Phelpsová (1988) found that people retain information for longer when they learn for short periods with breaks between each (distributed learning). This operation is aided by the hippocampus, a structure within the brain that plays a significant role in the distributed learning effect (Sedláková, 2004).

Scrabble is a strategic word board game in which players create words from seven randomly selected letters on a 15×15 board to maximize the point gains of creating high-value words and using bonus letters (Fatimah 2022). The game is not only a fun activity, but also represents a complex cognitive tool with therapeutic potential for different age groups. Learning to play, often referred to as ludic pedagogy or game-based learning, is an educational approach that uses game mechanisms and game activities to facilitate the learning process, while relying on the principles of active engagement, motivation, and immediate feedback (Draková, 2024, Kobzeva, 2014). In the context of Scrabble, this approach is manifested through the simultaneous activation of multiple cognitive processes – including vocabulary, spelling, strategic thinking, and working memory – which creates optimal conditions for effective learning and memory consolidation (Supriadi & Jalaluddin, 2023; Kong et al., 2025). A recent study by Indrastuti et al. (2025) provided empirical evidence for the therapeutic potential of Scrabble in a clinical context. The authors investigated the effectiveness of brain exercises and Scrabble as therapeutic interventions in elderly individuals with memory impairment in the Tegal Selatan Public Health Center area, Indonesia. The results of this case study demonstrated that the integration of brain exercises and Scrabble game

therapy resulted in significant improvements in memory and overall well-being. After seven days of treatment, the first client's Mini-Mental State Examination (MMSE) score increased from 16 (mild cognitive impairment) to 21, while the second client's score increased from 18 to 25, indicating no cognitive impairment. These findings are particularly relevant in the context of an aging population, as dementia is a condition characterized by cognitive decline that impairs essential activities and social relationships, with memory loss being one of the earliest symptoms of the disease. The mechanism of Scrabble's effect on cognitive function can be explained through neuroplasticity and the theory of bilateral hemispheric activation (Seberini, 2019). As Indrastuti et al. (2025) have suggested, brain exercises that activate both hemispheres of the brain can stimulate cognitive function and improve brain activity (Aljadaan, 2025). Scrabble specifically provides the left hemisphere, responsible for language processing, and the right hemisphere, involved in spatial orientation and strategic planning, providing comprehensive cognitive stimulation. These findings are consistent with a study conducted in Indonesia that examined the effectiveness of using games to learn and memorize complex technical terms; it found that participants who used distributed learning were able to understand complex terms more easily and were more motivated to achieve better results (Supriadi & Jalaluddin, 2023). In addition, playing logic games can also develop critical thinking skills, promote creative and analytical thinking, and improve logical skills, as demonstrated in a study by Kobzeva (2014). Memory, one of the main cognitive functions, is known to decline with age. Serious games, defined as games designed for educational or training purposes beyond mere entertainment, have been increasingly used to enhance memory and cognitive flexibility in adults. The effectiveness of such games has been supported by several studies (Kappi et al., 2024), which reported significant improvements in short-term recall, attention, and problem-solving skills. Among serious games, *Scrabble* – a word-based logic and language game – promotes verbal reasoning, working memory, and strategic thinking, making it a valuable tool for cognitive stimulation and learning through play (Abd-Alrazaq et al., 2022). Learning through games refers to the process in which gameplay facilitates the acquisition of knowledge or skills through active engagement, feedback, and motivation. This study builds upon previous findings by examining how logic games like Scrabble can enhance memory and self-efficacy in adults (Zuo et al., 2024).

Language and mental functions are closely intertwined (Aljadaan, 2025). Logic games players are able to retain more words than the general population; their vocabulary is enriched with words not commonly used in speech, and their cognitive functions are trained to retrieve memory contents according to multiple criteria simultaneously. Hargreaves et al. (2011) conducted experiments on memory recall, including memory production experiments, as part of their investigation into the visual word recognition system. The study found a significant difference in production between a group of logic games players and the comparison sample. The authors attributed the superior performance to the players' experience with word processing, extensive vocabulary, and intensive practice in expert logic playing.

The intertwined nature of language with mental functions can be used in examining the relationships between different language components and mental functions. Although playing logic games and self-efficacy may not be directly related there may be a link

and mutual influence between the two. Playing logic games can potentially improve an individual's self-efficacy in several ways; players may, for example, experience a sense of accomplishment and increased confidence in their ability to achieve positive outcomes due to completing words and achieving high scores. As players progressively improve in areas such as vocabulary, spelling or strategy skills, they may also develop stronger beliefs about their ability to excel at these tasks. This may lead to greater self-efficacy in other areas of life. Daulay and Adelita (2023) suggest that individuals who have confidence in their ability to learn new words or strategies are more likely to engage in purposeful training, overcome obstacles, and ultimately succeed in the logic games. They note, however, that a high level of self-efficacy can also harm a player's performance in logic games.

**Context and review of literature**

The self-efficacy construct is rooted in Albert Bandura's social-cognitive theory. It assumes that human success is influenced by the interplay between a person's behaviour, their personality factors (such as thoughts), and environmental conditions (Bandura, 1997, 2006). According to this theory, individuals are proactive agents in regulating their cognitive processes, motivation, and actions, rather than passive elements that only react to their environment (Feltz, 2008). As defined by Bandura (2002), self-efficacy refers to an individual's views and judgments about their ability to organise their behaviour and achieve satisfactory outcomes. It is directly related to the conative component of self-efficacy, namely performance. In addition to expectations, this belief has three basic dimensions in its structure: level, generality, and strength. Level refers to the difficulty of the task for which we determine self-efficacy, generality refers to the possibility of specifying context-specific self-efficacy for other activities such as speaking, working and paying attention, and strength determines how confidently a person thinks they can handle a given task.

According to Schunk and DiBenedetto (2021), self-efficacy is the product of the complex cognitive processing of multiple sources of self-relevant information and is mediated by direct and proxy influences, as well as by social and physiological feedback. According to Bandura (2006), each person's self-efficacy is based on four basic sources of self-efficacy expectations. One source is Mastery, related to past performance, when successful situations increase the expectation of future success and, on the contrary, failures reduce it. Another is vicarious experience, related to social comparison, when self-efficacy is increased by the belief that we can do what others can do. Social persuasion (verbal persuasion), the third source, affects self-efficacy through expressing the trust of another person on a real basis; the trust of other people motivates to achieve goals with the deployment of all resources. The final source is an individual’s emotional and physiological states (emotional arousal, physiological information), which can influence self-efficacy both positively and negatively; fatigue, stress, pain, illness, anxiety, bad mood, sadness and depression have a negative effect. These sources enter the process of building self-efficacy during a specific activity. Ramirez and Andreu (2014) posited that the logic game affects the cognitive profile of the individual - their memory, attention, reaction time, verbal ability, logical thinking, critical thinking, etc. Logic games can develop social and emotional skills (such as

communicating, cooperating, resolving conflicts, building self-esteem) and be a useful educational tool (to aid improvement of language skills or vocabulary, or practise more efficient ways of memorising information). Playing logic games also is a fun activity that can improve mood and reduce stress.

This study aims to identify disparities in long-term memory between individuals who play Scrabble and those who do not; additionally, the study seeks to establish a correlation between the level of self-efficacy in logic game players and in the general population, and to highlight any differences.

The main objectives of this research are: 1) to examine whether regular engagement in logic-based games such as Scrabble is associated with enhanced long-term memory performance in adults; 2) to analyze the relationship between participation in logic games and levels of self-efficacy, comparing frequent players with the general population; 3) to contribute to the understanding of how cognitively stimulating recreational activities can support memory retention and self-belief mechanisms in adulthood. Hargreaves et al. (2011) conducted memory recall experiments to investigate the visual word recognition system. The results confirmed a significant difference in production between the group of logic game players and the comparison sample, in favour of the players. Based on these findings, the following hypotheses were formulated: H1: There is a significant difference in the production of long-term memory content between logic game players and the general population. Playing logic games can potentially improve an individual's self-efficacy in several ways. A higher level of self-efficacy may ensure better gaming success, or conversely, successful gaming may increase self-efficacy (Schunk & DiBenedetto, 2021). Using the findings of Schunk and DiBenedetto (2021) as a starting point, we formulated Hypothesis H2: The level of self-efficacy is significantly higher in logic game players than in the general population.

## METHOD

### Sample

The base set sample comprised logic games, Scrabble, and puzzles. Players in our research sample were intentionally included, meaning it is a non-random selection. We selected the research sample because the group of logic game players had to play at least three times a week for a certain number of hours. Of the 64 respondents in the study, four were excluded due to failing to complete the memory test or partially fulfilling the questionnaire. The evaluated research population consisted of N = 60 respondents, divided into two groups; the first consisted of 30 league players of logic games, consisting of 18 males (60%) and 12 females (40%), aged from 34 to 69 years (mean age M = 52.41, standard deviation SD = 9.31). The second group of 30 general population respondents was made up of 16 males (53.33%) and 14 females (46.67%), with an age range of 26 to 70 years (M = 49.27, SD 10.04 ). Participants were selected using purposive sampling to ensure that all respondents had basic familiarity with digital or board games, which was essential for meaningful participation in the intervention.

**Instruments**

This study adopted a quasi-experimental design, specifically, a non-equivalent control group design (Krishnan, 2025). This design was selected due to ethical and practical constraints inherent in the recruitment setting, which precluded the random assignment of participants to the game-based (Scrabble players) and control groups. We utilized self-selected groups of players and a comparison sample from the general population. While an actual experiment offers the highest internal validity, the quasi-experimental approach was deemed essential for maintaining ecological validity, allowing for the examination of the cognitive outcomes within a genuine, naturalistic environment. We acknowledge the potential threat of selection bias, but rely on this design as the most appropriate and justifiable balance between internal validity and the real-world applicability of the findings. The extent of verbal production to symbolic stimuli and their comparison was investigated. Single letters of the alphabet (K, P, D, N, R, I, CH, C, Š) served as symbolic stimuli. The General Perceived Self-Efficacy Scale, originally developed in 1981 by Schwarzer and Jerusalem (Luszczynska, 2005) under the name General Self-Efficacy Scale (GSES), was used as a research instrument to measure the degree of self-efficacy. The Slovak translation of the scale by Košč and Heftyová (1993) was used in the research. The questionnaire was obtained from http:// userpage.fu-berlin.de/health/selfscal.htm, where 32 language versions are available.

**Procedure**

The participants had to write as many nouns as possible beginning with the given letter within one minute. The results of the word production investigation were statistically processed according to the occurrence of each symbolic stimulus in agreement with the 2003 Short Dictionary of the Slovak Language. The reliability value was 0.85 for Cronbach's alpha. The questionnaire consisted of 10 items, where the participants' responses indicated their level of agreement with the validity of statements about their relationship with themself.

**Data analysis**

We used a specialised statistical computer to process the research data using the software Statistical Package for the Social Sciences - SPSS 25. Comparative-correlational research was conducted using the following: a reliability test for detecting normality; descriptive statistics to describe the data obtained (Mean, SD, Min., Max.); a t-test for two independent samples, to compare differences.

Table 1
Test of normality (production of memory to individual suggestions)

| | Shapiro-Wilk | | |
|---|---|---|---|
| | Statistic | df | Sig. |
| Memory production by logic game players | 0.972 | 30 | 0.605 |
| Memory production, general population | 0.950 | 30 | 0.174 |

Source: Own processing according to SPSS

The Shapiro-Wilk test for normality showed a typical distribution ($p = 0.605$, $p = 0.174$, $p > 0.05$) for the variable of memory production in both groups. Therefore, based on the

demonstrated normal distribution of data for testing hypothesis H1, we used a parametric t-test for two independent samples. We investigated whether there was a statistically significant difference in the level of long-term memory measured by the number of words produced between the group of Scrabble league players and the group of the general population.

Table 2
Normality test (a measure of self-efficacy)

| | Shapiro-Wilk | | |
|---|---|---|---|
| | Statistic | df | Sig. |
| Self-efficacy rate of the logic game players | 0.986 | 30 | 0.946 |
| Self-efficacy rate of the general population | 0.975 | 30 | 0.672 |

Source: Own processing according to SPSS

Parametric tests were used to test hypothesis H2, as the normality test indicated that the data had a typical distribution. The study aimed to determine whether there was a statistically significant difference in the level of self-efficacy, as measured by the General Self-Efficacy Scale, between league-level Scrabble players and non-players. To test this hypothesis, we performed a parametric t-test for two independent samples, taking into account the normality of the data distribution and the nature of the variables.

## FINDINGS

Both groups had to generate as many nouns as possible for a given letter of the Slovak alphabet, within a one-minute time frame, for each stimulus in the production experiment on long-term memory recall. The letters were chosen according to how often they occur in the Slovak language. Table 3 presents the descriptive statistics of memory production.

Table 3
Descriptive statistics of memory production

| | Group of logic game players | Group of the general population |
|---|---|---|
| N | 30 | 30 |
| Average | 126 | 90.33 |
| Median | 127.5 | 90 |
| Standard deviation | 20.435 | 22.513 |
| Skewness | 0.297 | 0.527 |
| Pointedness | 0.705 | 0.152 |
| Interval | 79 | 87 |
| Minimum | 82 | 36 |
| Maximum | 161 | 123 |

Source: Own processing according to SPSS

Descriptive Table 3 shows that the logic game player group produced an average of 126 words within a total time limit of nine minutes (9 x 1 minute per stimulus), while the general population group produced an average of 90.33 words. The highest production was observed in the player group, at 161 words, and the lowest in the general population group, with only 36 words.

Table 4
Overview of production for individual stimuli for both groups

| | Logic game players (N = 30) | | General population (N = 30) | | | |
|---|---|---|---|---|---|---|
| | Mean 1 | Std. deviation | Mean 2 | Std. deviation | Difference in average scores | Vocabulary |
| Production of K | 14.97 | 5.206 | 13.00 | 4.026 | 1.97 | 152 |
| Production of P | 15.07 | 3.798 | 11.87 | 3.246 | 3.20 | 150 |
| Production of D | 15.34 | 3.177 | 10.07 | 3.704 | 5.28 | 47 |
| Production of N | 14.14 | 3.613 | 8.47 | 2.432 | 5.67 | 76 |
| Production of R | 16.69 | 3.274 | 11.07 | 3.600 | 5.62 | 44 |
| Production of I | 11.07 | 3.161 | 8.03 | 3.368 | 3.04 | 10 |
| Production of CH | 12.21 | 3.155 | 9.40 | 2.799 | 2.81 | 10 |
| Production of C | 13.21 | 2.769 | 9.00 | 2.913 | 4.21 | 9 |
| Production of Š | 13.38 | 1.953 | 8.90 | 3.044 | 4.48 | 25 |

Source: Own elaboration

Table 4 shows that the Scrabble players achieved higher mean scores in noun production across all stimulus categories (all noun examples have been translated in English from the original Slovak answers). The logic game players had the highest mean score in item R with 16.69 words, while the general population group had the highest mean score in item K with 13.00 words. Both groups had the lowest mean scores in item I, with the logic game player group achieving 11.07 words and the general population group achieving 8.03 words. The groups' largest production difference was in items N, R, and D, which had a difference of more than five words. These items are considered to have medium occurrence according to the vocabulary. The smallest difference in production between the groups was in cue K, which had a difference of 1.97 words. Cue C, which had the lowest occurrence, had a difference of 4.21 words between the groups.

Table 5
Level of long-term memory (t-test for two independent selections)

| Levene's Test for Equality of Variances | | t-test for Equality of Means | | | |
|---|---|---|---|---|---|
| F | Sig. | t | df | Sig. (2-tailed) | Mean Difference |
| 0.038 | 0.847 | 6.438 | 58 | 0.000 | 35.736 |

Source: Own processing according to SPSS

Table 5 shows a statistically significant difference ($p = 0.000$) in long-term memory levels, as measured by the production experiment, between league-level Scrabble players and the general population. The logic game players scored significantly higher, while hypothesis H1 was confirmed. The results of the differences are also shown in

Table 6 shows the measured values for the self-efficacy variable. The maximum possible score is 40.

Table 6
Descriptive statistics of the self-efficacy rate

| | Group of logic game players | Group of the general population |
|---|---|---|
| N | 30 | 30 |
| Average score | 31.2 | 30.13 |
| Median | 31.5 | 30 |
| Standard deviation | 4.437 | 3.91 |
| Skewness | -0.056 | 0.226 |
| Pointedness | -0.393 | -0.018 |
| Interval | 18 | 16 |
| Minimum | 22 | 22 |
| Maximum | 40 | 38 |

Source: Own processing according to SPSS

Based on the results presented in Table 6, it can be observed that respondents who play logic game at the league level have an average gross score of 31.2 on the General Self-Efficacy Scale, while respondents who do not play at the league level have an average score of 30.13 points. Both groups achieved a minimum raw score of 22, which is more than 50% of the maximum value. The highest score of 40 points was obtained by the Scrabble players. To determine the normality or non-normality of the data distribution, which is necessary for subsequent verification of the H2 hypothesis, we used the Shapiro-Wilk normality test due to the sample size ($N < 50$).

Table 7 shows the self-efficacy rate for participants who are either league-level logic game players or members of general population (t-test for two independent samples).

Table 7
Self-efficacy rate for participants

| Levene's Test for Equality of Variances | | t-test for Equality of Means | | | |
|---|---|---|---|---|---|
| F | Sig. | t | df | Sig. (2-tailed) | Mean Difference |
| 0.859 | 0.358 | 0.988 | 58 | 0.327 | 1.067 |

Source: Own processing according to SPSS

Table 7 shows that there is no statistically significant difference ($p = 0.327$) in self-efficacy between respondents who are logic game players at the league level and those who are not, as measured by the GSES, while hypothesis 2 was rejected.

## DISCUSSION

This study aimed to identify disparities in long-term memory between individuals who play Scrabble and those who do not, and to establish correlations between self-efficacy levels in logic game players and the general population. The research addressed three main objectives: examining the association between regular engagement in logic-based games and enhanced long-term memory performance, analyzing the relationship between game participation and self-efficacy levels, and contributing to the understanding of how cognitively stimulating recreational activities support memory retention and self-belief mechanisms in adulthood. The research confirmed Hypothesis H1, demonstrating a significant difference in long-term memory performance between

logic game players and the general population. Logic games league players exhibited statistically significantly higher levels of long-term memory performance across all stimulus items. This finding aligns with the theoretical framework of neuroplasticity and bilateral hemispheric activation proposed by Indrastuti et al. (2025), who demonstrated that activities engaging both brain hemispheres—such as Scrabble, which simultaneously activates the left hemisphere for language processing and the right hemisphere for spatial orientation and strategic planning—can stimulate cognitive functions and improve brain activity. The observed superior word production in Scrabble players can be attributed to enhanced lexical access and retrieval mechanisms developed through repeated engagement with word-based cognitive challenges (Abd-Alrazaq et al., 2022).

Word production varied quantitatively for each alphabetic stimulus, depending primarily on vocabulary size and the frequency of letter usage in the language. Letters permitting a larger number of possible word formations generated more responses, while those with limited combinatorial possibilities produced fewer. This pattern can be explained by the interference theory with targets of different sizes and is consistent with findings by Hargreaves et al. (2011), who confirmed significant differences in production between logic game players and comparison samples. The mechanism underlying this enhanced performance likely involves the development of more efficient semantic networks and strengthened associations between lexical items through regular gameplay (Kappi et al., 2024). Our findings corroborate previous research demonstrating cognitive benefits of serious games in adults. Supriadi and Jalaluddin (2023) found that participants using game-based distributed learning mastered complex terms more easily and demonstrated higher motivation, while Kobzeva (2014) established that logic games develop critical thinking skills and promote creative and analytical thinking. The superior long-term memory performance observed in our Scrabble players extends these findings by providing empirical evidence for the specific domain of verbal memory and lexical retrieval.

**Self-Efficacy Levels**

Contrary to our expectations, Hypothesis H2 was rejected. The General Self-Efficacy Scale revealed no statistically significant difference in self-efficacy levels between league-level Scrabble players and the general population. Although mean values slightly favored logic game players, both groups achieved identical minimum scores (22 points), and only the Scrabble group reached the maximum score (40 points), suggesting individual variability rather than group-level differences. This unexpected finding warrants careful consideration within Bandura's (2006) self-efficacy framework. Bandura conceptualized self-efficacy as domain-specific rather than generalized; individuals may exhibit high self-efficacy in particular contexts while demonstrating lower confidence in others. The General Self-Efficacy Scale measures broad, generalized beliefs about one's competence across diverse situations, which may not capture the specific self-efficacy developed through logic game expertise. It is plausible that Scrabble players possess elevated task-specific self-efficacy related to word games, verbal reasoning, and strategic thinking, but this specialized confidence may not translate to generalized self-efficacy across life domains. The age composition of our

sample provides an alternative explanation. Both groups contained a higher proportion of participants aged 45 and older, and accumulated life experiences may have already shaped robust self-efficacy beliefs independent of gaming activities. As Schunk and DiBenedetto (2021) noted, self-efficacy develops through mastery experiences, vicarious learning, social persuasion, and physiological states—sources that accumulate throughout the lifespan. Older adults in both groups may have established relatively stable self-efficacy levels through decades of varied life experiences, potentially obscuring any incremental effects of logic game participation. Additionally, the bidirectional relationship between self-efficacy and gaming success proposed by Schunk and DiBenedetto (2021) suggests complexity in this association. While higher self-efficacy may facilitate gaming success, successful gaming may reciprocally enhance self-efficacy specifically within the gaming context. Our measurement approach may not have adequately captured this domain-specific enhancement.

**Cognitive Benefits and Theoretical Implications**

The confirmed differences in long-term memory performance between groups have important theoretical and practical implications. From a neurobiological perspective, regular engagement with cognitively demanding activities like Scrabble may promote neuroplasticity, the brain's capacity to reorganize neural pathways in response to experience (Indrastuti et al., 2025). Their clinical study demonstrated measurable improvements in Mini-Mental State Examination scores following Scrabble-based interventions in elderly individuals with memory impairment, providing compelling evidence for the game's therapeutic potential.

Our findings align with extensive research on cognitive reserve and successful aging. Klimová et al. (2016) concluded that board games, including Scrabble, should be encouraged for older adults to maintain cognitive health and prevent cognitive decline. Verghese et al. (2013) established that older adults engaging in board games had reduced dementia risk compared to non-players. Engvig et al. (2014) identified associations between board game playing and increased grey matter volume in brain regions involved in cognitive processing and executive functions. These converging findings suggest that Scrabble and similar logic games function as cognitive stimulation interventions that may build cognitive reserve and delay age-related cognitive decline.

The cognitive mechanisms underlying these benefits likely involve multiple processes. Norton and Mondello (2011) found that Scrabble players demonstrated superior performance in information processing, problem-solving, abstract thinking, and vocabulary, with benefits particularly pronounced in middle-aged and older adults. Rasti and Rapp (2009) observed improvements not only in language skills and verbal memory but also in self-confidence and social interaction among Scrabble players. Hsiao and Chen (2021) extended these findings to clinical populations, demonstrating that logic games can enhance attention, reaction speed, and working memory in adults with depression.

The integration of our findings with recent empirical evidence from Indrastuti et al. (2025), who documented substantial MMSE score improvements (from 16 to 21 and from 18 to 25) following seven days of combined brain exercise and Scrabble therapy,

underscores the potential of game-based cognitive interventions across diverse populations and contexts. The consistency of positive outcomes across educational, recreational, and clinical settings strengthens the argument for incorporating cognitively stimulating games into health promotion strategies for adults. The finding that desk games improve long-term memory should be interpreted in the context of individual needs and approaches. A study (Oyetola et al., 2025) demonstrated that learning style preferences (e.g., visual, group) significantly influence learning study habits. The Scarbble game, as a flexible tool, can effectively engage multiple learning styles simultaneously (e.g., visual manipulation and individual strategy), thereby optimizing the learning process for a broader range of seniors.

**Limits of this study**

Several methodological limitations should be acknowledged. The modest sample size may have limited statistical power to detect smaller effects, particularly for self-efficacy differences. Online administration, while convenient, lacked laboratory-based controls, and variations in testing conditions may have introduced unmeasured variability. Demographic matching focused on age and gender but did not account for education, employment, or socioeconomic status—variables that may influence both cognitive performance and self-efficacy. Additionally, the General Self-Efficacy Scale may not have captured domain-specific confidence related to logic game expertise; future research should employ game-specific self-efficacy measures alongside generalized scales.

Longitudinal designs would clarify causal relationships between logic game engagement and cognitive outcomes. Our cross-sectional design cannot determine whether superior memory performance results from gaming practice or reflects pre-existing cognitive capacities. Randomized controlled trials with pre- and post-intervention assessments, similar to Indrastuti et al. (2025), would provide stronger causal evidence. Future investigations should explore mediating mechanisms such as neural efficiency changes, semantic network organization, and metacognitive strategies, as well as dose-response relationships between gameplay frequency, duration, intensity, and cognitive outcomes.

## CONCLUSION

This study examined disparities in long-term memory and self-efficacy between individuals who regularly play logic-based games such as Scrabble and those who do not. The results confirmed a significant advantage in long-term memory performance among Scrabble players, supporting Hypothesis H1 and aligning with theoretical frameworks of neuroplasticity and cognitive stimulation. These findings reinforce evidence from recent research (e.g., Indrastuti et al., 2025; Kappi et al., 2024; Abd-Alrazaq et al., 2022) indicating that cognitively demanding recreational activities enhance memory performance and may contribute to maintaining cognitive health in adulthood.

In contrast, Hypothesis H2 was not supported, as no significant group-level differences were found in general self-efficacy. This outcome suggests that self-efficacy developed

through logic game expertise may be domain-specific rather than generalized, reflecting Bandura's (2006) theoretical distinction. Future studies should therefore incorporate domain-specific self-efficacy measures to better capture task-related confidence and explore its interaction with cognitive performance. From a practical perspective, Scrabble and similar logic games can be viewed as accessible, low-cost, and enjoyable tools for cognitive engagement that may help strengthen memory and promote active learning in adults. However, serious games should currently be considered as a complementary intervention rather than a replacement for established cognitive training methods until stronger causal evidence is obtained.

Future research should employ longitudinal and experimental designs to clarify causal pathways between logic game engagement and cognitive outcomes, and to identify mediating mechanisms such as neural efficiency, semantic network reorganization, and metacognitive strategies. It would also be valuable to investigate the effects of various types of logic and word-based games across age groups and cognitive profiles, assessing both their benefits and potential limitations (Diana et al, 2025, Chang et al, 2023, Cebreros-Valenzuela at al, 2020)

Therefore, serious logic games should be offered as a supplement to existing proven and safe interventions rather than as a complete substitute until further, more robust evidence is available. Future studies should investigate the short- and long-term effects of serious games on memory, self-efficacy and other cognitive abilities among people of different age groups with or without cognitive impairment.

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