Studying the Effects of Memory-Based Games on the Enhancement of Memory

Rishav Katoch, Mohit Sankhyan, Abha Aggrawal
Computer Science and Engineering Chandigarh University Mohali, India

Abstract - This research has explored the use of Memory-Based Games for the enhancement of memory and basic cognition and also their effects on short-term memory, especially in terms of recall memory.
In the research, we have examined the effects that the memory game has on the recall capability of a person. The infinite-level memory- based games for this task were developed with the use of HTML, CSS, JavaScript, and MongoDB. A group of people selected at random (n=20) was first tested on this game and a baseline recall score (s=8.3) was established. In the end, we observed that the memory-based game had a significant positive impact (s=10.2) on recall memory in the experimental group in contrast to the control.

Keywords - Memory Enhancement, Memory Based Game, Recall Memory, Memory Game Development.

I. INTRODUCTION

Everyone has played some kind of memory game at some point. Whether that's spotting the difference, simple pairing games using playing cards, or even doing a crossword. They all require the players to use their memory to complete the game. Playing memory games can help improve other brain functions, such as attention, concentration, and focus. Memory games give space to critical thinking and that helps people nurture their attention to detail.

Implementing a memory game involves several steps, including designing the game rules and mechanics, creating the user interface, developing the logic for the game, and testing and debugging the final product. The infinite-level memory-based games for this task were developed with the use of HTML, CSS, JavaScript, and MongoDB.

The memory game is based on the classic Simon game. Creating a classic Simon game involves designing a memory-based electronic game where players repeat progressively longer sequences of lights and sounds.
In this research, we will be testing the game and its ability to enhance the recall memory in a person. We

will achieve this by using a group of people selected at random (n=20) to verify the game's ability to enhance memory. The group would be split into two groups, one control and one experimental. A baseline score would be established for both groups. Then for the entire next week the experimental group would be instructed to use the memory game for some duration. After this, both groups will be tested again to observe the difference in their ability to recall information.

II. MEMORY GAME

Our memory game is designed after the classic Simon game. Designing an electronic memory game where players repeat longer and longer sequences of lights and noises is the concept of creating a Simon game. Improving recall memory through games can be a fun and effective way to exercise memory and cognitive skills.

The game's basic yet difficult concept consists of a device with four vibrant, touch-sensitive buttons. As the game progresses, the player will be displayed different patterns of lights and sounds, which the player must accurately imitate. As new levels of intricacy are added with each successful replication, players' focus and memory are put to the test.


Interface- 01

III. METHODOLOGY

We have developed a memory-based game using the concepts of HTML5, CSS, JavaScript, and MongoDB for the database to explore the use of Memory Based Games for the enhancement of memory and basic cognition and also their effects on

short-term memory, especially in terms of recall memory. The game is based on the classic Simon game.[1] Creating a classic Simon game involves designing a memory-based electronic game where players repeat progressively longer sequences of lights and sounds.

Algorithm:

Step 1: Start

Step 2: Create a list of colored boxes with unique beep sounds.

Step 3: Initialize the score to 0 and display the scoreboard.

Step 4: Initialize an empty sequence list.

Step 5: Present a "Start" button to begin the game.

Step 6: When the "Start" button is clicked, start with Level 1 and clear the sequence list.

Step 7: For each level add a random color box to the sequence and provide visual cues and sounds then wait for the player to replicate the sequence.

Step 8: If the player makes an error or takes too long, display "Game Over" and reset.

Step 9: If the player succeeds, increase the score, display it, and move to the next level.

Step 10: Continue until the player decides to end.

Step 11: Upon ending, display the final score and offer the choice to restart or exit.
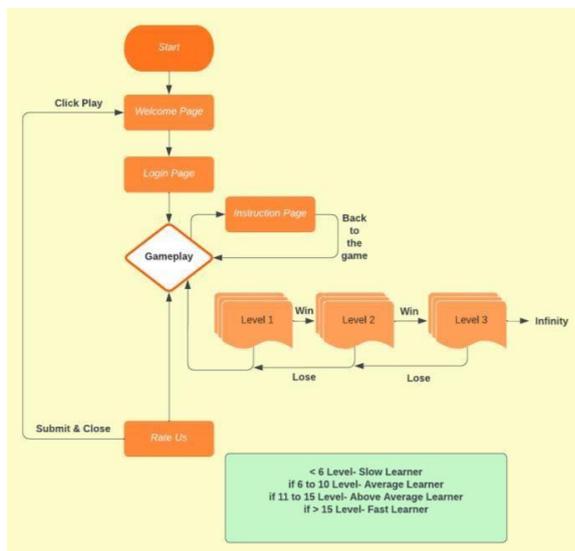
Flow Chart

The experience is enhanced with visually appealing animations and sound effects to engage players and an added benefit of that is an enhanced user experience. The homepage consists of an attractive outlay with different buttons and an optical illusion for the users to witness. For each level, we add a random color box to the sequence and provide visual

cues and sounds then wait for the player to replicate the sequence.[2][3]

Interface- 02

For each level add a random color box to the sequence and provide visual cues and sounds then wait for the player to replicate the sequence. If the player makes an error or takes too long, display "Game Over" and reset. If the player succeeds, increase the score, display it, and move to the next level.

Interface- 03

To test the performance of the game we will be using a group of people selected at random (n=20) to verify the game's ability to enhance memory. The group would be split into two groups, one control and one experimental. A baseline score would be established for both groups. Then for the entire next week, the experimental group would be instructed to use the memory game for some duration. After this, both groups will be tested again to observe the difference in their ability to recall information.[8]

IV. CONFIGURATION FRAMEWORK

OS- Mac iOS
Processor- M2 chip
RAM- 8GB
GPU- Inbuilt GPU
Compilers- Live Servers
IDE- VScode
Programming languages- HTML5, CSS, JavaScript and MongoDB.

V. DIFFERENT MODELS FOR DEVELOPING MEMORY GAME

Board Game Model

The fundamental concept involves creating a gaming board with a variety of face-down cards that hide matching pairings underneath. Tokens will be used to track each player's progress as they take turns showing cards and searching for matching pairings.[6] This interactive approach to memory gaming is fun and interesting, making it a great project for fans of tabletop games who want to create a tangible game that combines strategy, memory, and fun competition.

Conventional Web-based Model

In the conventional web-based approach, you use basic web technologies like HTML, CSS, and JavaScript to construct a memory game. You can also use libraries like jQuery or write your own unique code [5]. The fundamental logic, aesthetics, animations, and user interactions of the game are all implemented entirely within the web browser, allowing for broad accessibility without the need for difficult setups or installations. This model is a sensible option for anyone looking to construct browser-compatible games without a lot of complexity or dependencies because it is perfect for creating simple and interactive web memory games.

Mobile App with ML Model

The machine learning approach allows you to develop a memory game app specifically for mobile devices that uses machine learning to customize each player's gaming experience [9]. A suggestion system is integrated into the game, allowing it to dynamically modify the level of difficulty according to the player's performance and memory. An engaging and adaptive gaming experience that provides a unique and personalized journey through memory-based challenges is ensured as players advance in the game, meaning that the challenges become increasingly tailored to their specific skills. This makes the game an excellent choice for those looking for a more personalized and adaptive gameplay experience on their mobile devices.[7]

VI. RESULT AND ANALYSIS

The game performed well in determining the ability of a person to retain and recall information. As expected, no significant difference was found in the recall ability of the control group between the pre and post-intervention group.

Pre-Intervention

Group	No.	Mean(s)	SD	Min.	Max.
Experimental	10	8.3	2.3	5.6	11.1
Control	10	8.1	2.1	6.2	10.9
Total	20	8.2	2.2	5.9	11.0

Table 1. Recall scores of pre-intervention group.

However, we found a positive impact on the recall memory of individuals from the experimental group, in contrast to the ones in the control group post-intervention [6]. A significant difference was found in the recall ability of the experimental group between the pre-and post-intervention highlighting the ability of the memory game in enhancing recall memory.

Post-Intervention

Group	No.	Mean(S)	SD	Min.	Max.
Experimental	10	10.2	2.7	7.5	13.3
Control	10	8.2	2.1	5.7	10.5
Total	20	9.2	2.4	6.6	11.9

Table 2. Recall scores of post-intervention group.

From the above results, we can see a significant impact in the mean recall score of people in the experimental group (M= 10.2, SD=2.7) and control group (M=8.2, SD=2.1) in post-intervention group.

VII. FUTURE WORK

In the future, we aim to improve upon the different aspects of our memory game
● We will try to improve upon our memory game so that it can also improve other aspects of memory like Working memory, Long-term memory, and Sensory memory.
● We also hope to improve the interface and design of the current memory game and make the UI even more attractive for an enhanced user experience.
● We can also enhance the complexity of game design and iron out various kinks in the game to make a more seamless experience for the users.

VIII. CONCLUSION

A significant difference was found in the recall

ability of the experimental group between pre-and post-intervention, highlighting the ability of the memory-based game to enhance recall memory. As we saw in the results there was a significant impact on the mean recall score of people in the experimental group (M= 10.2, SD=2.7) in contrast to the control group (M= 8.2, SD=2.1) in the post intervention group.

We can conclusively say that the game had a significant impact on the recall memory of an individual, highlighting the impact that memory-based games can have on enhancing cognition and memory

IX. REFERENCES

[1] Kim, S.-C.; Lee, H.-s. Effect of Game-Based Cognitive Training Programs on Cognitive Learning of Children with Intellectual Disabilities. Appl. Sci. 2021, 11, 8582.

[2] Virginia I. Douglas, Penny Parry, Peter Marton, and Chrystelle Garson. Assessment of a Cognitive Training Program for Hyperactive Children. Journal of Abnormal Child Psychology, Vol. 4, No. 4, 1976.

[3] George Savulich, Thomas Piercy, Chris Fox, John Suckling, James B. Rowe, John T. O'Brien, Barbara J. Sahakian. Cognitive Training Using a Novel Memory Game on an iPad in Patients with Amnestic Mild Cognitive Impairment. International Journal of Neuropsychopharmacology (2017), Vol. 20 No.8, pp. 624–633.

[4] Elly Zwartkruis-Pelgrim and Boris de Ruyter. Developing an Adaptive Memory Game for Seniors. Fun and Games (2008), LNCS 5294, pp. 170–181.

[5] Hannes Noack, Martin Lövdén, & Florian Schmiedek. On the validity and generality of transfer effects in cognitive training research. Psychological Research (2014), Vol. 78 No. 6, pp. 773-789.

[6] Jacky Au, Ellen Sheehan, Nancy Tsai, Greg J. Duncan, Martin Buschkuehl, Susanne M. Jaeggi. Improving fluid intelligence with training on working memory: A Meta-analysis. Psychonomic Bulletin and Review (2015), Vol. 22 No. 2, pp. 366–377.

[7] Monica Melby-Lervåg, Charles Hulme. Is Working Memory Training Effective? A Meta- Analytic Review. Developmental Psychology (2013), Vol. 49 No. 2, pp. 270–291.

[8] Susanne M. Jaeggi, Martin Buschkuehl, John Jonides, and Walter J. Perrig. Improving fluid intelligence with training on working memory. The Proceedings of the National Academy of Sciences May 13, 2008, Vol. 105, No. 19, pp. 6829 – 6833.

[9] Torkel Klingberg, Hans Forssberg, and Helena Westerberg. Training of Working Memory in Children With ADHD. Journal of Clinical and Experimental Neuropsychology (2002), Vol. 24, No. 6, pp. 781-791.