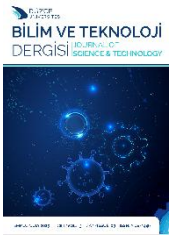

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Research Article

Mind-Focused Interaction: A Convergent Thinking Approach in a Story-Based Detective Game

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ABSTRACT

This study explores how convergent thinking can be integrated into the game development process in story-driven mystery and thriller themed games. While creating the technical infrastructure, spatial cues, interactive objects and detailed environment designs that support convergent thinking were developed through tools such as Unity, Blender and Inkscape. Convergent thinking is an analytical and logical way of thinking that aims to reach the most appropriate solution from a large number of possibilities. In this context, various scenario possibilities were evaluated while creating the game fiction; elements such as consistency in the plot, cause-effect relationships and player guidance were focused on. In the game, the player's role as a detective directly triggers the convergent thinking process. The player has to collect clues, make connections between clues, extract the right information and make logical inferences in order to solve the case. The game is designed to encourage analytical thinking, logical sequencing and coherent problem-solving skills, not just memorization or reflexes. Each scene is structured to guide the player's mental processes; attention, memory and reasoning skills are emphasized by supporting visual and auditory data. The goal of "reaching the right answer", which is the basis of convergent thinking, was used as the primary guide in the progression of the game. The player's analysis directly affects the outcome. Thus, the player was encouraged to think strategically and analytically. This approach, which has not been addressed in a similar way in the literature, is an original and innovative contribution and aims to provide a guiding resource for developers who want to develop a 3D story-based game on the Unity platform by addressing all stages of a convergent thinking-based game design in detail.

Keywords: *Game development, convergent thinking, serious game, game design*

Zihin Odaklı Etkileşim: Hikâye Tabanlı Bir Dedektiflik Oyununda Yakınsak Düşünme Yaklaşımı

ÖZ

Bu çalışma, hikâye odaklı gizem ve gerilim temalı oyunlarda yakınsak düşünmenin oyun geliştirme sürecine nasıl entegre edilebileceğini derinlemesine incelemektedir. Teknik altyapı oluşturulurken, Unity, Blender ve Inkscape gibi araçlar aracılığıyla yakınsak düşünmeyi destekleyen mekânsal ipuçları, etkileşimli objeler ve detaylı ortam tasarımları geliştirilmiştir. Yakınsak düşünme, çok sayıda olasılık içerisinden en uygun çözüme ulaşmayı hedefleyen analitik ve mantıksal bir düşünme biçimidir. Bu bağlamda, oyun kurgusu oluşturulurken çeşitli senaryo

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olasılıkları değerlendirilmiş; olay örgüsü içerisindeki tutarlılık, neden-sonuç ilişkileri ve oyuncunun yönlendirilmesi gibi unsurlar üzerinde yoğunlaşılmıştır. Oyunda, oyuncunun bir dedektif rolüne bürünmesi, yakınsak düşünme sürecinin doğrudan tetiklenmesini sağlamaktadır. Oyuncu, karşılaştığı vakayı çözebilmek için ipuçlarını toplamak, ipuçları arasında bağlantı kurmak, doğru bilgileri ayıklamak ve mantıklı çıkarımlar yapmak zorundadır. Oyun, yalnızca ezber ya da refleks değil; analitik düşünmeyi, mantıksal dizilimi ve tutarlı problem çözme becerilerini teşvik edecek şekilde tasarlanmıştır. Her bir sahne, oyuncunun zihinsel süreçlerini yönlendirecek şekilde yapılandırılmış; görsel ve işitsel verilerle desteklenerek dikkat, hafıza ve muhakeme becerileri ön plana çıkarılmıştır. Yakınsak düşünmenin temelinde yer alan "doğru cevaba ulaşma" hedefi, oyunun ilerleyişinde birincil yönlendirici olarak kullanılmıştır. Oyuncunun yaptığı analizler, sonucu doğrudan etkilemektedir. Böylece oyuncu, stratejik ve analitik düşünmeye teşvik edilmiştir. Literatürde benzer biçimde ele alınmamış bu yaklaşım, özgün ve yenilikçi bir katkı niteliği taşımakta olup, Unity platformunda 3D hikâye tabanlı bir oyun geliştirmek isteyen geliştiriciler için yakınsak düşünme temelli bir oyun tasarımının tüm aşamalarını ayrıntılı biçimde ele alarak rehber niteliğinde bir kaynak sunmayı amaçlamaktadır.

Anahtar Kelimeler: *Oyun geliştirme, Yakınsak düşünme, Amaç odaklı oyun, Oyun tasarımı*

I. INTRODUCTION

The COVID-19 pandemic has catalyzed a substantial acceleration in the global growth of the gaming industry [1, 2]. Within this context, narrative-driven games—particularly those centered on mystery and suspense—have emerged as highly favored genres among players. These games primarily aim to construct immersive and engaging storylines that draw players into the narrative world. By integrating investigative elements, they encourage players to adopt the role of a detective, thereby fostering active participation in problem-solving and critical analysis throughout the gameplay experience.

Mystery and thrill-enhancing elements commonly found in such games often include puzzles, ciphers, and clues that require synthesis and interpretation. While many of these components present a high level of challenge, some are intentionally designed to be easier. These cognitively demanding elements compel players to approach problems from diverse perspectives and engage in deeper analytical thinking. In addition to these challenging components, games frequently incorporate low-to-moderate difficulty tasks—such as simpler puzzles, codes, and clues—which are strategically employed to sustain player engagement and provide a sense of achievement. This balance between difficulty levels is intended to optimize player motivation and prolong in-game immersion.

Thinking styles play a fundamental role in individuals' problem-solving and decision-making processes. In this context, convergent thinking refers to a cognitive process that aims to reach the most logical and accurate conclusion by analyzing available clues to solve a specific problem.

Convergent thinking holds significant importance across various contexts in scientific research and everyday life. For instance, this type of thinking forms the basis of data analysis, hypothesis testing, and scientific validation processes in academia. Researchers systematically evaluate the data they collect to arrive at valid and reliable conclusions. Similarly, convergent thinking also plays a decisive role in fields where analytical skills are critical—such as detective work. A detective solving a criminal case or a player engaged in a detective-themed game must synthesize scattered clues into a coherent whole to identify the perpetrator [3-6].

Weicheng Yuan's Design and Implementation of Puzzle Adventure Game Based on Unity, published in 2023, discusses a game developed with Unity in which the progression of the game is provided by puzzles containing logic. In their article, Michael Holly et al. examine GameDevDojo, a game that aims to teach the tools and definitions used in the game development process. This game includes both game development and gamification methods. In the article developed by Joshua Austin Widjaja and colleagues, a study that blends technology and education is presented. In the study, a 2D game developed with Unity was aimed to facilitate the learning of mathematics, which is difficult to learn, especially for

children [7, 8].

Gamification strategies have been better employed to integrate convergent thinking into game development. These strategies aim to increase the player's motivation to remain engaged in the game. For example, implementing a time-based leaderboard that is visible to all players encourages competition, thereby enhancing player retention and participation [9, 10].

This study aims to examine the applicability of convergent thinking within a game context. Convergent thinking offers focused solutions in a wide range of areas—from reaching accurate information in academia to the logical reasoning a detective uses to identify a suspect—and can provide a unique perspective when used as the foundation for game design. A game developed through this cognitive approach has the potential to distinguish itself with its originality and to offer novel insights compared to other studies in the field.

The study is outlined as follows: In Section II of the article summarizes the methodology and tools used in the development process and Section III details the stages of the game development process, including the implementation of design, story, and interactive components. Section IV describes the technical aspects of the game in detail. Finally, we summarized and presented our conclusions in Section V.

II. METHODOLOGY

The game development process was carried out using robust tools to integrate various thinking systems and keep the player experience consistently at the center of the design. Professional and open-source software such as Unity, Blender, and Inkscape were among these tools. Each played a critical role in optimizing different game design components and enhancing the development workflow's overall efficiency. Unity was utilized to construct the core game mechanics, Blender was employed for 3D modeling processes, and Inkscape played a significant role in the interface design.

Unity offers a variety of components that form the foundation of game mechanics, enabling the character to interact with the environment naturally through its physics engine [11]. Camera and movement systems were managed using specific components such as PlayerController, Unity’s Input System, while Raycasting was employed to facilitate player interaction with the surroundings. With its extensive plugin support, robust physics engine, and user-friendly interface, Unity significantly accelerates the game development process. Its cross-platform capabilities allow for development on mobile, PC, and console platforms. However, performance issues may arise in games requiring optimization. Memory management and processing overhead can become significant in more complex games, necessitating a carefully planned optimization strategy [12, 13].

Blender is a professional, free, and open-source 3D computer graphics software used for creating animation films, visual effects, art, 3D printed models, interactive 3D applications, and video games. In the game development process, Blender is a crucial tool for editing pre-existing models and making them suitable for use within the game [14, 15].

Inkscape is a free, open-source vector drawing and editing tool [16]. It enables UI design creation of buttons, icons, and other graphic elements. Vector-based graphics deliver sharp and scalable visuals, thus contributing positively to performance by keeping file sizes low. However, it is limited when working with raster (pixel-based) images and does not offer advanced effects or filters like those available in Photoshop [17-19].

Thanks to the advantages offered by these tools, the game development process becomes more efficient. However, being aware of their disadvantages and developing appropriate solutions is crucial for the success of the project.

III. GAME DEVELOPMENT

A. GAME DEVELOPMENT PROCESS

A draft of the game can be created at the beginning of the development process. This allows the developers to have a roadmap. During the planning phase, the core dynamics of the game and the writing process of the story on which the game will be built can be initiated. The game will then be shaped around this story. After the story is determined, the level designs that will define the story flow are established. Level designs will determine the sections of the game. The last part before diving into technical details is the design phase. At this point, the general outline of the game and the characters will be defined, and the game mechanics can be added. After these stages, the game mechanics are incorporated into the game, which now has its general framework. This sequence may vary depending on the developers and the games being developed. However, by following a clear roadmap, developers will avoid potential complexities during the process.

This section thoroughly discusses the processes mentioned above.

A. 1. Planning

The project's objectives have been clearly defined in the Project Planning phase. In this project, the aim was to investigate the use of convergent thinking in a game. Accordingly, time and task planning have been made.

As the project progresses, a risk analysis was conducted to address potential risks, and solution scenarios were created based on the possible risks. For example, one of these risks could be encountering an error in one of the coding phases during the game development process, with a solution taking an extended period to be found. In this case, the problematic section might be removed, and another addition could be made in its place, or the risk of time delay might be accepted, allowing additional time to solve the problem [20].

This study uses the agile model used in the planning phase is shown in the Figure 1. Each cycle includes planning, implementation, testing, and evaluation phases. The process has been made even more dynamic with the flexible and adaptable structure offered by the agile management methodology. This dynamic structure allows for improvements to be made to the game developed during the process.

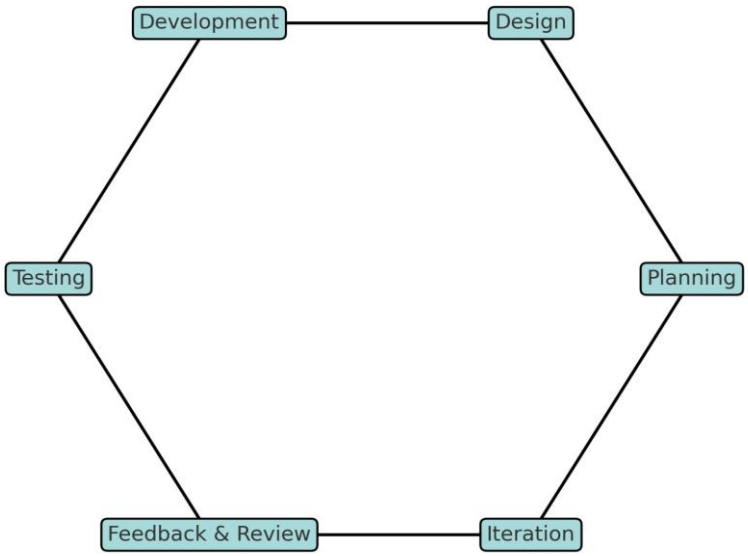

Figure 1. Agile development cycle used in the project

A. 2. Story And Scenario

In determining the theme and atmosphere, existing games in the industry with a focus on detective themes were analyzed. Ultimately, a decision was made to develop a game with a dark theme in the mystery and thriller genre.

The story progresses as the player assumes the role of a detective and works to solve a murder case. The main character is set as the detective, and they interact with the supporting characters in the game, helping to move the story forward.

The scenario is designed around the player completing tasks to advance the plot. After each task the player completes, they move one step closer to the outcome and the game's completion [21, 22].

The general progression of the game scenario is presented in Figure 2. The player starts the game, collects evidence, and eventually makes a decision by selecting a suspect. Based on the correctness of the decision, the player either receives feedback and continues or completes the game by submitting the result to the leaderboard.

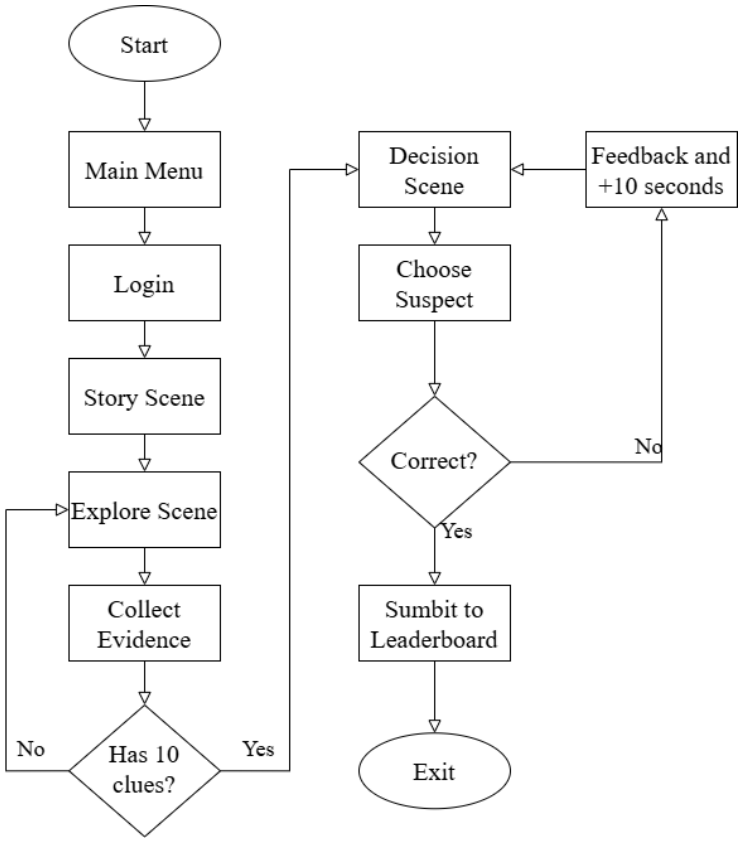

Figure 2. *Flowchart representing the core gameplay loop*

A. 3. Level Design

For the environment and spatial design of the game, a dark theme was chosen to align with the story. Research was conducted to find suitable assets for this theme. The goal was for the game's locations, lighting, and sound elements to be harmonious and support the game mechanics. Scene design plays a crucial role in achieving the desired atmosphere of the game. Game developers can either utilize designers from their teams for creating the elements, scenes, and characters of the game or take advantage of the ready-made assets offered by Unity and other game engines. In this game, pre-made assets were used for environment and character designs, as well as for crime scenes and objects, enhancing the game's visual quality.

Interactive elements were used to guide the player within the game. The aim was for the player to progress through the game, explore its locations, and learn its story and flow. These interactive elements were supported by sound effects and lighting, reinforcing the environment and spatial design [23, 24].

A. 4. Design

The game generally features a tense and dark atmosphere. Design elements reflecting 19th-century Europe were incorporated into the spatial designs to evoke this feeling.

The characters have been designed to emphasize their attributes and reflect the era's spirit.

Throughout the game, background music and sound effects that support the elements of tension and mystery are used to influence the player auditorily.

The game’s menus, inventory system, and storytelling interfaces have been designed to be user-friendly and thematically appropriate, ensuring coherence across the entire experience [12].

A. 5. Gameplay Mechanics

Figure 3 presents the use case diagram of the Detective Game System, outlining the player's interactions with the core gameplay functionalities. This diagram illustrates essential actions such as collecting evidence, interacting with NPCs, selecting suspects, and accessing the leaderboard, providing a general overview of the gameplay structure.

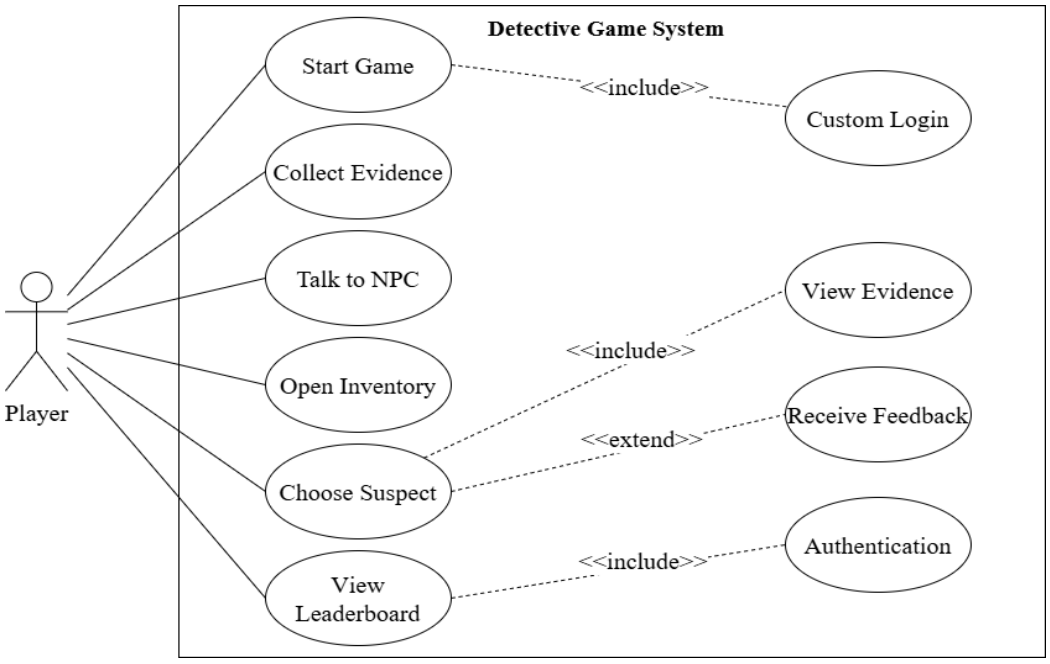

Figure 3. *Use case diagram of the Detective Game System illustrating the interactions between the player and core game functionalities*

A.5.1. Movement Mechanics

The player's movement mechanics have been developed to provide a smooth and natural experience. The character is controlled using the W-A-S-D keys, while the mouse can be used to change the field of view. The sprinting mechanic is activated by pressing the Shift key, which increases the character's speed. To make the movements feel more realistic, a gradual acceleration and deceleration have been implemented, avoiding sudden transitions during speed changes.

A.5.2. Environment Interaction Mechanics

Specific objects and non-playable characters (NPCs) have been identified for the player to interact with in the environment. Raycast algorithms have been used to facilitate interaction with objects, as described in Unity's official documentation [25]. When the player approaches an object closely enough and presses the 'E' key, an inspection window for that object opens. The player can add this information to their inventory if the object contains an important clue.

For interactions with NPCs, dialogue systems have been implemented. When the player approaches an NPC, an interaction icon appears on the screen, and upon pressing the 'E' key, a set of dialogue options is displayed.

Here the player must use convergent thinking to find clues, make sense of them and interpret the dialogues. For example, an ink bottle found at the crime scene can be used to infer that the victim or the murderer was doing something related to writing. Or he/she should be able to make sense of the contradictory statements made by the suspects. This aligns with research showing that games targeting convergent thinking help players develop problem-solving and interpretative skills by focusing on logical connections between clues [26].

(a)

(b)

Figure 4. (a) *Object interactions in the game environment* ***(b)*** *NPC interactions with the player*

A.5.3. Puzzle And Intellectual Mechanics

The core puzzle mechanic for the player revolves around finding missing items and using them to identify the culprit. Various pieces of evidence scattered throughout the game world require players to use their attention and explore. While some items are visible, others require the player to carefully observe the environment or interact with specific objects. After collecting sufficient evidence, the player must evaluate the clues to determine the culprit. In the final stage, the player is presented with various options and must choose the perpetrator. If an incorrect choice is made, additional guidance may be provided, or the game may be replayed to encourage the player to reach the correct conclusion. This way, the game offers a more immersive experience by requiring players to use their observational skills and logical deduction abilities.

The puzzle and logic mechanics are designed to support the player's convergent thinking. For example, the player is expected to make connections between the discovery of bloodstains, a poison bottle, and a sharp tool. The player should conclude that the incident was caused by an injury rather than poisoning. Such game-based assessments of creative and convergent thinking processes have been demonstrated to effectively enhance players' abilities to integrate information and arrive at logical conclusions [27].

A.5.4. Time And Progress Mechanics

To track the player's progression through the story, both time mechanics and progress systems are employed. The player's time spent solving the case is measured and compared against other players on the leaderboard. Additionally, each time a piece of evidence is collected, the player's progress value in the task section increases. This system helps the player track their progress throughout the game.

The player must collect a total of 10 pieces of evidence to solve the murder case. With each piece of evidence collected, the progress bar in the task section increases by one. After the 10th piece of evidence is collected, the player can proceed to the stage of selecting the killer. If the player makes a wrong choice, 10 seconds are added to the timer, and the player must make a new choice, trying to identify the correct culprit. This mechanic encourages the player to be more attentive and carefully examine the evidence.

A.5.5. Multiplayer Mechanics

A leaderboard system has been implemented in the game to increase competition and encourage players to race against each other. After completing the game, players are ranked based on their solving times. The leaderboard is divided into three tiers to display the players' best performances: Gold, Silver, and Bronze. Each tier is determined by the player's solving time and performance. Gold is awarded to the player with the fastest time and best performance, Silver goes to the player with the second-best result, and Bronze is assigned to the third-place player. This ranking creates a competitive environment, motivating players to achieve better results. Figure 2 shows the leaderboard used in the game.

Figure 5. *The leaderboard interface displayed within the game*

B. UNITY USAGE AND TECHNICAL DETAILS

Unity, the primary platform used for developing this game project, is a highly preferred platform among developers due to its features and advantages. However, Unity can sometimes also be a complex platform to work with. This section provides general information about Unity and discusses the interfaces, animations, coding, and additional tools used during development.

One of the biggest challenges encountered during game development is performance optimization. Especially with the high density of objects in scenes and real-time calculations, unexpected device slowdowns can occur. This issue not only becomes a technical problem but also a factor directly affecting the player's experience. Throughout the development process, it may be necessary to restructure the system multiple times, simplify the code, and optimize graphical details.

B.1. Game Engine And Tools

Unity accelerates and simplifies the game development process by offering a wide range of tools. These tools include technical resources such as Unity UI, TextMeshPro, Leaderboards, Authentication, Recorder, and Unity Version Control [11, 25]. Tools like Unity UI and TextMeshPro allow for creating dynamic and visually rich user interfaces. Leaderboards and Authentication are used to encourage competition among players and securely manage user accounts. Unity Version Control facilitates file management, allowing multiple developers to work on the project simultaneously, thereby optimizing teamwork.

During the game development process, 3D modeling software like Blender is used for character and environment modeling, while vector design tools like Inkscape are employed for creating icons and visuals. These tools help enhance the visual quality of the game.

B. 2. Coding And Animation

Character movements are implemented using Input and Time algorithms from the UnityEngine library [25]. Input algorithms allow the player to control movements by reading data from input devices like the keyboard and mouse. The Input.GetAxis("Mouse X") and Input.GetAxis("Mouse Y") functions are used to control the character's camera angle, while the Input.GetButtonDown("W") function is used for walking. To ensure smooth timing and fluidity of movements, Time.deltaTime is used, which helps maintain consistent character movement even at varying frame rates.

Raycast algorithms are used to enable interaction with in-game objects [25]. These algorithms send a ray up to a specified distance based on the player's viewpoint to detect nearby objects. A Ray, consisting of an origin point and a direction vector, is generated using functions like *Camera.ScreenPointToRay* or *ViewportPointToRay*, originating from the near clipping plane rather than the camera’s position [11]. When the character approaches an object, the Physics.Raycast function is used to access the object. The object's tag is then checked to verify its type, and the appropriate actions are carried out. When the correct object is detected, interaction options are displayed on the screen, allowing the player to perform the necessary actions.

Time algorithms are used to manage the in-game time mechanism [25]. The game's time can be paused or sped up using functions like Time.timeScale to fit the game mechanics. Time is paused when menus are opened to control the game's flow.

Unity's Authentication and Leaderboards services are used for the leaderboard and player authentication systems [25]. Leaderboard is a service that allows players to rank and compare their scores, while Authentication offers player identity management, allowing players to manage their accounts through the Unity Dashboard [11]. This system allows players to log in, save their scores, and compare them with other players. User information and settings are stored using PlayerPrefs, ensuring that the player's settings are preserved for each session.

In the animation system, Unity's Animator component is utilized [11]. An Animator component is added to the object to be animated, and an Animator Controller is created to manage the object's different states. The Animator Controller is the structure that manages animation clips and transitions between them with a state machine [11]. Light effects are applied to make in-game objects more prominent, and

these lights are dynamically adjusted through animation. The intensity of the lights is modified based on proximity to the object, drawing the player's attention.

B. 3. User Interface

The game's user interface is carefully designed to enhance the player experience and make it more efficient and user-friendly. Using Unity's tools and UI elements, each screen is ensured to display at the correct resolution and appropriate sizes. To achieve this, the Canvas Scaler Component's UI Scaler Mode is set to "Scale with Screen Size," and the Reference Resolution is set to 1920 x 1080. This setting ensures that the game interface is consistently displayed across devices with different screen sizes. Thus, the goal is for the user interface to provide the same visual experience for every player.

B.3.1. Game Entry Interface

Figure 3 shows the game's entry screen. The design of this screen aims to allow users to easily complete the necessary steps to start the game. An intuitive and user-friendly design has been created for the entry screen using Unity's UI elements (buttons, panels, etc.). The start buttons, options, and other interactive elements on the screen are arranged to enable players to quickly and easily begin the game.

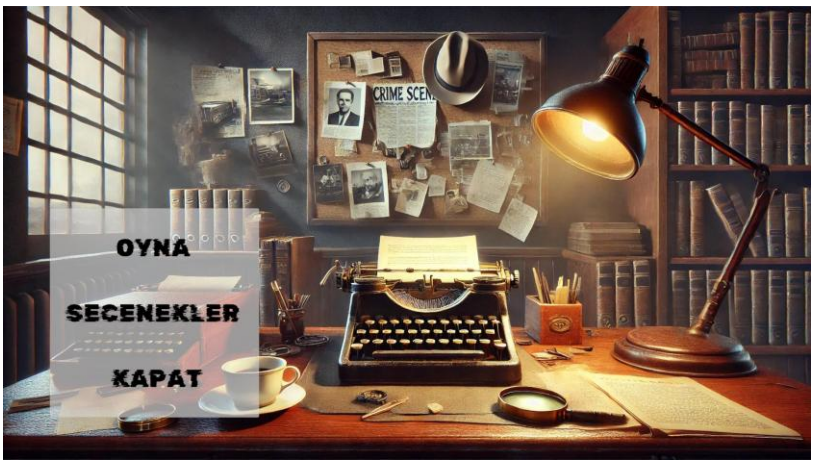

Figure 6. *The main game menu layout*

B.3.2. User Login Interface

The login screen designed for players to enter the game is shown in Figure 4. This screen is created in a simple and functional way to allow players to log in with their username and password. The UI elements on the screen are optimized to ensure the player can quickly log in and seamlessly enter the game. The user interface can be rearranged and customized to facilitate in-game user interaction and provide a smooth experience.

Figure 7. *Player login or entry screen*

B.3.3. User Settings Interface

The settings interface, which allows players to customize certain in-game parameters, is designed to provide a more comfortable experience for players. This interface allows users to modify basic settings such as volume level and sensitivity. The screen shown in Figure 5 provides all the necessary tools for changing and saving in-game settings. The Volume Slider added for volume control enables the player to dynamically adjust the sound level, and these values are saved using PlayerPrefs [25]. As a result, settings can be reloaded according to the player's preferences in each session.

Figure 8. *Player settings interface*

B.3.4. Inventory Interface

The inventory interface, created to allow players to visually track the items they have collected, enables users to easily view in-game items. Players can access this screen by pressing the ‘I’ key on the keyboard. The inventory screen has a simple structure that lists the names and descriptions of the collected items. Additionally, by clicking on each item, players can obtain more detailed information about it. The interface shown in Figure 6 aims to provide a comfortable experience for the user by presenting the collectible items in an organized manner.

Figure 9. *Inventory screen used for item management*

B.3.5. Decision-Making Interface

The decision-making interface, which the player will use in the final stage to find the culprit, provides an interactive screen that allows the player to view information about the evidence and suspects they have collected. This screen enables players to compare the evidence gathered for each suspect. The evidence is listed in a scrollable section of the screen, and detailed access is provided for each piece. This helps players carefully examine each piece of evidence and make the correct decision. The interface clearly visualizes and organizes the evidence, allowing the player to make an informed decision. Figure 7 shows this decision-making interface.

Figure 10. *Interactive decision screen where the player selects the suspected killer*

IV. CONCLUSION AND DISCUSSION

This study comprehensively addressed the development of a mystery and thriller-themed detective game on the Unity platform, based on convergent thinking. Players focus on using convergent thinking to identify the culprit and strive for success. This study examined the integration of convergent thinking into the game design process through the development of a story-driven mystery and thriller game and demonstrated how this thinking approach can play a constructive role in interactive digital experiences. Convergent thinking allows the player to establish logical connections between numerous clues, events, and interactions, make consistent decisions, and progress toward the goal, thereby increasing the game's mental depth.

In the developed game example, the detective theme is integrated with a plot and puzzle-based task structure, continuously guiding the player to analyze, collect data, and synthesize information. In this respect, the game not only provides an enjoyable experience but also transforms into a learning environment that enhances the player's cognitive skills and strengthens their decision-making processes. In future studies, games can be developed that use multiple types of thinking to reach a conclusion. This will enable the design of richer cognitive experiences and more dynamic player decision-making processes.

As a result, this study aims to serve as a comprehensive guide for developers who wish to create a 3D story-driven game on the Unity platform by detailing the processes involved in creating a game that incorporates convergent thinking. It provides a novel contribution that has not been previously addressed in the literature in this way. In this aspect, the study offers theoretical contributions and aims to bring applicable innovations to educational and decision-making processes.

Article Information

Author's Contributions: Fatma Nur Işık: Conceptualization, Algorithm development, Prepared the figures, Wrote the initial manuscript. **Ece Karakoç**: Conceptualization, Algorithm development, Prepared the figures, Wrote the initial manuscript. **Ferhat Demiray**: Conceptualization, Supervision, Edited and wrote the final manuscript.

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Conflict of Interest Disclosure: The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Plagiarism Statement: This article was scanned by the plagiarism program.

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