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SCHOOL OF ENGINEERING
DEPARTMENT OF ELECTRICAL AND COMPUTER ENGINEERING

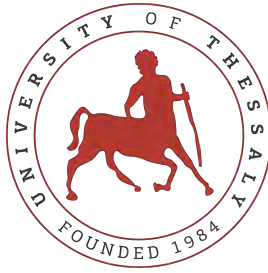
**Design and development of an educational
game/environment for contact with history and culture
using the Unity platform**

Diploma Thesis

Makris Dimitrios-Konstantinos

Supervisor: Tsalapata Hariklia

January 2024



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ΠΑΝΕΠΙΣΤΗΜΙΟ ΘΕΣΣΑΛΙΑΣ

ΠΟΛΥΤΕΧΝΙΚΗ ΣΧΟΛΗ

ΤΜΗΜΑ ΗΛΕΚΤΡΟΛΟΓΩΝ ΜΗΧΑΝΙΚΩΝ ΚΑΙ ΜΗΧΑΝΙΚΩΝ ΥΠΟΛΟΓΙΣΤΩΝ

**Σχεδιασμός και ανάπτυξη εκπαιδευτικού
παιχνιδιού/περιβάλλοντος για επαφή με την ιστορία και τον
πολιτισμό με χρήση της πλατφόρμας Unity**

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Diploma Thesis

Design and development of an educational game/environment for contact with history and culture using the Unity platform

Makris Dimitrios-Konstantinos

Abstract

The integration of educational video games into the learning environment has gained significant momentum, with educators recognizing their potential to engage students in immersive and interactive learning experiences. This thesis focuses on the design and development of an educational game/environment aimed at fostering contact with history and culture. Leveraging the capabilities of the Unity platform, this work represents a novel approach to combining technological innovation with pedagogical objectives. The proposed educational game seeks to create an engaging and immersive environment where learners can explore historical and cultural contexts. Through interactive storytelling, rich 2D and 3D graphics, and captivating gameplay mechanics, the game invites students to step into different time periods and cultures, effectively bridging the gap between the classroom and the past. The thesis' impact on education is two-fold: first, it offers an engaging and interactive medium for learning, enhancing students' motivation and retention. Second, it underscores the potential of the Unity platform in creating educational content that transcends traditional classroom boundaries. As we advance towards a future where technology plays an integral role in education, the fusion of educational video games and Unity platform holds promise for enriching the pedagogical landscape and fostering a deeper understanding of history and culture. The game's name is "XploreNation", and was developed with the exclusive use of the Unity Platform and its multifunctional Asset Store. Simultaneously, many gamification elements have been applied, and the creation of a contemporary environment for player interaction with the game has been prioritized including a presentation of all the ideas required to comprehend the structure and progression of an application like this with particular attention to educational/serious games.

Keywords:

Game Development, Education, Video Games, Unity Engine, Game Design, History, Culture,

Educational Games

Διπλωματική Εργασία

Σχεδιασμός και ανάπτυξη εκπαιδευτικού παιχνιδιού/περιβάλλοντος για επαφή με την ιστορία και τον πολιτισμό με χρήση της πλατφόρμας

Unity

Μακρής Δημήτριος-Κωνσταντίνος

Περίληψη

Η ενσωμάτωση των εκπαιδευτικών βιντεοπαιχνιδιών στο μαθησιακό περιβάλλον έχει κερδίσει σημαντική δυναμική, με τους εκπαιδευτικούς να αναγνωρίζουν τις δυνατότητές αυτών να εμπλέξουν τους μαθητές σε καθηλωτικές και διαδραστικές εμπειρίες μάθησης. Η παρούσα διατριβή επικεντρώνεται στο σχεδιασμό και την ανάπτυξη ενός εκπαιδευτικού παιχνιδιού/περιβάλλοντος που στοχεύει στην ενθάρρυνση της επαφής με την ιστορία και τον πολιτισμό. Αξιοποιώντας τις δυνατότητες της πλατφόρμας Unity, το έργο αυτό αντιπροσωπεύει μια νέα προσέγγιση συνδυάζοντας την τεχνολογική καινοτομία με παιδαγωγικούς στόχους. Το προτεινόμενο εκπαιδευτικό παιχνίδι επιδιώκει να δημιουργήσει ένα ελκυστικό και καθηλωτικό περιβάλλον όπου οι μαθητές μπορούν να εξερευνήσουν ιστορικά και πολιτιστικά πλαίσια. Μέσα από διαδραστική αφήγηση, πλούσια 2D και 3D γραφικά, και τη μαγευτική μηχανική του παιχνιδιού, το παιχνίδι προσκαλεί τους μαθητές να μπουν σε διαφορετικό χρόνο περιόδων και πολιτισμών, γεφυρώνοντας ουσιαστικά το χάσμα μεταξύ της σχολικής τάξης και του παρελθόντος. Ο αντίκτυπος της διατριβής στην εκπαίδευση είναι διπλός: πρώτον, προσφέρει ένα ελκυστικό και διαδραστικό μέσο για μάθηση, ενισχύοντας τα κίνητρα και την προσοχή των μαθητών. Δεύτερον, υπογραμμίζει τις δυνατότητες της πλατφόρμας Unity στη δημιουργία εκπαιδευτικού περιεχομένου που ξεπερνά τα όρια της παραδοσιακής σχολικής τάξης. Καθώς κατευθυνόμαστε προς ένα μέλλον όπου η τεχνολογία διαδραματίζει αναπόσπαστο ρόλο στην εκπαίδευση, η συγχώνευση των εκπαιδευτικών βιντεοπαιχνιδιών και η πλατφόρμα Unity υπόσχονται εμπλουτισμό στο παιδαγωγικό τοπίο και την ενίσχυση της βαθύτερης κατανόησης της ιστορίας και του πολιτισμού. Το όνομα του παιχνιδιού είναι "XploreNation" και αναπτύχθηκε με την αποκλειστική χρήση της πλατφόρμας Unity και το πολυλειτουργικό Asset Store της. Ταυτόχρονα, έχουν εφαρμοστεί πολλά στοιχεία παιχνοποίησης και η δημιουργία ενός σύγχρονου περιβάλλοντος για την αλληλεπίδραση των παικτών με το παιχνίδι έχει αποτελέσει προτεραιότητα, συμπεριλαμβανομένης της παρου-

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Λέξεις-κλειδιά:

Ανάπτυξη Παιχνιδιών, Εκπαίδευση, Βιντεοπαιχνίδια, Μηχανή Unity, Σχεδιασμός Παιχνιδιών, Ιστορία, Πολιτισμός

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Chapter 1

Introduction

In the ever-evolving landscape of digital entertainment, video games have transcended their initial role as mere sources of leisure and escapism. Today, they have emerged as powerful tools capable of facilitating learning, fostering critical thinking, and providing immersive experiences that extend beyond the realm of entertainment. This report delves into the realm of educational gaming and serious games, exploring their profound impact on knowledge acquisition and presenting a firsthand account of the creation of a video game designed to delve into the annals of history and civilization.

Educational gaming represents a transformative intersection of technology and pedagogy, where the traditional boundaries of learning are expanded through interactive and engaging experiences. These games are strategically designed to educate players while captivating their attention, thereby creating an environment conducive to effective knowledge acquisition. The integration of educational content into gaming narratives has opened up new avenues for educators and learners alike, providing an innovative approach to disseminating information [1].

This thesis is divided into several sections, each one providing significant and various information regarding its subject. Particularly, in the second section video games and their history is discussed, and more generally the idea of serious gaming, by emphasizing on the impact they have originated in the field of education and learning processes. Additionally, the third section focuses on educational gaming, and specifically game genres that include history and civilization, by stating numerous examples and providing details about its current state and benefits it could provide in the modern world. In the fourth section, the Unity game engine is presented, in which this game was developed, with an emphasis on the engine's

capabilities, its past applications and the UI (User Interface) environment. The fifth part of this report prioritizes the steps that were followed regarding the design and development of the game "XploreNation", while presenting screenshots, explaining the logic and the reasons behind its way of implementation, the audience that it is addressed to as well as some of its code snippets that are deemed somewhat interesting. Conclusively, in the sixth and final section, the epilogue, an overview of "XploreNation" is provided, along with the future plans that consider it.

Chapter 2

History and culture in education

In the following section, the concept of History and Culture in Education is referenced, its fields are analyzed and a historic view is presented, as well as a comparison of its Universal state against the state in Greece and of course the benefits that stem from this particular method in education for students.

2.1 Definition

While there is no particular definition of this type of education, there is an interdisciplinary approach that integrates history, cultural studies, ethics, and other relevant disciplines which is referred to as HCEM (History, Culture, Ethics and Multidisciplinary) studies. By giving students a thorough understanding of the historical and cultural underpinnings that shape societies, the HCEM approach aims to produce knowledgeable and culturally competent people.

2.2 Fields of HCEM

The main key elements of and HCEM approach, can be defined more thoroughly below:

- **History:** focusing on comprehending historical developments, events and how they affected societies, while stressing the importance of critical thinking and historical source analysis.
- **Culture:** investigating the many cultures that have influenced humankind and/or studying language, literature, art and other forms of cultural expression.
- **Ethics:** incorporating moral questions into the curriculum and motivating students to investigate the moral implications of historical occurrences and cultural customs and

encouraging dialogue about moral decision-making and responsible citizenship.

- **Multidisciplinary Studies:** promoting the interdisciplinary study of sociology, anthropology, philosophy, geography and other fields in order to provide a comprehensive understanding of historical and cultural phenomena.

Even though these definitions can be considered the main and more established descriptive terms there is much more in them. Specifically, this report focuses mainly on the first two, History and Culture, which can also be found to be the most prevalent and also interconnected, as culture is both a reflection of historical change and cultural conservatism and consistency whilst culture at one historical moment is linked to culture at another historical moment [2].

2.3 Brief historical review

The Greeks and Romans established the foundation for a comprehensive educational system that included literature, philosophy, and the arts, which is where the humanities in education have their roots. Universities in Europe carried on this tradition during the Middle Ages by stressing the trivium and quadrivium as foundational subjects. Classical education saw a revival during the Renaissance, which supported humanism and sparked a fresh interest in literature, history, and the arts. Political science and sociology are just two examples of the disciplines that have been added to the humanities as a result of the Enlightenment's emphasis on individualism and reason in education.

The humanities continued to develop in the 19th century as a result of shifting social mores and the rise of new academic fields like anthropology and psychology. The humanities continued to diversify in the 20th century, adopting an interdisciplinary approach and emphasizing cultural studies and critical thinking. Humanities education is now a vital component of academic institutions all over the world, encouraging critical thinking, cultural awareness, and an appreciation of the complexity of the human experience. The humanities' long history in education serves as a reminder of the subject's continuing importance in developing well-rounded people who can successfully navigate the challenges of the contemporary world.

In summary, the evolution of humanities education over centuries is a rich tapestry that captures the dynamic nature of human intellectual endeavors. The humanities have always been a vital component of education, from the foundations set by the ancient philosophers to the Renaissance's resurgence of classical learning and the current focus on interdisciplinary studies. The humanities continue to be relevant and useful in preparing students for the chal-

allenges of the twenty-first century by providing them with a comprehensive understanding of culture, history, and ethics. Through the study of philosophy, literature, and the arts, people can cultivate a nuanced understanding of the human condition, critical thinking abilities, and cultural empathy. The way humanities education has developed over time is evidence of its adaptability and resilience, guaranteeing that it will continue to shape people who are curious and well-rounded for many years to come.

2.4 HCEM and humanities in education today

The most recent indication of the decline in the humanities in American higher education is the decrease in enrollment from 17.2 percent of degrees in 1967 to 6.5 percent in 2013, with the declining number of academic positions available in this discipline serving as additional evidence of this decline. Although many causes can be numbered for this impairment, two are the main factors, (a) prioritizing STEM fields (science, technology, engineering, and mathematics) has resulted in an increase in student enrollment and funding from academic institutions, governmental bodies, and commercial enterprises, thereby undermining the humanities and (b) the decline in confidence shown by humanities professionals themselves as they seem to have not been able to convince the public, administrators, colleagues, or students of their value [3].

However, programs in Humanities Education and LAE (Liberal Arts Education) in general have expanded to 58 non-US countries in recent years, with a greater emphasis on Asia. According to a cross-country case study, LAE colleges use high-impact, multidisciplinary, and interdisciplinary teaching methods to foster the organization's core values. This is consistent with the general education core curriculum model. Although there are some similarities in these programs, they present unique regional characteristics. For example East Asian societies tend to place a greater emphasis on the whole-person perspective, which is a reflection of Confucian traditions while the application and adaptation of LAE in European contexts, including the UK, Germany, and the Netherlands, primarily show off a highly interdisciplinary model.

Furthermore, diverse organizations engage in dynamic interactions through research, advocacy, and collaborative efforts to shape the global landscape of Liberal Arts Education (LAE). Initiatives for teaching, research, and communication among member institutions are greatly aided by regional consortia like the Alliance of Asian Liberal Arts Universities (AALAU) and global alliances like the Global Liberal Arts Alliance (GLAA) across national

and cultural boundaries, proving how this multitude of initiatives highlights the global commitment to whole-person education [4].

2.5 State of humanities and social sciences in Greece today

In Greece, although there has been signs of increased activities in STEM programs, regarding Science, Technology and Mathematics, and high participation in student programs in Humanities and Social Sciences things don't appear to be positive when it comes to scores and performance which highlights the importance of the need to further support the initiatives happening for Liberal Arts Education, as it was stated above.

According to PISA (2022) Greece is ranked 40th out of 81 countries participated, and while the results focus on mathematics and science, there is evidence about reading, which can be referenced when discussing about social sciences, showing decrease by 38.5 and 19.0 in mean performance from 2012 to 2020 and from 2018 to 2022 respectively [5]. On the contrary, further research from OECD (Organisation for Economic Co-operation and Development) and partner countries where data is available, the proportion of international doctorates in the humanities and arts is among the highest (24.2%, position 2/38, 2021) and the proportion of students enrolled in the arts and humanities is comparatively high (16.4%, position 5/36, 2021), however, the percentage of recent graduates entering doctoral programs in the social sciences, journalism, and information is comparatively low (5.9%, position 35/37, 2021) [6].

Moreover, according to the Authority for Quality Assurance in Primary and Secondary Education (or Αρχή Διασφάλισης Ποιότητας στην Πρωτοβάθμια και Δευτεροβάθμια Εκπαίδευση, Α.ΔΙ.Π.Π.Δ.Ε in Greek) the 2019 study results show that the percentages of students from the 2nd grade of Secondary Education in 2017-2018 academic years who got below baseline in modern Greek language and History courses were 4.36% and 14.83% respectively [7]. Although these percentages are significantly lower than the ones regarding Sciences, Technology and Mathematics they still provide an indication that there are measures to be taken so that Greece can significantly accelerate its pace towards modern and qualitatively upgraded education.

2.6 Benefits of HCEM and social sciences in education

The advantages of STEM education for the individual are clear; they are founded on STEM principles and can support students in many facets of their lives, beyond the profes-

sional. These benefits extend beyond those to the nation's economy and larger society. The primary ones include:

- **Critical Thinking and Analytical Skills:** Students who study the humanities are encouraged to think critically, evaluate sources, and construct persuasive arguments. For example, studying philosophy, literature, and history improves one's capacity to weigh the available information, take into account different viewpoints, and render well-informed decisions.
- **Cultural Understanding and Empathy:** Students who study humanities are exposed to a wide range of cultures, viewpoints, and historical settings. This exposure promotes empathy, diversity appreciation, and cultural understanding and also fosters tolerance and an appreciation of various points of view in students.
- **Communication Skills:** Learning humanities subjects, such as rhetoric and literature, improves one's ability to communicate both orally and in writing, providing students with skills in clear self-expression, idea articulation, and meaningful conversation.
- **Ethical and Moral Reasoning:** Examining moral and ethical issues is a common part of humanities education as it allows pupils to interact with philosophical ideas and moral conundrums, encouraging the growth of moral reasoning and ethical decision-making abilities.
- **Creativity and Innovation:** Humanities fields that foster imagination and creativity include literature and the arts since they are necessary for both innovation and problem-solving, proving them to be valuable skills in many different professional domains.
- **Historical Awareness:** Learning about history gives people a sense of continuity and enables them to comprehend the societal issues' historical roots, encouraging historical consciousness and allowing students to relate historical occurrences to current issues.
- **Personal Growth and Self-Reflection:** Education in the humanities promotes introspection and personal development as people are frequently prompted to reflect on their values, beliefs, and place in the world by literature, philosophy, and the arts, which helps them become more self-aware and self-discovering.

- **Interdisciplinary Thinking:** By tying concepts from different disciplines together, humanities education promotes interdisciplinary thinking. This method helps students grasp complex problems holistically and gets them ready for the interconnected nature of today's world.
- **Global Citizenship:** Education in the humanities helps create knowledgeable and active global citizens as it raises awareness of global issues and cultivates a dedication to environmental sustainability, human rights, and social justice.
- **Lifelong Learning:** Last but not least, humanities education imparts perspectives and transferable skills that are useful in a variety of settings providing students with a flexibility that encourages a lifelong learning philosophy, empowering people to navigate a world that is changing quickly.

Chapter 3

Video games and serious gaming

In the first part of this section reference is made to Video Games along with historical facts, historical milestones, their current state, and their various categories. In the second part of the section, games that aren't meant to be entertaining are presented, and specifically the ones defined by the term "serious games". A special emphasis is placed on the advantages of serious games for education within the particular sector, as well as a number of gamification techniques and how they are applied to the learning procedure. Lastly, the section concludes with how everything that has been discussed is integrated into the History/Civilization gaming industry as well as some examples of such serious games.

3.1 Definition of video games

With more than 50 years in the business, video games have ingrained themselves into our culture. However, we have only been examining video games in depth for a short while. In light of this circumstance, we could apply current scholarly research to new design techniques and novel scientific perspectives on the video game industry. Possibly the first step would be to define the term "video game." We are aware of precise definitions for this term, but many of them are either excessively draft to include into some academic research, or they are too general and don't really capture the context. A brief and straightforward explanation of what a video game is, is the following:

"A videogame is a type of game that we can play using an audiovisual device and that may have a narrative at its core" [8].

3.2 Brief history of video games

Despite being a relatively recent phenomenon, video games profited from their close association with the well-established amusement industry. If anyone helped to establish the foundation for the modern computer and video game industries, it would be David Gottlieb. In 1931, he invented the game "Baffle Ball" [9] after realizing the ideal ratio between skill and chance. Baffle Ball was an electric-free game that wasn't much like pinball nowadays. It had just one moving part, the plunger, and was installed in a countertop cabinet. Using a plunger, players launched balls onto a plane that had eight holes, or "scoring pockets", surrounded by pins at a 7-degree slope. Although this was not the only game that had been developed



Figure 3.1: Baffle Ball Coin Op Pinball - The first Pinball type game

at the time (there are elements of many other games even before the Baffle Ball, sometimes involving even cards, e.g Hanafuda - Japanese cards) it had a significant impact, as David Gottlieb became the first individual to manufacture pinball machines in large quantities in a factory and paved the way for other massive productions of games that occurred in the following years.

It is noteworthy that the first digital computers were finished in the early 1940s, but the

first computer games weren't released for almost ten years. Particularly, in 1951 Martin Bromley purchases the only form of electronic entertainment at the time, the pinball machines and places them in Unit Entertainment Centers in American camps in Hawaii, while at the same time he founds SEGA (Service Games), a company soon to play a crucial role to the development of the Video Game Industry. The gathering of these electric-mechanical devices in a single place served as the forerunner of the well-known electronic game stores, or "Arcades", which dominated the Video Game industry until the 1980s, eventually giving rise to the video game market as it is today [10].

Numerous occasions throughout their history have influenced and guided the creation of numerous video games and stations. Among the most important ones are:

- A.S. Douglas made the first graphic video game ever as part of his PhD thesis at the University of Cambridge in **1952**.
- In **1970** Nolan Bushnell, who later founded ATARI, released the first coin-operated slot machine in electronic stores, where a variation of "Spacewar!" was being played.
- The "Magnavox Odyssey," the first home gaming system, is introduced in **1972**.
- In **1976**, the first public debate about Video Game violence began.
- In **1977**, Nintendo recruited a young artist named Shigeru Miyamoto and together they worked on the creation of the iconic Video Games "Mario", "Legend of Zelda" and "Donkey Kong", which revolutionized and established the Video Game Industry.
- In **1979**, "Asteroids", the first game that maintained high scores and the player's initials was released on the market.
- When Dona Bailey creates Atari's iconic "Centipede" in **1981**, she breaks the mold of the male-dominated industry and opens the door for other gifted women to follow.
- In **1982**, Midway released the first video game based on a movie, specifically the Disney movie "Tron".
- Perhaps the most played game ever, "Tetris," was invented in Russia in **1985** by Alexey Pajitnov and has since been released on all major gaming platforms.
- In **1989**, Nintendo introduced the "Gameboy", the first successful handheld game console to be sold commercially.

- The release of "Doom" in **1993** established the benchmarks for modern multiplayer games.
- In **1994** Sony released its own game console, which it named "PlayStation".
- With the release of Blizzard's "World of Warcraft" in **2004**, the internet became one of the most popular gaming platforms, with over 12,000,000 users worldwide.
- In **2007**, Microsoft released "Halo 3", making the first video game with a budget on par with a feature film.
- Around **2010**, with the help of cloud gaming services like NVIDIA GeForce Now, Microsoft xCloud, and Google Stadia (2019), playing games via the internet instead of relying solely on powerful local hardware became possible.
- Between **2016-2019**, launch of Virtual Reality Headsets, such as the Oculus Rift (2016), HTC Vive (2016), and PlayStation VR (2016) helped Virtual Reality (VR) to evolve, offering immersive gaming experiences.

3.3 Current state of video games

Video games today are widely available on a variety of platforms, including consoles, computers, and mobile phones, and are now regarded as an acceptable form of entertainment alongside movies, books, and music. They are studied because of the potential aesthetic and educational value and are now played by people of almost all ages and enhance the social interaction of a sizable portion of the population.

3.3.1 Video games during the 2010s

By the end of 2009, games were more widely available everywhere. Gaming laptops and PCs are in high demand due to their superior build quality and hardware specifications. Technological developments in hardware, software and internet networks have also brought about new methods of device connectivity, allowing users from either computers, mobile phones or consoles to enjoy the perks of cross-play technology. One major instance is the multiplayer game "Fortnite", which debuted in 2017, attracted over 100 million players and set a record for the highest annual earnings for a video game ever with \$2.4 billion in revenue. Another way to characterize this era is as the **game launcher** era. The majority of large companies

have constructed their own digital distribution networks, following Steam's success. Companies like Epic Games, Electronic Arts and Blizzard Entertainment have restricted access to their games to their own proprietary game launchers, Battle.net, Origin and the Epic Game Store, respectively. Although they still sell popular game titles, platforms like Steam and Good Old Games (GoG) are more accommodating to independent developers [11].

3.3.2 Video Games from the beginning of 2020

Moving on to the current decade, the video game is focusing on photorealistic graphics and ray-tracing which is made possible by the new graphics cards and the ninth generation console, which include "PlayStation 5", "Xbox Series X and Series S" and their hardware supporting the aforementioned features. Additionally, the integration of Artificial Intelligence (AI) has emerged as a significant player in the rapidly changing interactive entertainment industry, pushing the boundaries of games and user experiences, with one of most intriguing aspects of this fundamental transformation being Procedural Content Generation (PCG), a technique that uses machine learning algorithms to create video game content dynamically [12]. Additionally, video games today are being highly incorporated in more serious matters, such as education and sometimes even in medicine sciences as a means of improving patient participation in recovery, increasing the chance that they will continue therapy after their progress stalls, and generally enhancing mental health while undergoing treatment [13].

3.4 Video game genres

A video game's informal classification according to gameplay mechanics, as opposed to graphics or storyline, is called a genre, with the ones most commercially successful being the following:

- **Action/Adventure:** Games from this genre place their emphasis on exploration, puzzle-solving, and narrative-driven gameplay. They often feature a mix of combat and non-combat challenges. Some examples include "The Legend of Zelda: Breath of the Wild" (Nintendo, 2017) and "Uncharted 4: A Thief's End" (Naughty Dog, 2016).
- **First-Person Shooter (FPS):** These games are viewed from the protagonist's perspective, with a focus on shooting and combat mechanics. They include fast-paced action, and sometimes even multiplayer modes. Main examples consist of "Call of Duty: Modern Warfare" (Infinity Ward, 2019) and "Overwatch" (Blizzard Entertainment, 2016).

- **Battle Royale:** These games include a Last-person-standing gameplay in a shrinking play area. Players scavenge for weapons and items, with the gameplay combining survival, exploration, and intense combat. Notable examples are "Fortnite" (Epic Games, 2017), "PlayerUnknown's Battlegrounds (PUBG)" (PUBG Corporation, 2017).
- **Riddles/Puzzles:** In these types of games the player, without particular controlling a specific character is asked to solve a series of puzzles, usually in a limited period of time or with increasing difficulty. Some such examples are "Lumines" (Q Entertainment, 2004), "World of Goo" (2D Boy, 2008) and "Peggle" (PopCap Games, 2007).
- **Role-Playing Game (RPG):** These are mainly character development games, with narrative-driven gameplay, and a focus on player choices. They are often set in expansive, immersive worlds with quests and exploration. Famous examples include "The Elder Scrolls V: Skyrim", (Bethesda Game Studios, 2011) "Final Fantasy XV" (Square Enix, 2016).
- **Sports Simulation:** This category consists of realistic simulations of sports, including accurate player movements, strategies, and statistics, which often contain career modes and multiplayer options, such as the "FIFA" series (EA Sports, Various Years) and the "NBA 2K" series (Visual Concepts, Various Years).
- **Open-World/Sandbox:** Expansive, non-linear world games for exploration and interaction. Players have freedom to choose activities and quests, often with emergent gameplay. Some examples include "Grand Theft Auto V" (Rockstar Games, 2013), "Minecraft" (Mojang, 2011).
- **Strategy (Real-Time and Turn-Based):** Planning and decision-making are a central part in these games. Real-time strategy games involve simultaneous actions, while turn-based allow players to take turns in a strategic manner. A real-time strategic game is "StarCraft II" (Blizzard Entertainment, 2010) while a turn-based is "Civilization VI" (Firaxis Games, 2016).
- **Simulation:** Simulation games attempt to replicate activities and experiences from the real world in a virtual environment, as faithfully as possible. Some examples are "Real Racing" (Firemint, 2009), "Forza" series (Turn 10 Studios, Playground Games, Sumo Digital, 2005, 2023) and "The Sims" (EA, 2014-present).

- **Horror/Survival:** Finally, these games focus on creating fear and tension and often involve limited resources, vulnerable protagonists, and atmospheric storytelling. Most popular examples include "Resident Evil 7: Biohazard" (Capcom, 2017) and "Amnesia: The Dark Descent" (Frictional Games, 2010).

3.5 Non-entertainment video games

Regarding the majority of the population, the concept of Video Games, or Games in general, is linked with entertainment and amusement. But beyond this widely popular perception of Video Games there is a wide range of applications that use this medium as a tool for learning, training, practice, advertising, awakening and informing the public, or sometimes even for propaganda and proselytism.

Video games for entertainment are very popular with younger audiences. However, as a tool for digital game-based learning, they are still hardly studied, even though they have the potential to enhance cognitive functioning [14]. For instance, they can improve spatial perception and teach hand-eye coordination but can also be used to develop more than physical skills. They offer a secure environment where the player can try new things, get better, fail, without his failing having a realistic impact, but aiding in the learning procedure.

A thriving subset of the gaming industry emerged in the 1990s, known as edutainment—a term derived from the merging of education and entertainment. This domain was able to incorporate learning and gaming, something that even the US military took advantage of, using these characteristics of video games to provide a secure training environment for its soldiers.

Since then, video game use for purposes other than amusement has expanded significantly outside of homeschooling and the military. Large sums of money are currently invested in an entire industry dedicated to creating "serious" video games—that is, games whose primary goal is not amusement.

3.6 Definition of serious games

Even a brief examination of the literature quickly reveals that there appear to be many definitions, but most concur on the fundamental definition: serious games are (digital) games that are played for purposes other than mere entertainment-amusement [15]. The term "serious" is used to justify the usage of these games in a wide range of non-entertainment industries, including the military, government, education, business and healthcare. How serious games

differ from entertainment games is a good question to ask. For serious games, solving a problem using the game model or simulation is more crucial than offering "rich experiences" that die-hard players are looking for. Furthermore, in order for a simulation to be feasible, it must focus on the most crucial aspects of learning and make the necessary assumptions; otherwise the simulation will teach the incorrect kinds of skills. Conversely, leisure games enable players to concentrate on the enjoyable aspects and employ various strategies (such as time compression and random numbers) to streamline the simulation procedures.

3.7 Serious games in education

It is imperative to look into the impact of serious game-assisted learning given the growing use of technology in education. Reviewing the growing body of research on serious games is necessary to identify areas for future investigation and to identify the characteristics of well-received serious games. A review of the literature is also necessary for the designs of serious games and their educational applications, as this will help educators and designers do their jobs more effectively in the future [16].

Serious games' ability to uplift students' spirits could be one of the factors contributing to their success in the classroom. As a form of entertainment, gaming has a significant impact on how emotions like happiness, rage, and sadness are formed [17]. The effect of successful serious games is that they try to create a happy atmosphere to entice players to keep playing, which improves academic performance and increases interest in the game, whilst gamers who are content and engaged can easier achieve focus on meaningful game-assisted learning.

Although it's undeniable that serious games can play a ground-breaking role in enhancing the learning procedure, educators' reactions to the term "serious games" will vary based on their familiarity with and exposure to online gaming. Teachers and students must both become adept at playing digital games before they can successfully incorporate serious games into learning environments [18]. Following research on the barriers preventing educators from effectively utilizing video games in the classroom, Baek (2008) identified the following barriers:

- Parents and more seasoned teachers frequently worry that their children will develop a gaming addiction.
- Insufficient resources to assist educators in incorporating serious games into the classroom.

- A strict curriculum and set class schedules are two of the biggest barriers to teachers using serious games.
- Compared to their less experienced (younger) counterparts, teachers with more experience (older) are more opposed to the use of serious games in the classroom.

Specifically in Greece, the integration of Game-Based Learning (GBL) is more complicated. In particular, teachers noted a few potential challenges with implementing GBL in Greece, stating that the lack of enough equipment and the short class period are the main challenges. Additionally in Greece, unlike other nations like the US, where teachers have more control over how they teach their subject, the Ministry of Education makes the decision about the curriculum that will be studied.

However, it appears that GBL is used in a few exceptional master's or bachelor's degree programs, and to be more precise, this method of instruction is applied at the test level in the bachelor's program in sound and color arts at Ionian University (CNN Greece, 2018), where in order to pass a course, students are periodically asked to end a game. Moreover, the "Gamelearn" GBL platform has been made available in Greek educational settings as a result of "Gamelearn" and "Wide services" (Services) working together, a tool that is considered the world's most award-winning game-based learning platform for corporate training, improving soft skills (Gamelearn, 2012) [19]. Although, the need for alteration in Greece's educational system is major, and there are still actions to be done to achieve it.

3.8 Benefits of serious games in education

The use of serious games in education can offer a range of benefits, making learning more engaging and effective. Some of the most remarkable are:

- **Engagement and Motivation:** Students are drawn in by serious games because they offer engaging and entertaining learning opportunities. Students are more engaged overall because the gameplay component encourages them to actively participate in the instructional material.
- **Active Learning.** Playing serious games promotes experiential, hands-on learning. Through the active application of ideas and abilities in a simulated setting, students strengthen their comprehension.

- **Problem-Solving Skills:** Serious games often present challenges and scenarios that require critical thinking and problem-solving. Students learn to analyze situations, make decisions, and strategize, fostering the development of valuable problem-solving skills.
- **Immediate Feedback:** Serious games provide instant feedback on students' actions, allowing them to learn from their mistakes and make corrections in real-time. This immediate feedback loop enhances the learning process and promotes a deeper understanding of the material.
- **Retention of Information:** The interactive and immersive nature of serious games can contribute to better retention of information. The combination of visual, auditory, and interactive elements helps reinforce key concepts and improves long-term memory retention.
- **Customized Learning Paths:** Serious games can be designed with adaptive features, allowing for personalized learning experiences. The game can adjust the difficulty level based on individual progress, ensuring that each student learns at their own pace.
- **Real-World Application:** Serious games often simulate real-world scenarios relevant to the subject matter. This connection to real-world applications helps students see the practical relevance of what they are learning, making the content more meaningful.
- **Collaboration and Social Skills:** Many serious games incorporate collaborative elements, promoting teamwork and social interaction among students. Collaborative problem-solving within the game environment helps develop effective communication and interpersonal skills.
- **Accessibility and Inclusivity:** Serious games can be designed to accommodate various learning styles, making education more accessible for diverse student populations. This inclusivity ensures that students with different preferences and needs can benefit from the learning experience.
- **Data Analytics for Progress Tracking:** Serious games often incorporate analytics tools that track students' progress and performance. Teachers can use this data to identify areas of strength and weakness, allowing for targeted interventions and personalized support.

3.9 Gamification and its integration in education

3.9.1 Definition

If the term gamification is to be recognized in academia, it must be distinguished from earlier studies and be incorporated into already-existing fields. Therefore, we must first define the terms that are related to this definition in order to better understand gamification:

1. **Game:** While "playing" refers to free-form, expressive, improvisational behaviors and meanings, "gaming" is defined as rule-based playing with predetermined goals.
2. **Element:** While "serious games" are full-fledged games meant for purposes other than entertainment, gamified applications only incorporate game elements, that consist of both social and technical content but should also allow for imaginative interpretations and enactments rather than focusing on being playful.
3. **Design:** While the term "game design" is more broad, important aspects of it include game interface design patterns and game design principles and heuristics, the former meaning common, effective interaction design elements and design fixes, including prototype implementations, for a known issue in a context, and the latter focusing on guidelines for evaluating a design problem or a specific design solution.
4. **Non-game contexts:** Typically, game design elements are made with entertainment in mind. But in the case of gamification, these components are now applied to improve other applications in a manner akin to serious games [20]. Although, it is recommended against restriction of the definition of non-game context to any particular use, goals, situations, or media because (a) there is no obvious benefit to doing so and (b) serious games have evolved to fit into a variety of contexts even though their original purpose was primarily educational.

Conclusively, the definition of gamification can be summarized using the above terms as: "The use of game design elements in non-game context" [21].

3.9.2 Gamification of learning

Specifically on the context of education, gamification, or gamification of learning particularly, is an instructional strategy that uses elements of video games and game designs to

inspire students in learning environments. The main objective is to maximize enjoyment and engagement by drawing the students' interest and motivating them to continue learning.

Some game elements that can be used to motivate students and facilitate learning include:

- **Points and Rewards**
- **Leaderboards**
- **Levels and Progression**
- **Quests and Missions**
- **Storytelling and Narratives**
- **Immediate Feedback**
- **Collaborative Challenges**
- **Personalization**
- **Time Constraints and Urgency**
- **Competition and Challenges**
- **Real-World Applications**

The above-mentioned elements have proved to be encouraging students to consistently engage in the learning environment and activities. This is crucial, especially since the most common problems seem to be low student motivation brought on by little interaction between teachers and students. Thus, it has been implied that gamification has a greater impact on a learner's degree of participation than does on exam score, leading to the conclusion that longer learning sessions, along with higher participation rates, can improve academic performance and learning abilities. In this way, considering that test scores and engagement behaviors are positively impacted by the gamification strategy in a moderately positive way, it is considered vital that this procedure should be integrated more deeply in the learning and educational processes [22].

3.10 Serious games in HCEM education

It is acknowledged that one of the global pedagogical approaches needed for students in the twenty-first century is the use of digital games in the classroom as study findings have demonstrated that combining creative and expanded gaming with joint learning results in the acquisition of practical knowledge and the development of skills that are highly relevant for professionals. Even from the students' perspective, the conclusion drawn from a survey for the gamification of education using history as an example, in which 40 students from Sechenov First Moscow State Medical University and the Peoples' Friendship University of Russia participated, it was stated that gamification in history education positively influences the evolutionary development of a personality that is suited to the socioeconomic circumstances in this day and age [23].

Virtual worlds are already being used in the field of cultural heritage as well, giving the general public an immersive way to enjoy cultural content that is remote (both in space and time). This is the situation with many virtual museum applications, which provide the chance to visit a far-off location firsthand, handle delicate artifacts without running the risk of damaging them, get extra multimedia information and track cross-correlations in the information, observe virtual reconstructions of damaged remains, and much more. These applications are beneficial, but they still lack a strong mechanism to motivate the general public to participate in active learning, where they are encouraged to generate their own knowledge instead of passively absorbing it. On the other hand, this kind of involvement is visible in computer games that offer entertaining and captivating experiences and maintain the player's attention for extended periods of time [24], proving that the use of Serious Games should be an integral part of Humanities Education.

3.11 Examples of serious games in HCEM education

Some examples of Serious Games that can be used in HCEM Education are the following:

- **Civilization Series:** The Civilization series by Sid Meier is one of the most well-known examples. In games like Civilization VI, players guide a civilization from ancient times to the modern era, making decisions about diplomacy, technology, culture, and warfare.
- **Europa Universalis IV:** This expansive strategy game covers the main historical periods from the Middle Ages to the Enlightenment. Players control a nation and are able



Figure 3.2: Snapshot from Sid Meier's Civilization Series [25]

to oversee industries, trade, the armed forces, and technology.



Figure 3.3: Snapshot from "Europa Universalis IV" [26]

- **Total War Series:** The Total War series combines turn-based strategy with real-time tactics. Games like Total War: Rome II and Total War: Three Kingdoms allow players to lead historical factions in large-scale battles and manage their empires.
- **Anno Series:** Anno games, such as Anno 1800, blend city-building and economic simulation within historical settings. Players construct and manage cities during specific historical periods.

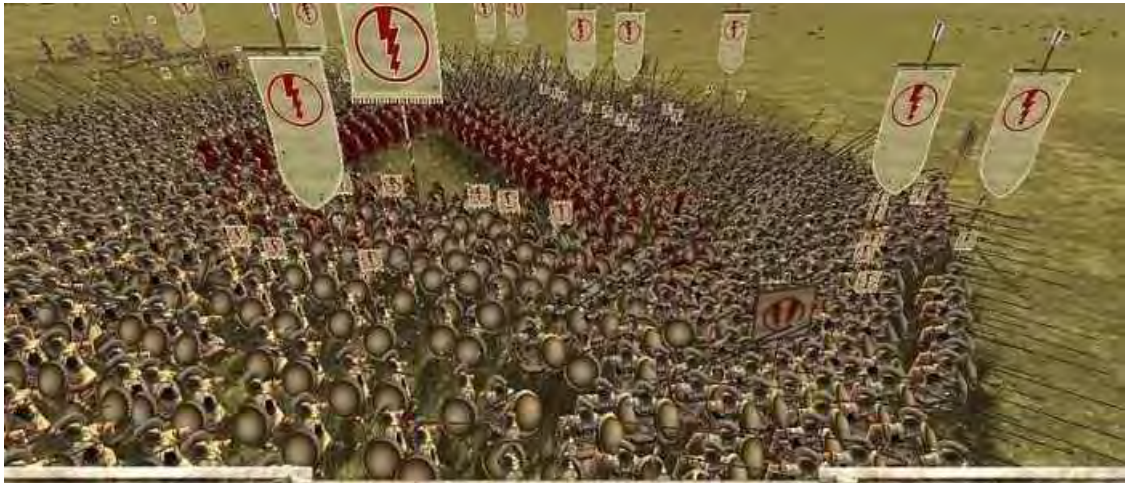


Figure 3.4: Snapshot from "Rome: Total War" [27]



Figure 3.5: Snapshot from "Anno 1800" [28]

- **Assassin's Creed Discovery Tour:** The Discovery Tour mode in the Assassin's Creed series offers an educational experience by allowing players to explore historical settings without combat. It provides information about the historical context, architecture, and daily life of different time periods.



Figure 3.6: Snapshot from "Assassin's Creed Discovery Tour" [29]

Chapter 4

Unity game engine

This section introduces game engines with an emphasis on Unity Game Engine. There are mentions of Unity's uses in a variety of industries, with a focus on the gaming industry. The kinds of games that can be created using Unity are also mentioned, along with particular instances. Subsequently, the Unity Editor environment is introduced and some concepts are quoted that the reader should be aware of in order to have a greater understanding of how Unity works internally. Finally, Unity's C# programming is covered, along with how games' sound effects and animations are created, finishing with reference at the crucial Asset Store that Unity provides.

4.1 Game engines

In the early days of the Video Game Industry every new video game was designed from the ground up because of hardware constraints. Years later, the idea of the game engine emerged as a result of the development of hardware and the requirement for quick game development cycles. A game engine is a software framework that is primarily intended for the creation of video games, typically coming with associated libraries and support applications.

By permitting code and game element reuse across games, a game engine's primary objective is to distinguish between features found in similar video games. In order to achieve this, it needs to include the following functionalities:

- A rendering engine, for 2D or 3D graphics.
- Input handling (for a keyboard and mouse, touch screen, other hardware, etc.)
- The internal program that recalculates game events every frame, known as the game loop.

- A physics engine equipped with response and collision detection.
- Sound.
- A scene graph, which controls the relationships between graphical elements on the screen.
- Animation (for 3D models or 2D sprites).
- Memory Supervision.
- Threading of processes (enabling several, concurrent processes).

Additional features could be:

- A high level programming language that is compatible with the game engine.
- Artificial Intelligence.
- Communication between the user and the server.
- Streaming.
- Assistance regarding localization.
- Publishing across multiple platforms.

Some of the most notable game engines are Unity, Unreal Engine and GameMaker [30].

4.2 Introduction to Unity

Since its initial release at the 2005 World Apple Developer Conference, the Unity game engine has significantly altered the video game industry. Its efforts to expand the scope of its target platforms are noteworthy, to start as it can now export to more than 25 platforms with the same code base. Another noteworthy aspect of Unity is its pricing as it allows independent developers and businesses with yearly sales under \$100,000 to use it for free. There is also a Pro version that offers several features for more advanced users, like low-level access to graphics processes and prefilters and GPU prefilters that are very helpful for resource optimization. Unity's versatility is demonstrated by its use in both large-scale AAA productions and smaller mobile games. In the video game industry, the term "AAA Games" designates high-profile, high-budget games that are usually created and released by major, well-known publishers. For this particular thesis, the free version of Unity was used.



Figure 4.1: Unity Engine's official logo.

4.3 The multidimensional nature of Unity

Unity is a platform for creating interactive content. Despite being more widely recognized as a game creation tool, its versatility and user-friendliness have allowed it to permeate numerous industries. Unity is a real-time engine that allows for completely interactive experiences for both the creator and the end user. "Real time" refers to the speed at which an image is rendered or shown on the screen. Unity facilitates rapid iteration and teamwork among creators, speeding up the development process and assisting the team in producing a final product that fully satisfies user needs. Although, as mentioned, Unity is a platform used mainly for creating Video Game, there are many other uses of Unity that prove what powerful multimedia tool it is [31]:

- **Interactive Experiences:** Interactive touch screen maps are taking the place of traditional maps in shopping malls; large movie theater chains allow ticket purchases to be made through kiosks; and McDonald's offers a touch screen experience for ordering food. To function, each of these solutions requires a robust multimedia platform which can be integrated with any back ends that these businesses currently have, by utilizing Unity's extensibility and its potent graphical features making it simple to visually stun audiences.
- **Animation:** Animated filmmakers are increasingly considering game engines as a vi-

able option. Although the industry is not there yet, It will eventually get to the point where real-time generated graphics and pre-rendered graphics are identical, considering the rate at which technology is progressing. Until then, Unity is a viable option for creating traditional animated films. When the powerful graphical features of Unity are combined with a timeline editor the ability to export frames individually and support supersampling allows users to work in real-time and also gives the possibility to automate tasks which saves time compared to manually animating these elements.

- **Previsualization for Film:** Although this seems fairly similar to Animation, they are not exactly the same. Making a live-action movie involves extensive pre-planning; often, the more planning, the better. While creating conventional storyboards is often a good place to start, it's also sometimes helpful to have a more accurate and realistic idea of how these scenes will appear. By taking advantage of Unity's tools and numerous features like settings, characters, props, and building tools, it is feasible to include real life elements to a virtual scene, allowing for a richer and more lifelike experience in Entertainment.
- **Architectural Visualization:** Massive amounts of complex geometry can already be handled by video game engines like Unity, which can also render surfaces and lighting that look realistic. It makes perfect sense to investigate virtual buildings for engineering and architectural purposes using a game engine such as Unity, as bringing data from 3D design software platforms into Unity and enhancing it with the powerful graphical features of Unity is a fairly simple process. Architects can utilize a game engine to create 3D experiences that can be accessed by clients via their desktop, mobile device, or web browser, rather than limiting their communication with them to concept renders and blueprints.
- **Simulations:** Video games are no longer only for amusement. For military and medical training, they can be extremely useful. Consider "Clinispace Virtual Sim Center", for instance. It's a collaboratively developed "serious game" that lets medical professionals practice clinical management and patient care in a virtual setting. Dealing with multiple scenarios prior to the real thing happening increases efficiency, and Unity's realistic graphical capability, ease of use, and extensibility make it perfect for industrial simulator development.

4.4 Examples of games made with Unity

Although Unity was first intended to be used only for creating games for Mac OS-based systems, twenty-four more platforms have been added over the years, including Xbox, PlayStation, Windows and Nintendo Switch. Unity is primarily meant for 3D game development, but 2D game creation is also possible with it. Some of the most notable examples of Video Games the Unity Engine is capable of making are the following [32]:

- **Angry Birds Series:** It is impossible to deny the Angry Birds series' success—very few video games are the subject of a full-length, feature-length movie. The game's idea is straightforward: launch birds into buildings in an effort to bring down the evil green pigs' constructions. Angry birds gives the player the chance to play in leagues, join guilds, and access an apparently limitless number of stages.



Figure 4.2: Snapshot from "Angry Birds" [33]

- **Beat Saber:** Beat Saber could be considered one of the first Virtual Reality (VR) experiences, making its debut with as the Wii Sports of VR gaming. It's a winning combination of dazzling graphics, entertaining gameplay, and a fantastic soundtrack.
- **Subnautica Series:** It's inevitable to deny that Subnautica offers a breathtaking underwater environment and thrilling exploration of the unknown, proving another stunning example of what Unity-powered games can create, giving users the possibility to live an enormous experience while swimming in the ocean.
- **Pokemon Go:** Pokemon Go, is one of the most popular games released, receiving

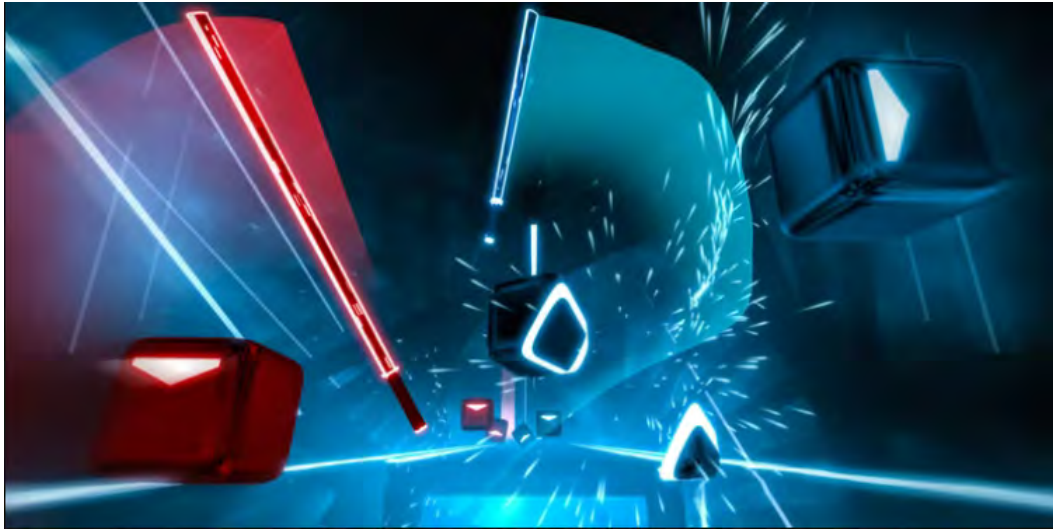


Figure 4.3: Snapshot from "Beat Saber" [32]



Figure 4.4: Snapshot from "Subnautica: Below Zero" [34]

updates in its content up to this day. Since the game's release, numerous user-friendly changes have been made, such as more spawn locations and enhanced PVP battles, while the 2020 Battle League fulfilled a long-held desire of players: a worldwide Pokemon league featuring various classes according to a Pokemon's Combat Power.



Figure 4.5: Snapshot from "Pokemon Go" [32]

- **Cuphead:** Last but not least, among the most played games in the past ten years is Cuphead. This is partly because of the retro artwork in the game, which is reminiscent of Walt Disney and Max Fleisher's Silent Era cartoons. Cuphead is a 2D side-scrolling run-and-gun game that is reminiscent of classics like Mega Man and Contra. Cuphead's scrolling and animation are expertly handled by the Unity engine, which maintains a consistent 60 frames per second (24 frames per second for the animations).



Figure 4.6: Snapshot from "Cuphead" [32]

4.5 Unity's editor

The main User Interface Environment of Unity, used by developers is called Unity Editor. The most crucial windows are arranged in the Unity Editor's default layout to assist the user in performing common tasks. These windows are reviewed below [35]:

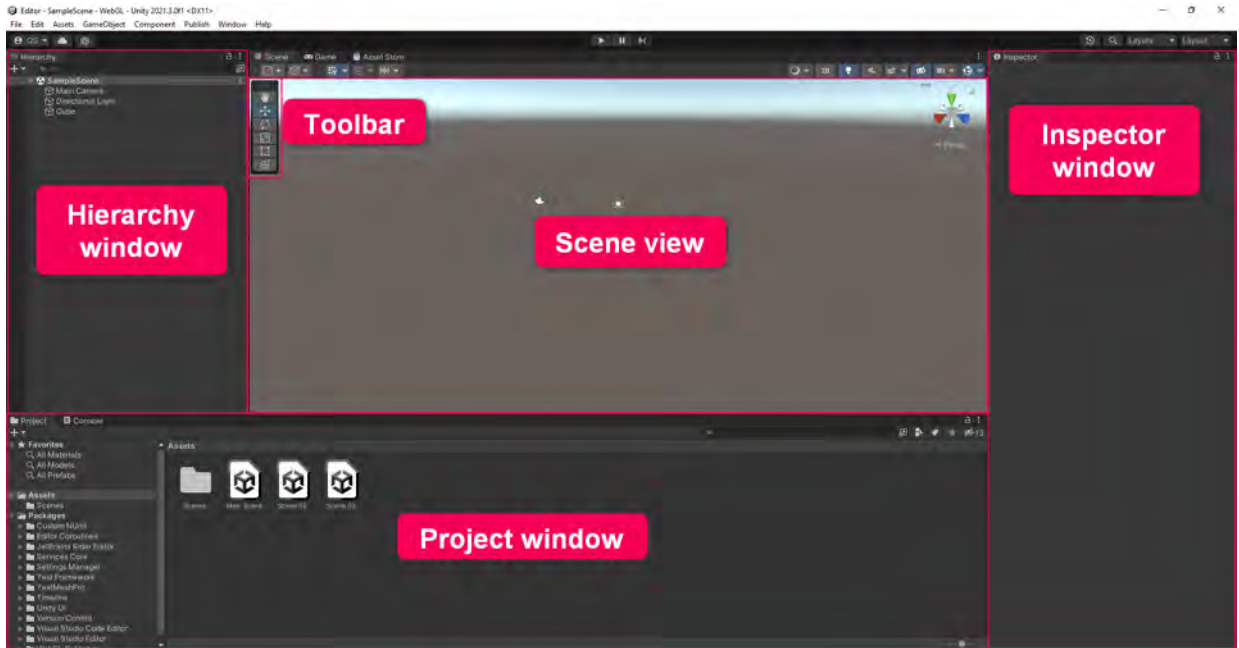


Figure 4.7: The five key areas of the basic Editor Interface

1. **Scene view and Game view:** The Scene view, which is the user's interactive window into the world they are creating and where they will manipulate objects and view them from different angles, is located in the center of the Unity Editor's default layout. This section of the default layout also has the Game view, which is used to playtest the game.
2. **Hierarchy window:** The user can arrange everything in their project using the Hierarchy. These are referred to as "GameObjects." A GameObject that is added to the user's project in Scene view will appear in the Hierarchy and will not be listed if it is removed from the scene.
3. **Project window:** All of the files, or assets, that are available for use in the user's project, whether they choose to use them or not, are listed in the Project window. The Project window functions similarly to a folder-based file explorer. Assets are added to the scene, by simply dragging them into the Scene view from the Project window. The difference between the Hierarchy and Project windows is that the assets available for

the entire project are all contained in the Project window, while all of the GameObjects in the current scene are contained in the Hierarchy.

4. **Inspector window:** Users are able to view and modify comprehensive GameObject information in the Inspector. A GameObject's components can be viewed in the Inspector when it is selected in Scene view or the Hierarchy. GameObjects' characteristics and actions are explained by their components.
5. **Toolbar:** To switch between points of view in the scene and to start and stop Play Mode, the toolbar buttons can be used. In the scene view, a floating toolbar houses the scene navigation features. Using these functions, the user can scale, rotate, and move the GameObjects that have been chosen.

4.6 Main elements of Unity's editor

Beside the main windows that Unity Editor's default layout consists of, there are a number of elements that are considered vital for the developer to take advantage of, in order to make the best out of the Editor. Some of the most important ones, are [36]:

- **Assets:** An asset is any object that can be utilized in the game or project. Certain assets might be imported from outside of Unity, meaning they come from a file that isn't included in Unity. For instance, a picture file, music file, 3D model, or any other kind of file that Unity supports. Additionally, there are some asset types that can be created within Unity, e.g an animator.
- **Projects:** A unity project isn't just one unity file; it's a group of files and dictionaries. All associative assets are contained in a project file, which may also include libraries and assets subfolders. The entire scene's functionality is included in the project, which may be found locally on the user's device or across Unity-affiliated clouds.
- **Packages:** Packages are simply collections of settings that are required for a project; they can be installed alongside the Unity editor or additional packages as needed. The packages that need to be installed are listed in the manifest for each project.
- **Scenes:** The Scene is an additional element included in the list of Unity's components. All of the items that are planned to be used at that level are contained in scenes. When a developer starts a new project, the scene window will only have the most basic elements (directional, camera, etc.). A default sample scene, as created is shown below [37]:

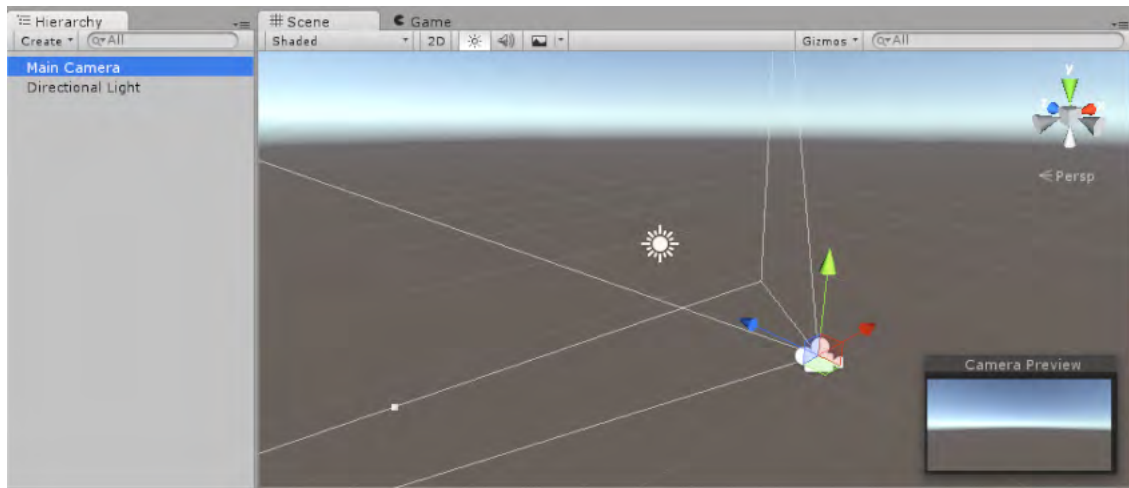


Figure 4.8: The default Unity sample scene, which contains a Main Camera and a directional Light

- **Components:** Components are the fundamental elements and useful parts of any GameObject and its operations. Every GameObject has the Transform component set by default. This will determine the position and transformation of the GameObject in the Unity environment. Components can be used in order to provide GameObjects with certain qualities. In the image below, the list of the most common components is presented [38]:

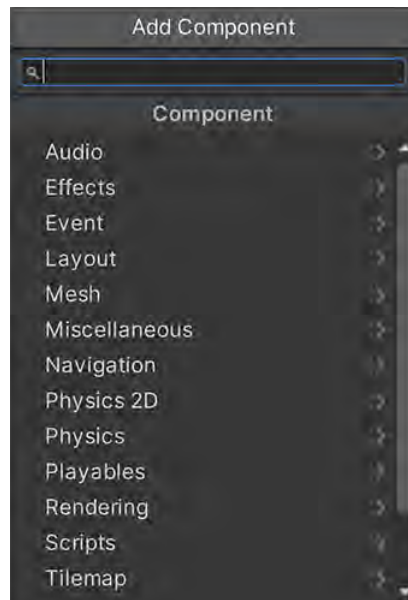
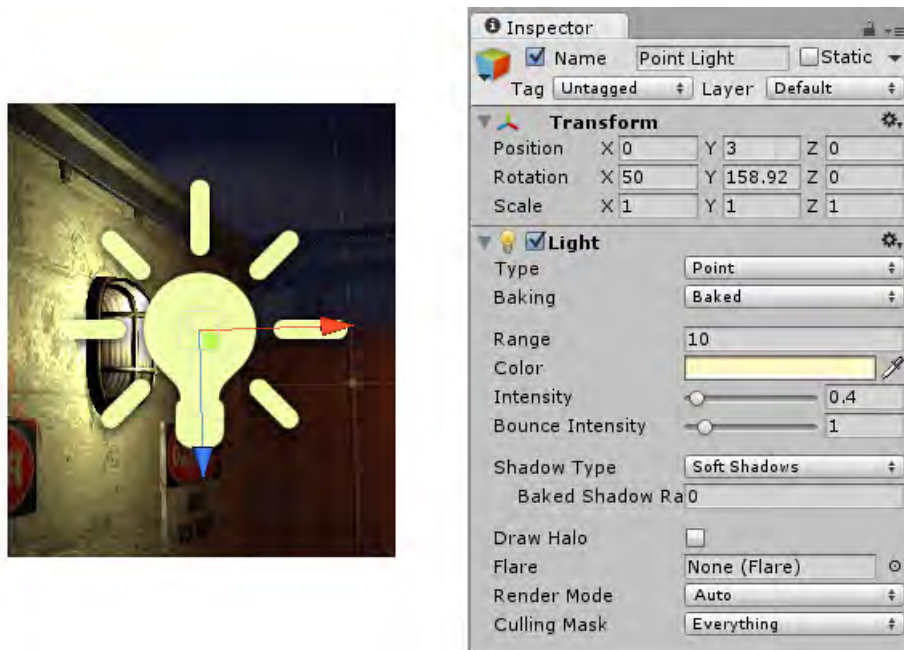


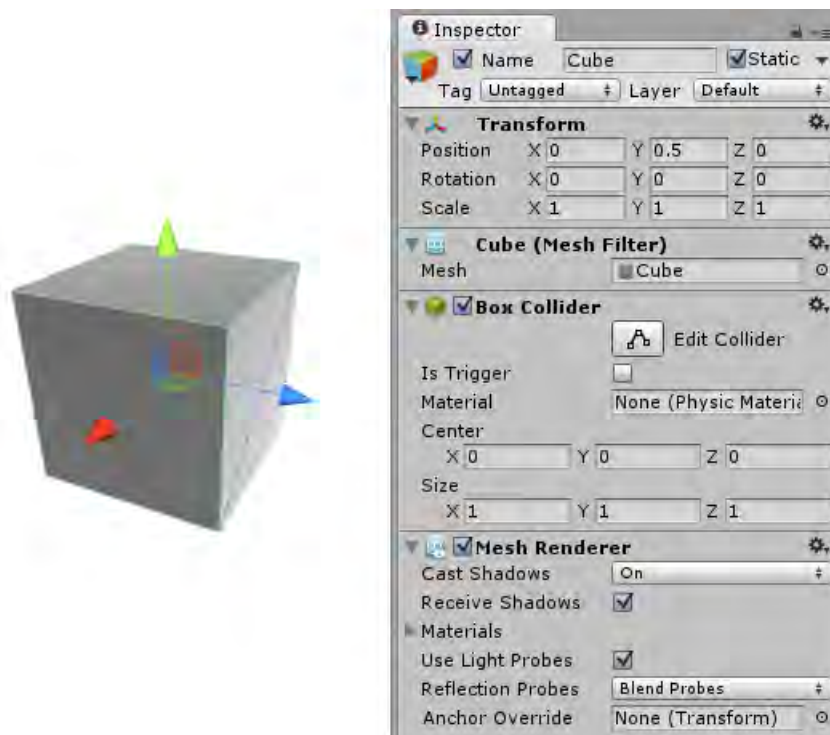
Figure 4.9: The Component browser

- **GameObjects:** The basic objects in Unity that serve as props, characters, and scenery are called GameObjects. While they don't accomplish much on their own, they serve

as housing for components that carry out the actual functionality. Below, there are two of the most basic GameObjects, a Light Object, which is created by adding a Light Component to a GameObject, and a simple Cube Object [39]:



(α') A simple Light Object



(β') A simple Cube Object

Figure 4.10: Unity GameObjects

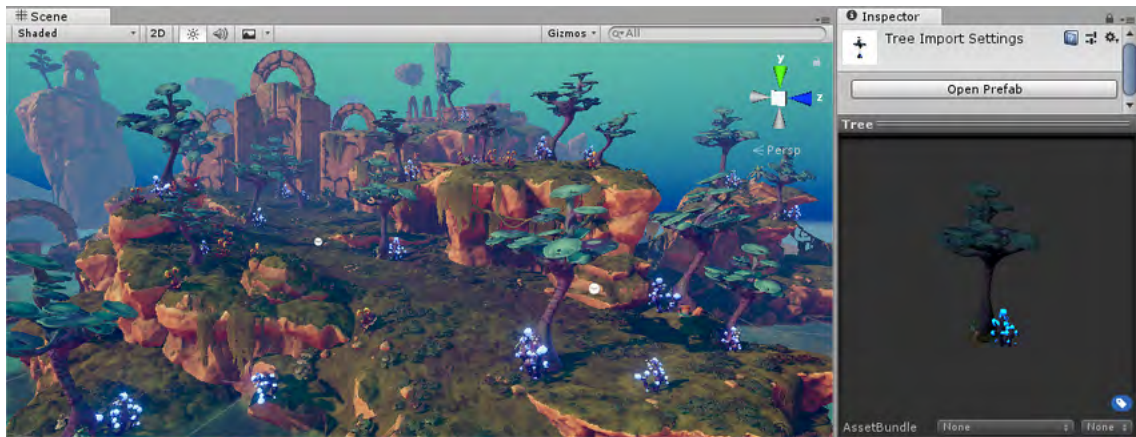


Figure 4.11: Prefab of a tree in the Inspector window

- **Prefabs:** Prefabs are simply GameObjects that can be reused. It is preferable to convert an asset to a prefab rather than just copying and pasting it repeatedly whenever there is the need to use the same asset in a scene or Unity scenario because the prefab automatically synchronizes all the objects [40].

4.7 Basic features of Unity

4.7.1 Programming

Scripting is a fundamental component of any Unity application that is created. Scripts are required by most applications in order for them to react to user input and schedule gameplay events. Beyond that, scripts can be used to control the physical behavior of objects, produce graphical effects, or even build a unique artificial intelligence system for the game's characters. Although the Unity engine is internally built in native C/C++, you can interact with it using a C# wrapper. As such, it is crucial to understand a few of the fundamental ideas behind C# scripting, which is offered by Unity's Manual, along with steps on how to get started as a beginner [41].

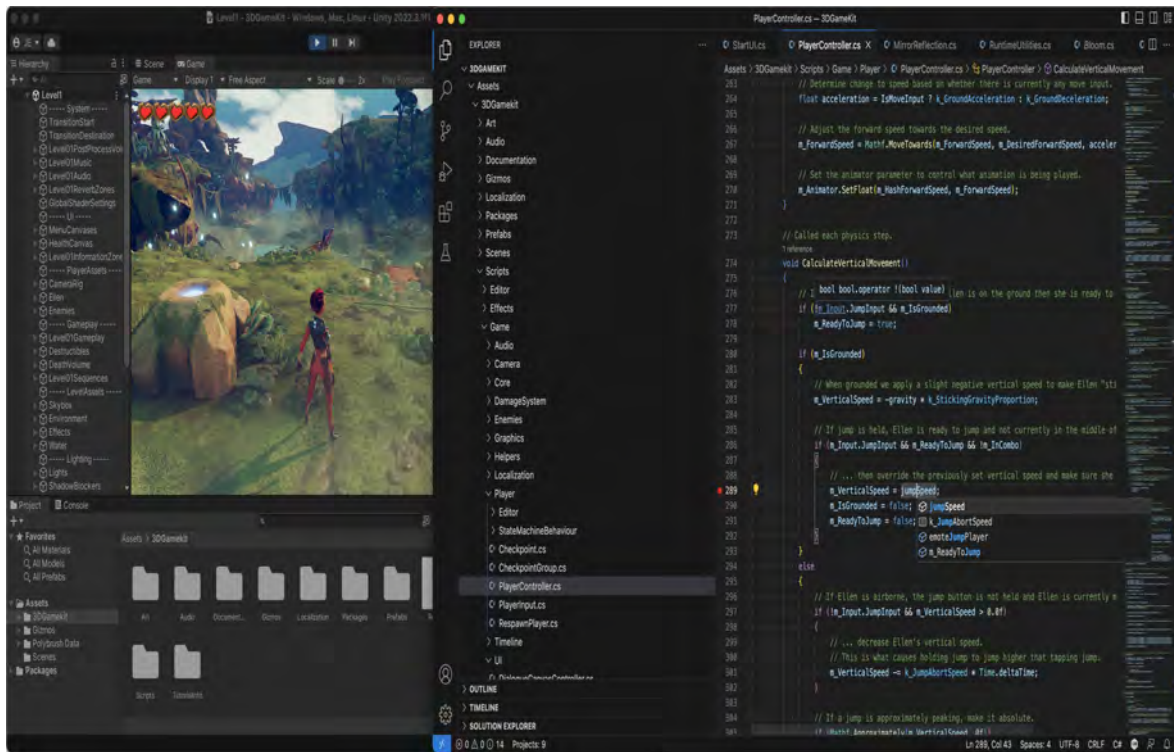


Figure 4.12: Scripting in Unity using VS Code, Microsoft’s well known source-code editor [42]

4.7.2 Audio

Without sound, whether it be sound effects or background music, a game wouldn’t be complete. Full 3D spatial sound, real-time mixing and mastering, mixer hierarchies, snapshots, and preset effects are some of Unity’s audio features. The audio system in Unity can play sounds in three dimensions, import the majority of common audio file formats, and apply extra effects like filtering and echo. Additionally, Unity has the ability to record audio from any microphone that is connected to the user’s computer for use in games or for transmission and storage. Similar to other assets, audio files in the AIFF, WAV, MP3, and Ogg formats can be imported into Unity and can also support brief audio samples as ”instruments” that can be arranged to play music. Finally, Unity’s Audio Mixer offers the opportunity to mix different audio sources, master them, and add effects allowing the developer to fabricate the appropriate sound effects and atmosphere for their project [43].

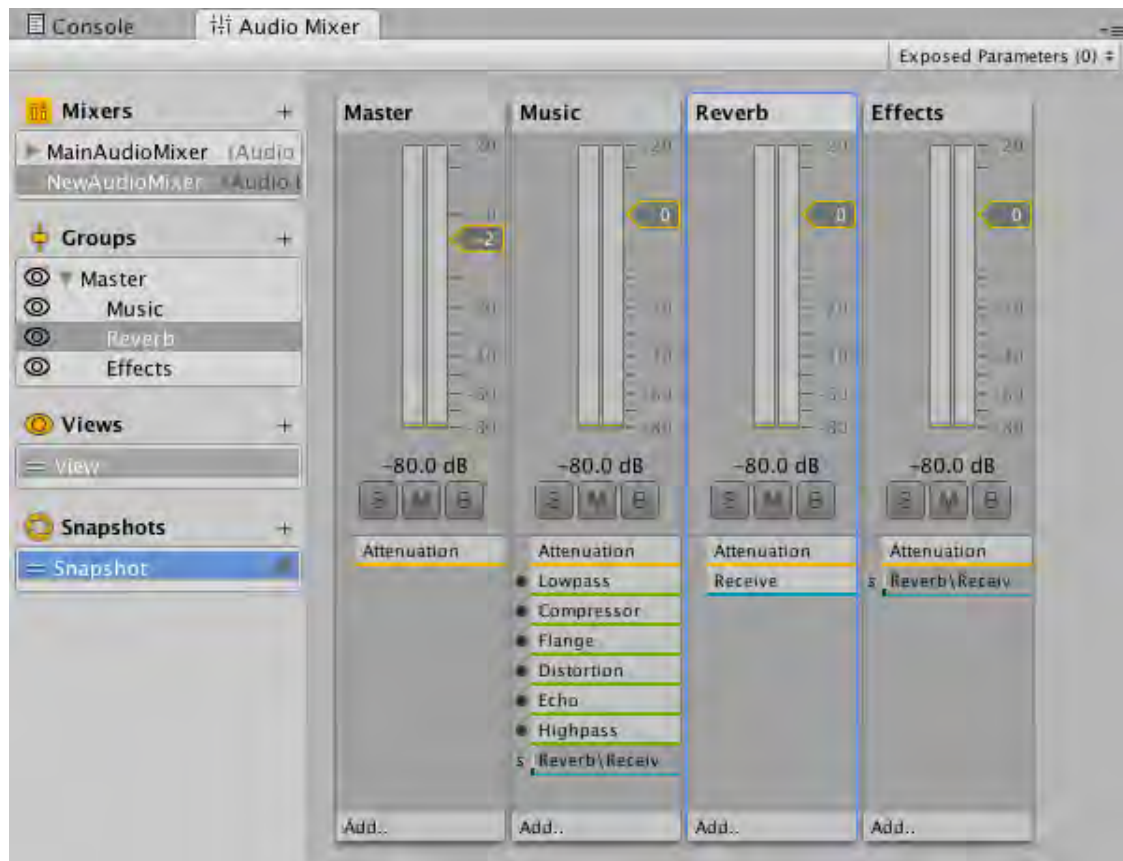


Figure 4.13: Unity's Audio Mixer

4.7.3 Animation

Unity's Animation features include retargetable animations, complete runtime control over animation weights, event calling from within the animation playback, intricate state machine transitions and hierarchies, blend shapes for facial animations, and many more features. While before Unity 4 the Animation component was the only animation system with only a limited feature set, by incorporating two new sections, the Animation window, and the Animator window, Unity now offers a rich and sophisticated animation system, also known as Mecanim.

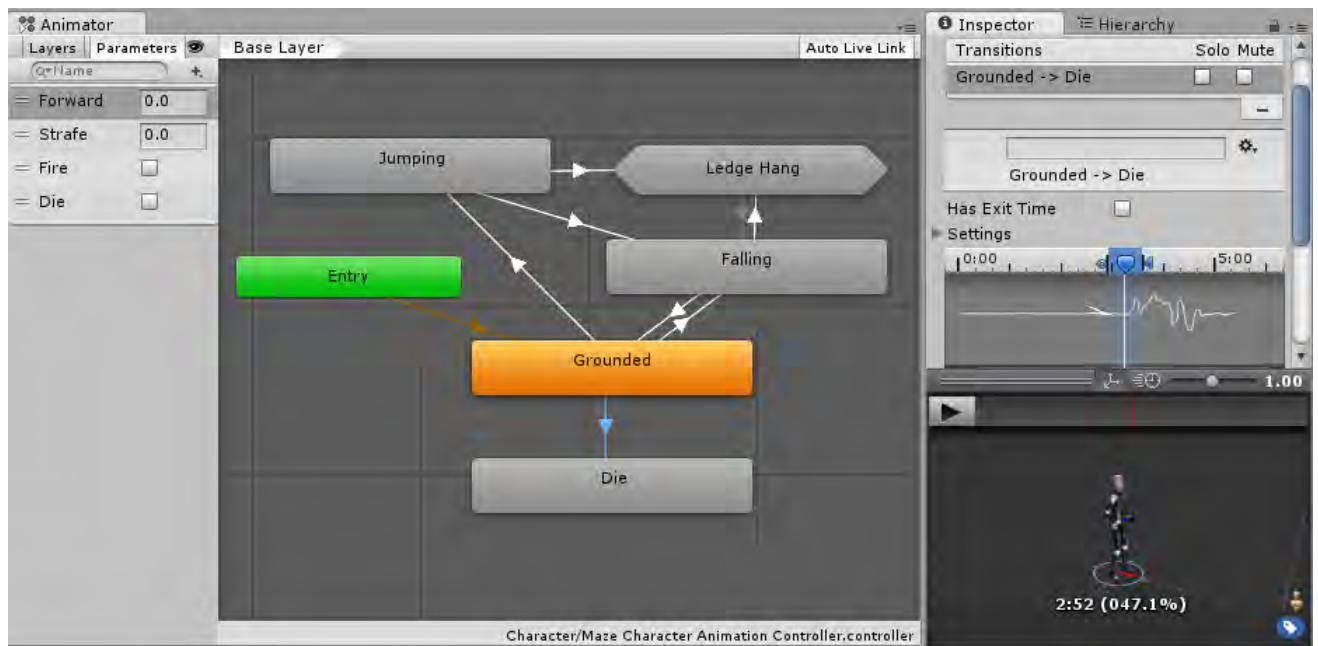


Figure 4.14: Typical view of an Animation State Machine in the Animator window [44]

Unity's animation system offers a significant amount of features, each one with each own function and purpose, so it's best to mention a few of them but focus mainly on the **animation workflow** [45]:

1. **Animation Clips** are imported, which are collections of data that specify how specific objects should rotate, change position, or have other properties over time.
2. Animation Clips are then arranged into an **Animator Controller**, a system that resembles an ordered flowchart. As a sort of "State Machine," the Animator Controller remembers which clip should play at any given time and when the animations should transition or blend together.
3. Unity's animation system also offers many unique features that lets the user modify muscle definitions and retarget humanoid animation from any source (like motion capture, the Asset Store, or another third-party animation library) to any character model. These unique features are made possible by Unity's **Avatar** system, which maps humanoid characters to a shared internal representation.
4. The Animation Clips, Animator Controller, and Avatar are all assembled on a GameObject by means of the **Animator Component**, which provides the user with the final animation result.

4.8 Unity's asset store

The Unity Asset Store contains a collection of both commercial and free assets created by Unity Technologies and community members. There are many different types of assets available, such as models, textures, animations, tutorials, full project examples, and Editor extensions. The dedicated Asset Store window is no longer hosted inside the Unity Editor as of Unity 2020.1, however it can be easily accessed at its website, <https://assetstore.unity.com/>, and users can still search for and import downloaded and purchased Asset Store packages directly in the Package Manager window. Thus, it offers numerous assets to be used in a variety of projects using Unity, and developers can discover a variety of free, neat, and high-quality resources for their games/projects [46].

Chapter 5

Design and development of "XploreNation"

This section describes the design and development of the game/environment "XploreNation". In particular, the reasons for selecting the Unity platform are mentioned, including this specific game's goal, the audience that it is aimed at as well as the player's role in it. Subsequently, the report presents the game's world and various scenes with the proper snapshots, along with some code snippets that are worth highlighting.

5.1 Selection of game development platform

Within the parameters of this thesis, the preferred development platform for creating the game "XploreNation" is the Unity game engine. This decision was made because Unity is arguably the most well-known game engine in the world and is utilized in a wide range of video game productions. It is also incredibly user-friendly and versatile, while the availability of the Unity Asset Store, which offers access to a wealth of character models, animation, and music—all for free—played a significant part in this decision. Microsoft Windows is the operating system for which the game was designed. This occurred as a result of the specific operating system's accessibility, as the majority of people own personal computers with the aforementioned integrated, and Windows computers are present in every school in the country. Additionally, this decision was due to students generally being quite familiar with the Windows operating system and being easier to extend a game to other platforms and operating systems if it is already designed for Windows. Unity version used for this thesis is 2021.3.22f1.

5.2 Purpose of the game

Gamification of learning is one of the newest trends in education, as was previously discussed in the preceding sections. In particular, students can broaden their knowledge and gain a better understanding of the concepts in the HCEM fields through the experiential learning that these games offer, as these fields are a fundamental and extremely challenging part of a human being's education and culture. More specifically, as mentioned, Greece has fallen behind in modernizing education compared to other countries, which makes the need for modifications in the traditional teaching methods highly important.

Therefore, the primary objective of the game "XploreNation" is to introduce HCEM subjects, particularly history and culture, to students by presenting an interactive, fun and rich environment that can immerse the player to the heart of the ancient world. Students in general tend not to engage too much in a subject if they see that their grades do not meet their expectations. As mentioned before in this report, history, culture and all liberal arts/social sciences in general have an enormous impact on a person's mental structure. In an educational system that focuses on memorizing and grade pursuing, video games like these are essential for students who struggle to stay interested in an educational concept, while also aiming to motivate them and advance their interest in these areas of personal development through methodical engagement with these fields.

5.3 Game's target audience

"XploreNation" is aimed at students who are prepared to move from primary to secondary school. Gender equality was taken into consideration when creating the game, so all students can benefit from it and find it enjoyable. Obviously, the game's attractive design appeals to kids of ages 10-14, as in Greece students have started gaining knowledge of the English language and it's a good age to dig deeper into the educational content of History and Culture sciences. Additionally, "XploreNation" is a game that can be played easily within a short period of time making it extremely time efficient for students who will to enjoy it, without that interfering with other extra-curricular activities.

5.4 Player's role in the game

The main goal of the player is to accept the quest offered to them by the first npc, "Diotima", in order to answer the questions of the quiz offered by the second npc, "Professor Socrates". In the meantime, the players can interact with various objects which will provide

them with an individual dialogue, while sharing clues and informative snippets from historic and cultural aspects of life in ancient Greece. While there is no success or failure result, a "Well Done!" message appears on screen, informing the player with the final score and the number of questions answered correct by the end of the quiz. For this game, a first-person view was selected, so there is not a main character other than the player. First-person view provides a more immersive experience and creates a deeper connection between the player and the in-game world.



Figure 5.1: Initial view as the game launches.



Figure 5.2: First npc, Diotima, inspired by philosopher Diotima in Plato's philosophical work "Symposium."

5.5 Competitive nature of the game

"XploreNation" is a single player game and does not include elements of multiple player games or signs of competition and does not keep track of score. However, it is encouraged that students play this as a group in order to challenge themselves by trying to improve their individual number of correct questions answered, rather than comparing their scores with one another. Moreover, as the players engage in interaction with the human-like objects inside the game, there is room for discussion offered, as these objects provide with meaningful and important information that can be analyzed and discussed, enhancing the Social Sciences' character of the game.

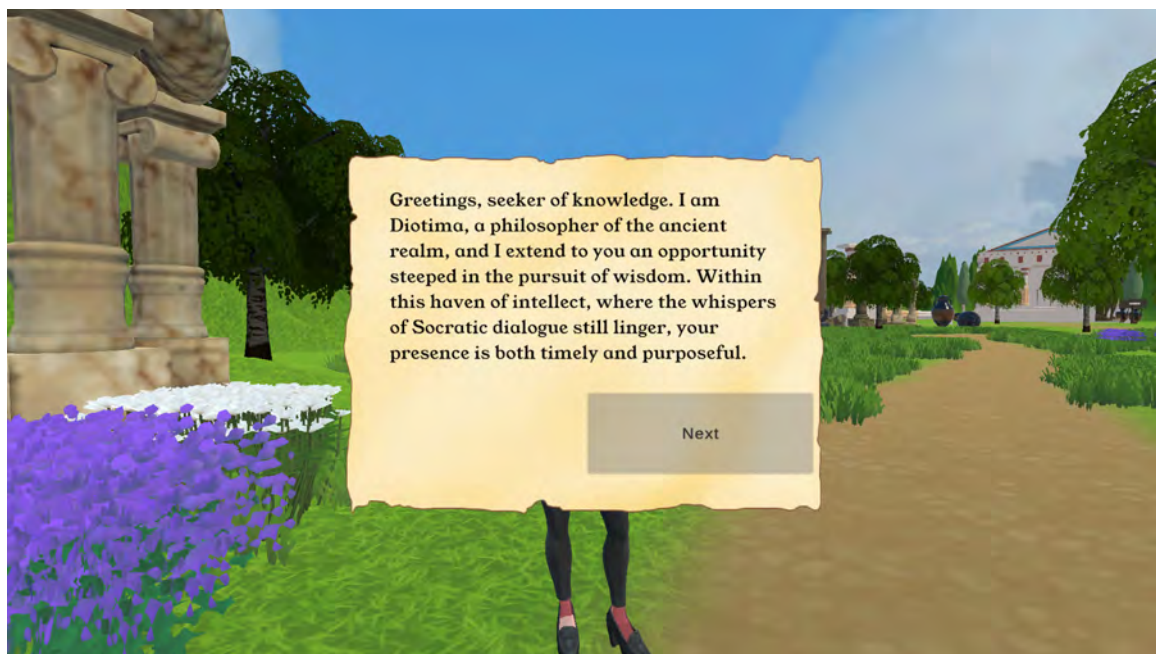


Figure 5.3: Snapshot from the dialogue with Diotima

5.6 The game's world/environment

The game takes place in an environment similar to an ancient Greece city state, with the npc characters appearing as people of the modern world. It is a 3-dimensional game, where the player can move in a first-person view, as mentioned. While the appearance of each city-state could vary, the game world incorporates the physical characteristics that would reflect the specific history, culture, and priorities of each city-state in ancient Greece. Such characteristics include temples mimicking the ancient Greek architectural structure, ancient ruins, amphorae and a plethora of statues. While most of these objects are for design purposes, the npcs and the interactive objects are quite distinctive. In particular, the game environment

consists of four interactive objects, a statue of the famous Discobolus, a statue of the goddess Athena, a statue of the god Poseidon, and a statue of a Slave, each one with their own informative dialogue.



Figure 5.4: Developer's view of the game world from Unity



Figure 5.5: Interactive object of The famous Discobolus



Figure 5.6: Interactive object of Athena, the goddess of Wisdom



Figure 5.7: Interactive object of Poseidon, King of the Sea



Figure 5.8: Interactive object of a Slave

5.7 Main menu

The Main Menu is the one the player experiences as soon as the game launches. It is part of the Game Scenes and it consists of three buttons as well as a background wallpaper of The Parthenon, with the name of the game, "XploreNation". This appearance tends to keen the interest of the students by offering minimalist but appealing graphics and attractive images. The three menu buttons include the following functionalities:



Figure 5.9: Game's Main Menu

- **"Play"**: By clicking on this button, the game is launched and the player appears in the beginning of the video game's world, where they see the initial view.
- **"Settings"**: By pressing this button the user enters the settings menu. Here the player can change various technical characteristics of the game and adapt them to their preferences. Firstly, a scrolling list contains all available resolutions and image frequencies that can be supported by the user's computer screen. Next, there is the possibility for the player to set the game window to full screen as well as a drop down list to further increase or decrease the graphics quality. Finally, there are two sliders where the player can either increase or decrease the Master and the Music Volume respectively.

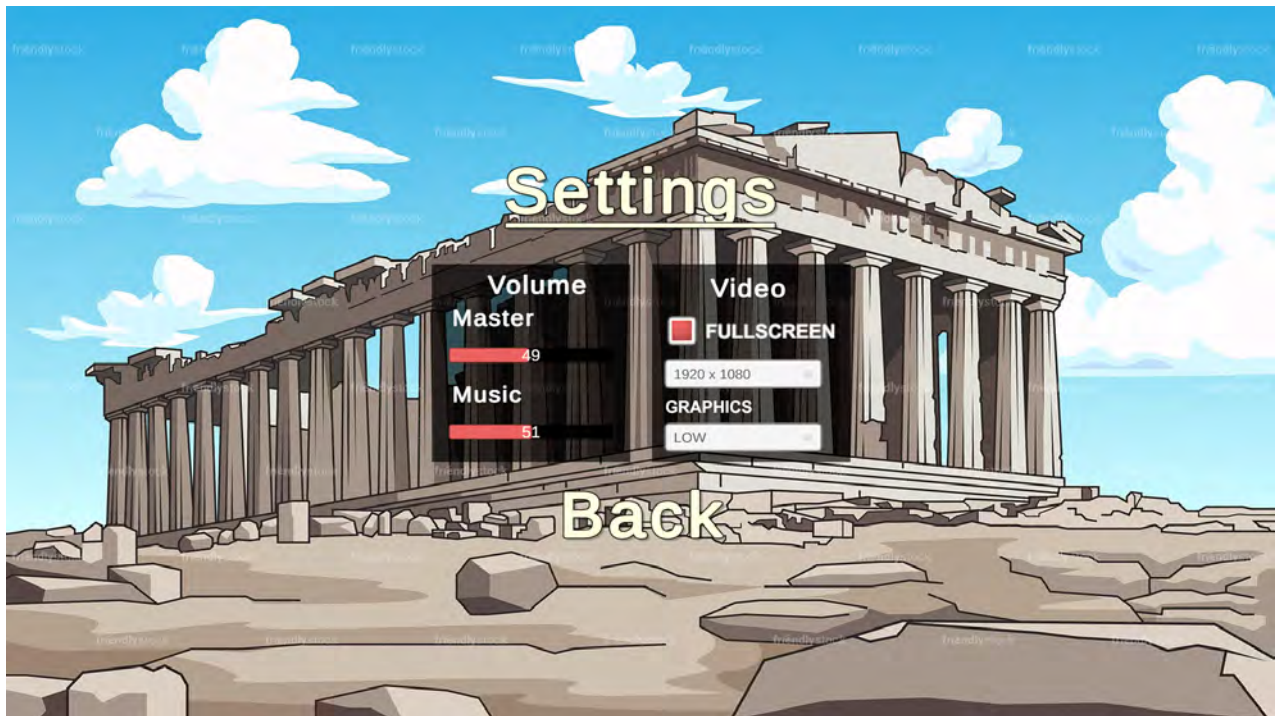


Figure 5.10: Settings Menu

- **"Quit"**: By clicking on this button, the player can exit the game, and return back to their home screen.

5.8 Gameplay

As mentioned, the player launches the game by clicking on the **"Play"** button of the Main Menu. When the application is loaded, the player is appeared on the beginning of the game's world where they can move using keys WASD, and an audio clip with music from ancient Greece also starts playing. When the main camera hovers over any object or character that can be interacted with, a text is shown ton the screen and the player can press the "E" keyboard button to begin the interaction.

In case of an interaction, the player's camera is locked and the Left Mouse Button (LMB) can be used, either to select an appropriate response, in case the interaction is between the player and an npc, or to click on the "Next" button, in case the interaction is happening between the player and an interactive object, to proceed with the next text.

When an interaction ends, the player's camera is unlocked and the cursor is disappeared, so that the player can freely continue moving around the world. Finally, when the interaction is between the player and the second npc, Professor Socrates, the camera is locked again,

and the player can use the LMB in order to answer the quiz questions until the completion message appears on the screen.



Figure 5.11: Snapshot of a dialogue with one of the interactive objects



Figure 5.12: "Socrates", the second npc, inspired by the philosopher Socrates.



Figure 5.13: Snapshot of a dialogue with Socrates.

5.8.1 In-game menu

While in-game, the player can press the "M" key from the keyboard and an In-Game Menu will popup, freezing the game's time, the players camera and will also present the mouse cursor. The player can then select between three options:

- **"Continue"**: The first option will unfreeze time, and will allow the player to keep playing the game, by unlocking the player's camera and hiding the cursor. The player can also turn the in-game menu off by pressing the key "M" again.
- **"Main Menu"**: This option will exit the game but will take the player to the initial, Main Menu, where the player can either start playing the game from the beginning, modify the game's settings or Quit the game.
- **"Quit"**: The third and final option has a result of completely terminating the application, as does the "Quit" option from the Main Menu.



Figure 5.14: The In-Game Menu

5.8.2 Game's quiz

The main challenge of the game is the final quiz. This quiz can be taken by accepting Professor Socrates' options, where an individual quiz window will pop up, generating random questions. These questions include information and possible answers gathered by the player during their interaction with the Interactive Objects. While the player is taking the quiz, correct answers are highlighted with green while incorrect ones are highlighted with red. Finally, a variable that keeps track of the correct answers will inform the player in the end of the quiz with how many questions they have answered successfully.



Figure 5.15: Snapshot of a correctly answered question.

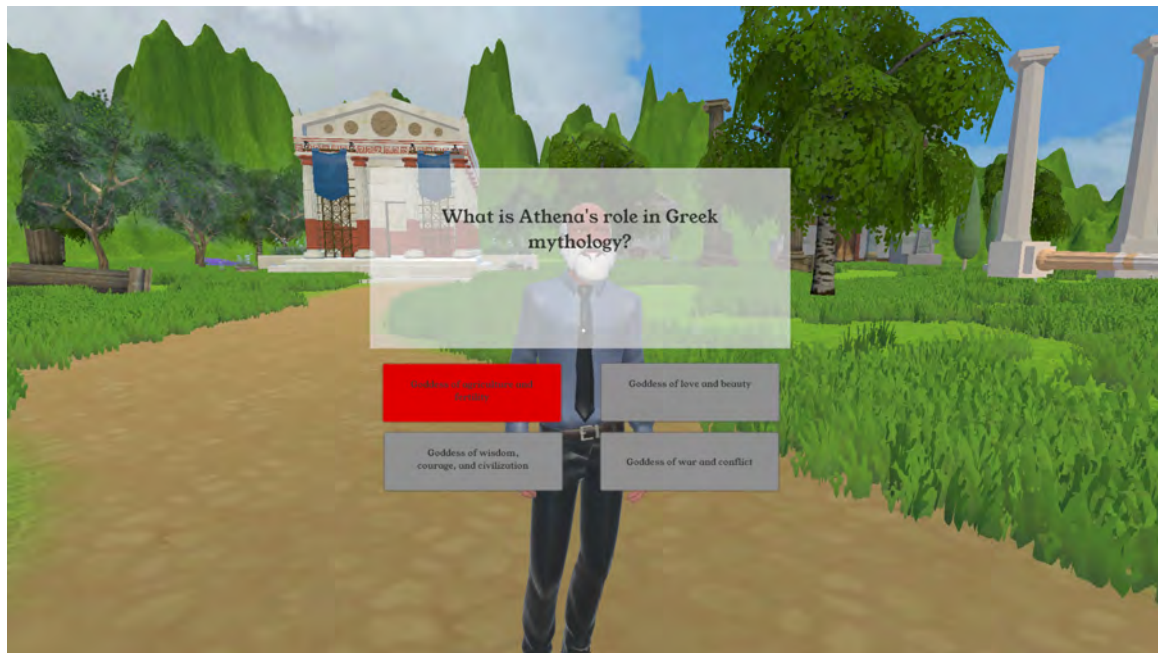


Figure 5.16: Snapshot of an incorrectly answered question.



Figure 5.17: Message indicating the number of correctly answered questions.

5.9 Implementations worth mentioning

Although the scripting of this game was a tedious and time-demanding process, with hours of developing, compiling and debugging code, there are a few code snippets that are really interesting and should be highlighted. These implementations are mentioned below:

- **Player Movement:** For the creation of the player, a capsule was used to which there were applied a number of physics properties. By manipulating these properties, the capsule can behave like an actual human being, by being forced to stay grounded (gravity), having the ability to jump and also move in a specific time-speed, which mimics the actual speed of a person walking.

```
public void Movement() {  
    //checking if we hit the ground to reset our falling velocity, otherwise we will fall faster the next time  
    isGrounded = Physics.CheckSphere(groundCheck.position, groundDistance, groundMask);  
  
    if (isGrounded && velocity.y < 0)  
    {  
        velocity.y = -2f;  
    }  
  
    float x = Input.GetAxis("Horizontal");  
    float z = Input.GetAxis("Vertical");  
  
    //right is the red Axis, forward is the blue axis  
    Vector3 move = transform.right * x + transform.forward * z;  
  
    controller.Move(move * speed * Time.deltaTime);  
  
    //check if the player is on the ground so he can jump  
    if (Input.GetButtonDown("Jump") && isGrounded)  
    {  
        //the equation for jumping  
        velocity.y = Mathf.Sqrt(jumpHeight * -2f * gravity);  
    }  
  
    velocity.y += gravity * Time.deltaTime;  
  
    controller.Move(velocity * Time.deltaTime);  
}
```

Figure 5.18: Snippet of the player's movement implementation.

- **Camera-Mouse movement:** For the player's point of view a camera was attached to the upper part of the capsule, which can be the "head" of the player. Then, a transform was performed to the player's camera, using the Quaternion.Euler function [47], which returns a rotation in each one of the three axes, applied in the order they are specified. This gives the user control over their viewing direction, by using the mouse.

```

0 references
void Start()
{
    playerCamera = GameObject.Find("Main Camera");
    //locking the cursor to the middle of the screen and making it invisible
    Cursor.lockState = CursorLockMode.Locked;
}

0 references
void Update()
{
    if(!MenuManager.Instance.isMenuOpen && !DialogSystem.Instance.dialogUIActive && !DialogueManager.Instance.isConversationActive && !FirstNPCDialogue.Instance.dialogUIActiveFirstNPC){
        float mouseX = Input.GetAxis("Mouse X") * mouseSensitivity * Time.deltaTime;
        float mouseY = Input.GetAxis("Mouse Y") * mouseSensitivity * Time.deltaTime;

        //control rotation around x axis (look up and down)
        xRotation += mouseY;

        //we clamp the rotation so we cant over-rotate (like in real life)
        xRotation = Mathf.Clamp(xRotation, -90f, 90f);

        //control rotation around y axis (look up and down)
        yRotation += mouseX;

        //applying both rotations
        playerCamera.transform.localRotation = Quaternion.Euler(xRotation, 0f, 0f);
        transform.localRotation = Quaternion.Euler(0f, yRotation, 0f);
        //transform.localRotation = Quaternion.Euler(xRotation, yRotation, 0f);
    }
}

```

Figure 5.19: Snippet of the camera's movement implementation.

- **Main menu:** The code below is really simple, as it includes the two methods of "Play", which launches the game by loading the main scene and "Quit", which exits the application completely.

```

0 references
public class MainMenu : MonoBehaviour
{
    // Start is called before the first frame update
    0 references
    public void Play(){
        SceneManager.LoadScene("GameScene");
        Time.timeScale = 1f;
    }
    0 references
    public void Quit(){
        Debug.Log("Quitting Game!");
        Application.Quit();
    }
}

```

Figure 5.20: "Play" and "Quit" menu choices implementation.

- **Settings menu:** The settings menu is worth mentioning separately, as it is a bit more complex. In order to retrieve the resolutions available for each player individually, Unity requests for access on the person's computer hardware to identify which resolutions are supported. Then, with the code previewed below, these options are incorporated inside the drop down box, and the user can select whichever one is more suited for them.

```

0 references
private void Start()
{
    resolutions = Screen.resolutions;
    resolutionDropdown.ClearOptions();
    List<string> options = new List<string>();

    int currentResolutionIndex = 0;
    for (int i=0; i < resolutions.Length; i++) {
        string option = resolutions[i].width + " x " + resolutions[i].height;
        options.Add(option);

        if (resolutions[i].width == Screen.currentResolution.width &&
            resolutions[i].height == Screen.currentResolution.height
        ) {
            currentResolutionIndex = i;
        }
    }

    resolutionDropdown.AddOptions(options);
    resolutionDropdown.value = currentResolutionIndex;
    resolutionDropdown.RefreshShownValue();

    backBTN.onClick.AddListener(() => {
        MainMenuSaveManager.Instance.SavedVolumeSettings(musicSlider.value, masterSlider.value);
    });
}

```

Figure 5.21: Retrieving all the resolution options.

- Interaction:** After implementing the player and camera movement, an important step was to develop the functionality of the interaction. By using the central part of the screen as the players eye-point, considering the player is in range of an interactable object, the camera matched with the ray of the mouse's position meaning the player is "looking" at the object's direction. In this way, as described in the gameplay section, there is the possibility to interact with the particular object and the message "Press E to interact" is appeared on the screen. Additionally, the code handles the conversation that shall start, by performing if-else states to distinguish between the objects that are in front of the player.

```

0 references
void Update()
{
    Ray ray = Camera.main.ScreenPointToRay(Input.mousePosition);
    RaycastHit hit;
    if (Physics.Raycast(ray, out hit, 15))
    {
        var selectionTransform = hit.transform;

        NPC npc = selectionTransform.GetComponent<NPC>();
        First_npc first_npc = selectionTransform.GetComponent<First_npc>();

        if (npc && npc.playerInRange)
        {
            Interaction_text.text = "Talk";
            Interaction_Info_UI.SetActive(true);

            if (Input.GetKeyDown(KeyCode.E) && npc.isTalkingWithPlayer == false)
            {
                npc.startConversation();
            }

            if (DialogSystem.Instance.dialogUIActive) {
                Interaction_Info_UI.SetActive(false);
            }
        }
        else if (first_npc && first_npc.playerInRange)
        {
            Interaction_text.text = "Talk";
            Interaction_Info_UI.SetActive(true);

            if (Input.GetKeyDown(KeyCode.E) && first_npc.isTalkingWithPlayer == false)
            {
                first_npc.startConversation();
            }
        }
    }
}

```

Figure 5.22: Object-Npc Interaction implementation.

- **Text and Coroutines:** There were two methods used for generating dialogue text. The first one was hard-coded, meaning that as soon as the player triggered the conversation window, the text was already attached in the component, completely visible to the player. The second method was implemented using coroutines [48]. By doing so,

```
0 references
private void Start () {
    firstNpcDialogueText = FirstNpcDialogue.Instance.dialogTextFirstNpc;
    optionButton1 = FirstNpcDialogue.Instance.option1btn;
    optionButton1text = FirstNpcDialogue.Instance.option1btn.transform.Find("Text (TMP)").GetComponent<TextMeshProUGUI>();
    optionButton2 = FirstNpcDialogue.Instance.option2btn;
    optionButton2text = FirstNpcDialogue.Instance.option2btn.transform.Find("Text (TMP)").GetComponent<TextMeshProUGUI>();
}
```

Figure 5.23: Generating complete text at once.

tasks that performed the text generation were spread across several frames, so that the conversation appears to be constructed at the very moment, allowing for a smoother and more interactive user experience.

```
1 reference
public void DisplayNextSentence()
{
    if(sentences.Count == 0)
    {
        EndDialogue();
        return;
    }
    string sentence = sentences.Dequeue();
    StopAllCoroutines();
    StartCoroutine(TypeSentence(sentence));
}

1 reference
IEnumerator TypeSentence (string sentence)
{
    dialogueText.text = "";
    foreach (char letter in sentence.ToCharArray())
    {
        dialogueText.text += letter;
        yield return null;
    }
}
```

Figure 5.24: Generating text using coroutines.

Chapter 6

Epilogue

This chapter covers the conclusion of this thesis. It includes a summary of the entire work and the conclusions that were reached. Furthermore, future expansions and plans available for “XploreNation” are mentioned.

6.1 Summary-conclusions

Education is starting to move away from the antiquated pedagogical strategies of the past and acknowledge the benefits of games and gamification of learning. Small but steady changes are being made in Greece as well, particularly in the area of HCEM, where the educational community has recently become more interested, considering the rich and meaningful content the Greek history and culture has to offer. Additionally, video games actively participate in this section and dispel the stereotype that only young children find enjoyment in them or that they can be used solely for entertainment.

In this thesis, the main purpose was the design and development of an educational game, focusing on History and Culture. The name of the game is ”XploreNation” and was developed using the Unity Game Engine, which was analyzed above, along with its capabilities. The game has an educational character with plenty of gamification elements and is most suitable for students between the ages 10-14, meaning students of primary and secondary school. The game focuses on helping students get in touch with History and Culture, as well as other social sciences, with quiz questions that can be found in both the internet and their school books. Moreover, the game’s elements and nature make it a really fun teaching material as it helps students immerse in an ancient world, something that would be almost impossible without the technology there is out today.

To make the game as appealing to the intended audience as possible, extra effort has

been put into it. This is accomplished by using a variety of animations, music, sound effects, thoughtful color selection, and a contemporary interface environment to grab students' attention. The game is also simple to use, and since most people play games—if not all of them—students won't have any trouble picking up the mechanics and understanding how "XploreNation" operates in comparison to other games on the market.

6.2 Future expansions

Like any game, "XploreNation" is currently open to some future extensions. Certain ones are already planned, while others will come about later.

One of the most important expansions could be the addition of score in the game. This will enhance the players' interest and competitive spirit and will provide with a reward system which will increase the students' feeling of achievement. Furthermore, with the inclusion of more levels the game can combine learning with different stages, by offering gradual progress for different levels of knowledge. An expansion suitable for the Greek educational system could be the incorporation of the subjects that students are being examined with, so that they can prepare for their exams in an enjoyable way. This can be achieved by including different environments, e.g. "ancient Egypt", "The Renaissance", and many more, depending on the students'/audience's needs.

Finally, like many industrial games out in the market consist of, a forum can be developed, where players of the game from all over the world can discuss ideas for further expansions, share their experiences regarding the game and aid for the further improvement and development of "XploreNation".

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