# The Potential of Digital Games as a History Teaching Tool: Overcoming the Unengaging Traditional Approach

## Júlio César Leal de Faria

Thesis presented to the School of Technology and Management in the scope of the Master in Informatics.

Supervisors:

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This document does not include the suggestions made by the board.

Bragança

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# Dedication

I would like to dedicate this dissertation to my parents, whose tireless efforts were instrumental in achieving this milestone in my life.

# Acknowledgment

I would like to take this opportunity to express my heartfelt gratitude to the individuals and institutions that have played a significant role in the successful completion of this dissertation.

First and foremost, I extend my deepest appreciation to my family, who has always supported me and rightfully celebrates this milestone in my life as if it were their own triumph.

I would like to express my deep gratitude to my advisors, Rui Pedro Lopes and Francisco Carlos Monteiro de Souza, for their dedication, guidance, and invaluable knowledge throughout this process.

I also want to thank my friends and colleagues who shared their ideas and experiences with me, enriching my knowledge and perspective.

To the institutions that provided me with this opportunity, Instituto Politécnico de Bragança and Universidade Federal do Paraná, I express my sincere gratitude.

To all those mentioned above and the countless others who have contributed in various ways, thank you for your invaluable support and encouragement. This dissertation would not have been possible without your collective contributions.

# Abstract

This work examines the challenges faced by students in learning history using traditional methods, which are frequently associated with uninteresting and uninspiring teaching approaches. Traditional history teaching methods often struggle to captivate students, resulting in reduced enthusiasm and an insufficient understanding of historical events.

As an alternative for increasing student engagement, digital games offer a more dynamic and captivating approach to history education, with the goal of addressing student disinterest in the subject. By incorporating interactive components, compelling narratives, and stimulating challenges, educational games have the potential to transform history learning into an engaging and meaningful experience.

The objective of this project was to develop an educational game, presenting the entire process and applied knowledge involved in creating a game with the aim of delivering history education in a dynamic and interactive manner. Following its completion, the game was made available for a group of participants to play, and we subsequently assessed the outcomes using a questionnaire to gain insights into the use of games as an educational enhancement tool.

We determined that developing games that are simultaneously engaging, enjoyable, and educational is a challenging endeavor. It necessitates meticulous planning, a solid grasp of game design, and expertise in all aspects of game production. Nevertheless, when these criteria are met, an educational game can motivate, enrich, and deepen students' knowledge, thereby rendering the classroom a significantly more enjoyable and effective learning environment for all.

# Resumo

Este trabalho aborda as dificuldades que os estudantes enfrentam ao aprender história por meio de métodos tradicionais, frequentemente caracterizados por abordagens de ensino desinteressantes e monótonas. Os métodos convencionais de ensino de história frequentemente falham em envolver os estudantes, resultando em falta de entusiasmo e compreensão inadequada dos eventos históricos.

Como alternativa para aumentar o engajamento dos alunos, os jogos digitais podem oferecer uma abordagem mais dinâmica e empolgante para a educação em história, com o objetivo de superar a apatia dos estudantes em relação à disciplina. Ao incorporar elementos interativos, narrativas envolventes e desafios estimulantes, os jogos educacionais têm o potencial de transformar a aprendizagem da história em uma experiência cativante e significativa.

O objetivo deste projeto foi desenvolver um jogo educativo, exibindo todo o processo e conhecimento aplicado na criação do jogo com a intenção de ensinar história de forma dinâmica e interativa. Após sua conclusão, disponibilizamos o jogo para um grupo de indivíduos jogar e, em seguida, avaliamos os resultados por meio de um questionário para obter uma compreensão melhor de como usar jogos como uma ferramenta de fortalecimento educacional.

Concluímos que desenvolver jogos que sejam envolventes, divertidos e educativos não é uma tarefa fácil. Isso requer planejamento detalhado, um bom entendimento de design de jogos e experiência em todas as áreas envolvidas na produção de jogos. No entanto, quando esses requisitos são atendidos, um jogo educativo pode motivar, enriquecer e aprofundar o conhecimento dos alunos, tornando a sala de aula um local muito mais agradável e eficaz

para todos.

**Palavras-chave:** Jogos Educacionais; História; Aprendizado; Jogos Digitais.

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# Chapter 1

# Introduction

This chapter centers on the introduction of the project, delving into the backdrop, motivations, and objectives that form the basis for its implementation. To begin, we furnish an outline of the project's context, subsequently elucidate the rationale buttressing the inception of the project, and eventually delineate the structure of the document.

## 1.1 Context

Currently, we have access to a wide range of innovations and digital tools. However, as previously highlighted, the discourse on innovation in education often exceeds actual implementation. Despite frequent discussions about the need for change, it is crucial to assess whether these changes are indeed taking place in the classroom. In alignment with the perspective of some scholars, it is essential to emphasize that genuine innovation only occurs when real changes transpire. This is because transformations in teaching approaches and methods tend to evolve more slowly than technology itself. Nevertheless, throughout the history of education, we can observe significant evolution. These changes in education have occurred in various ways, including some that were imposed and formalized by institutions, while others emerged more informally but consistently [1].

Conventional teaching methods came under criticism, leading to a quest for alternatives that would encourage students to construct historical knowledge in the classroom.

This involved moving away from traditional methods that heavily relied on reading textbooks. Instead, cinema, music, and literature were introduced as tools in history education, providing alternative means for building historical knowledge [2].

The teaching of history is a construction that adapts over time and according to changes in society. Contemporary technologies are often considered detrimental to primary education. Devices such as computers, tablets, smartphones, and video games are frequently viewed as disruptive in the educational environment. However, it is essential that teachers know how to use these tools to encourage their students in knowledge creation. Mere use of these audiovisual resources does not guarantee learning; instead, the adoption of an appropriate methodology and proper assessments are necessary [3].

History as a discipline of study reveals profound significance, both for personal development and for society as a whole. Scholars agree that history plays a fundamental role in promoting citizenship, shaping ethical and moral values, understanding the present, and guiding the future. It is an effective tool to strengthen our personal and collective identity, helping us understand who we are and where we come from. History is not limited to a mere narrative of the past but requires an "imaginative" approach to unravel its complexities. The ultimate goal of historical study is to improve our quality of life in the present and prepare us for the challenges the future holds [4].

Digital games used in education can enhance cognitive skills, such as repetitive actions to improve performance, analysis of situations, strategic planning, information retention, and decision-making. Furthermore, the introduction of technological resources and games in the classroom can make the learning process more playful and motivating for children while allowing pedagogical guidance on their appropriate use and raising awareness of potential issues associated with excessive and unsupervised usage [5].

One way to present educational content with visual, auditory, and interactive resources is through digital games, which have a greater potential to entertain, engage, and educate simultaneously.

## 1.2 Goals

The objective of this project was to create an educational game for teaching history based on the article "TimeCraX: Time-travelling to learn history" [6] and make it available to a group of participants. After playing, the participants were invited to fill out a form containing questions aimed at capturing their experiences regarding learning history through the game, so that the effectiveness of this work can be evaluated.

## 1.3 Documents Structure

The document is divided into six chapters. The present chapter provides the introduction and outlines the intended objectives. The subsequent sections of the document are structured in the following manner:

- Chapter 2: State-of-the-Art

  - This section encompasses the literature review pertaining to games in history education, an elucidation of gamification and game-based learning, my individual encounters with educational games, and their influence on our project.

- Chapter 3: TimeCrax Machine

  - This chapter delineates the project's objectives, its sources of inspiration, and offers an elucidation of its functionality.

- Chapter 4: Development

  - Describes the entire game development process, the tools used and the challenges faced.

- Chapter 5: Experiments and Results

  - Comprises a description of the execution of the experiment, evaluation of results and the final outcomes.

- Chapter 6: Conclusions and future work

  - Summarizes the findings derived from the project's development, and identifies areas that could be further explored in future research.

# Chapter 2

# State-of-the-Art

In this chapter, we discuss the fundamental concepts that played a critical role in the planning, analysis, and development stages of this project, providing a comprehensive overview of the research process and the selection of relevant works.

## 2.1 Primary Research

To craft the research questions, it was essential to identify the components that would facilitate the discovery of studies aligned with the objectives of our research. In this regard, we emphasize the following aspects:

- **Q1:** Games from the entertainment industry that have an accurate historical plot and teach about history even when it's not their primary objective.

- **Q2:** Various educational games developed with the purpose of teaching history.

Based on these points, we established the keywords and their English translations for the research in the table 2.1, and also defined the research repositories in the table 2.2.

The screening phase aims to identify primary studies that align with the previously defined points. Throughout this process, an analysis was conducted on all the primary

| Keyword | Portuguese translation |
|---------|------------------------|
| Games | Jogos |
| Teaching | Ensino |
| Learning | Aprendizado |
| History | História |

Table 2.1: keywords

| Research Repository | URL |
|---------------------|-----|
| Google Scholar | http://scholar.google.com.br/ |
| Capes | http://catalogodeteses.capes.gov.br/catalogo-teses/ |
| Science@Direct | http://www.sciencedirect.com |
| Research Gate | http://www.researchgate.net/ |

Table 2.2: Repositories

studies retrieved, and a set of criteria was applied to determine the inclusion or exclusion of studies. The defined and utilized inclusion criteria are as follows:

- **IC1:** If the study specifically addresses the teaching of history.

- **IC2:** If the study analyzed any entertainment industry games.

- **IC3:** If a game was developed during the study process.

The exclusion criteria are of paramount importance as they facilitate a more precise selection for the removal of studies that do not fall within the scope of the mapping. Thus, during the individual analysis of the studies, we excluded those that met at least one of the following exclusion criteria:

- **EC1:** Studies published before 2018.

- **EC2:** Studies that analyzed the same game (the most recent one was retained).

- **EC3:** If there is a more comprehensive study by the same author.

- **EC4:** Studies that did not fully develop games (if the initial proposal was the development of a game).

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As a result of this research, after applying all the criteria, 5 studies were selected as shown in Table. 2.3.

| Title | Year |
|-------|------|
| Descobrindo o Passado: o uso do RPG digital como artefato para mobilizar o conceito de empatia histórica [7] | 2022 |
| Ensino de história por meio de jogos digitais: Relato de aprendizagem significativa com games [8] | 2019 |
| Game Minecraft: uma abordagem sociocultural e digital [9] | 2023 |
| Jogos Digitais no Ensino de História: Uma experiência na educação básica em Mato Grosso [10] | 2020 |
| Games e Educação: Considerações sobre Assassin's Creed e o ensino de História [11] | 2018 |

Table 2.3: Selected Studies

## 2.2 Analysis Of The Selected Studies

Nunes [7] underscores the significance of choices and critical thinking in human life and relates them to the gaming experience. It accentuates how digital games can serve as effective educational tools, especially for Generation Z students. The proposal centers on the development of a digital game named "Discovering the Past" with the aim of fostering the development of historical thinking and historical empathy among students. The game is designed to provide multiple perspectives on historical events, promote decision-making, and move away from repetitive and didactic teaching methods. The text also delves into the incorporation of historical culture and second-order concepts into the educational process while acknowledging the challenges of competing with other historical narratives present in society, such as commercial games.

The author argues that their experience as a gamer equips them to create an educational game. They explore the intersection of gamer culture and school culture, highlighting the value of games as educational tools. The text emphasizes the integration of elements from strategy and role-playing games into their game and justifies the choice of the Enlightenment theme, aligning it with the demands of the Brazilian National Common Core (BNCC) to create an engaging educational game that combines gaming culture with historical education for students. The author also delves into game theory, addressing the relationship between narrative, ludology, and narratology. Two schools of thought are outlined: narratologists, who prioritize narrative in games, and ludologists, who argue that games are primarily focused on rules and gameplay. The author explores various theories about games, underscoring the importance of both narrative and rules, while discussing the tensions that can arise among scholars due to these divergent viewpoints.

Following the presentation of these arguments, the author proceeds to describe the process of creating the game "Discovering the Past" using the RPG Maker MV platform, acknowledging the platform's aesthetic limitations. The narrative aims to be both relevant to historiography and engaging for students. The game is seen as a way to immerse players in historical contexts, even within the graphical constraints of the platform.

In conclusion, the author highlights the growing presence of the past in media, often in commercial and aestheticized forms. They express concerns about making historical narratives more captivating for students, asserting that challenging and somber subjects, such as slavery and genocide, should be explored in the classroom. The author grounds their work in History Didactics, seeking to adapt history education to the digital realm and utilizing games as a means to inject imagination and interaction into the classroom. They advocate for innovative approaches to history education, including the use of games, comics, and other forms of media.

Bianchessi and Mendes [8] describes the author's experience in integrating digital games, specifically the interactive game Kahoot!, into high school history education. The research was grounded in the belief that meaningful learning occurs when new concepts

are connected to a student's existing relevant knowledge within their cognitive framework. Digital games, in particular, were seen as contemporary cultural artifacts rooted in microcomputer technologies, capable of providing engaging and effective educational experiences. The study was carried out with third-year high school students at a state school in Curitiba, Brazil, where the interactive game Kahoot! was employed as a pedagogical tool for reviewing and assessing history content.

The author underscores the significant role played by the interactive game Kahoot! in the learning process. It allows students to engage with logical reasoning concepts, stimulating cognitive skills such as analysis, judgment, decision-making, language, classification, and strategy. Kahoot! provides a spontaneous and enjoyable learning environment in which students can actively and interactively learn, offering immediate feedback on their learning progress and promoting healthy competition in the classroom.

Additionally, the author highlights the advantages of digital games, including Kahoot!, in providing interactivity, making them highly engaging, and enabling students to actively construct knowledge while playing. The incorporation of gamification elements into education encourages flexible and enjoyable learning. Games motivate students to apply knowledge in practical situations and connect it to real-life scenarios, thereby promoting more meaningful learning.

Moreover, the use of Kahoot! in history education is portrayed as an effective strategy for enhancing the attractiveness and engagement of teaching. Students become the protagonists of their learning, actively participating in the process. Digital games like Kahoot! have the potential to develop various skills in students, including understanding rules, problem-solving, motor coordination, quick thinking, and perseverance in the face of challenges.

In the closing statements, the author concludes that the integration of digital games, particularly Kahoot!, into high school history education yielded significant benefits. Students became more engaged in learning, fostering autonomy and collaboration. Despite initial resistance, students ultimately celebrated the results and shared the approach with other classes. The use of Kahoot! and digital games in high school history education

enriched the learning experience, engaged students, improved teaching practices, and deepened content understanding, positioning it as a promising and beneficial approach.

Albernazm, Albernaz, and Silva [9] underscores the highly connected and digitally immersed nature of contemporary society, with a significant portion of students possessing experience with and immersion in digital games and culture. This reality necessitates educators to consider the incorporation of digital games into their teaching methodologies, capitalizing on students' interest and familiarity with these technologies. The author suggests that electronic games can serve as valuable pedagogical tools to engage students and enhance the meaningfulness and challenges of learning. Additionally, the importance of Heritage and Digital Education in comprehending digital games as integral components of social, cultural, and digital elements in history classes is emphasized. The author calls for an analysis of the utilization of digital games like Minecraft in history education, emphasizing the requirement for an approach that takes into account cultural heritage and digital technologies.

The author delves into the significance of playfulness in educational processes across human history. They note that play and games have been fundamental to human beings, facilitating learning and skill development since ancient times. The concept of digital culture is introduced, denoting the influence of digital technologies on contemporary society, permeating all aspects of life and reshaping social and cultural dynamics. Furthermore, digital games, such as Minecraft, are positioned as sociocultural and digital elements that play substantial roles in today's digital culture.

The paper outlines an approach to integrate digital games into history education and promote Heritage Education. It highlights that constructing virtual models of historical structures using Minecraft Education serves as an excellent method to engage students in hands-on activities that connect them with cultural heritage. This approach fosters an understanding of heritage as a fundamental component of a group's identity, be it a nation, region, ethnicity, or family, and instills a sense of belonging to tangible history. Such a sense of belonging is vital for heritage preservation and the construction of cultural

identities.

Furthermore, the text underscores the adoption of active teaching methodologies, including gamification, as an effective strategy to enhance student engagement and empower students to take an active role in their own learning. This approach enables students to independently develop skills and competencies, which is particularly crucial in an environment where digital culture holds sway.

Additionally, the study highlights the necessity for teacher training that encompasses the use of digital technologies, such as games, as educational resources. Adequate teacher training is pivotal for harnessing the educational potential of these tools and overcoming the challenges associated with technology integration in education.

Miranda [10] shares a personal narrative about their relationship with video games throughout their life, from childhood to becoming a history teacher. They mention that their interest in digital games as an educational tool was awakened when they observed their students playing a game related to World War I called Valiant Hearts: The Great War.

This study focuses on the use of the game Company of Heroes 2 as a pedagogical resource in history classes and its analysis. The use of the game Company of Heroes 2 as a didactic resource was motivated by the understanding that contemporary students construct knowledge through various means that go beyond the traditional school environment.

The game was used in two classes: the third year A of the Technical Administration Course and the third year C of regular education. The teacher administered a two-part questionnaire: the first part before the classes to assess students' prior knowledge of World War II, and the second part at the end of the classes to evaluate students perception of digital games. 30 students from both classes participated, and they were also asked to research Fascism, Nazism, and the concept of minorities.

The classes were spread over four sessions covering various topics, including World War II, the emergence of Fascism and Nazism, minorities, the Cold War, and a simulation of

the German invasion of the Soviet Union. At the end of the fourth session, the second part of the questionnaire was administered.

The author concludes that it is important to make use of digital games as an educational resource for teaching history, as the new generations learn differently due to their "digital wisdom." They advocate for the integration of digital games in education as a means to promote effective and engaging learning. The author argues that schools should adopt digital technologies to keep pace with changes in how people seek knowledge and suggests that digital games can enrich history education, allowing students to experience meaningful learning experiences.

Severo and Zaduski [11] emphasizes the importance of recognizing the changes in social relations and the school environment brought about by technological advances, especially with the presence of the "digital native," a student who grew up immersed in technology. They express that the introduction of games like Assassin's Creed into history classes is a promising didactic strategy, as games are familiar to students and can engage them in the learning process. The author also notes the growing body of literature on the use of games in history education. This study aims to investigate how the game Assassin's Creed has impacted the school environment, particularly in history classes.

The conducted research follows a qualitative approach, focusing on the interpretation of phenomena and the attribution of meaning. This method seeks to deepen the understanding of the studied topics, considering the social context of the subjects involved, without the need for numerical representativeness. The research was based on a literature review, exploring topics related to Information and Communication Technologies (ICTs), education in the 21st century, the profile of contemporary students, and the use of digital games in education. In addition to literature, videos, articles, online interviews, and specialized magazines on digital games were consulted to support the research and obtain current information on the subject.

In conclusion, the use of technology in the educational environment is crucial in contemporary society, as digital native students are adept at using technological resources,

while many teachers belong to the digital immigrant generation, which does not share the same affinity with technology. This difference impacts the interaction between teachers and students, contributing to a disconnect between the school and the reality of young people. It is widely recognized that games can be an effective alternative when used as a pedagogical resource since they are part of the daily lives of digital natives and have the potential to make the teaching and learning process more efficient.

## 2.3   Gamification

Gamification is the use of game principles, mechanics, and design elements in non-gaming contexts, often implemented through digital platforms. Its purpose is to solve problems, stimulate engagement, and motivate people to achieve specific goals. This technique aims to provide an interactive and playful experience, reinforcing the feelings of autonomy, competence, and interaction among participants. With origins in various fields such as education, business, marketing, and services, gamification is a versatile tool that can enhance the user experience and create value in a wide range of contexts. Its significant impact in various sectors has reshaped traditional engagement approaches, especially in the educational field[12].

Games and gamification-based evaluation and intervention hold significance due to a variety of factors. Gamification has the potential to enhance the appeal and enjoyment of tasks, thereby facilitating behavior modification and increasing adherence to interventions. It is also effective in engaging individuals who may be introverted or easily distracted, leading to heightened engagement and communication. Gamification is widely employed in education, health sciences, and various other fields. The strategic use of gamification can make learning more enjoyable, elevate engagement levels, and ultimately yield improved outcomes for students. When applied in human resource management, gamification has the potential to enhance job satisfaction, increase engagement, and boost overall performance. It may additionally contribute to an improved corporate culture,

the resolution of internal issues, and enhancements in sales processes. In the context of assessment, gamification can significantly increase engagement and participation[13].

Gamification in education offers several advantages for students:

Improvement: Gamification leverages ICT (Information and Communication Technology) to enhance student learning, making it accessible anytime and anywhere. It utilizes elements like levels, points, and challenges to categorize information, aiding in concept retention and providing a sense of accomplishment and growth.

Motivation: Gamification fosters self-motivation by making education captivating and flexible. It promotes engagement and the desire to participate in the learning process. Researchers use gamified applications to study the impact of game design components on motivation, performance, and the overall learning experience. Social learning experiences can also enhance motivation and increase participation within a gamified context.

Engagement: Effective learning requires student engagement and participation, which can be boosted through gamified teaching methods. Gamification increases student interest and engagement in learning activities, leading to improved knowledge assessment results. Students' engagement and learning processes are supported by the use of gamification.

Student-Control: Gamification allows students to learn at their own pace. They can monitor their comprehension through formative tests and adjust their study methods accordingly. Gamified learning experiences enhance motivation, as students work to achieve incentives for completing subtasks. This approach encourages students to set goals, develop plans to overcome obstacles, and fosters creativity, imagination, and enjoyment. [14]

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## 2.4   Game-Based Learning

Digital Game-based Learning (DGBL) represents an innovative concept highlighting the effective utilization of video games in the classroom to enhance the learning experience for students. Video games have the potential to facilitate learning due to their enjoyable, engaging nature and interactive user interfaces. Within the Greek educational system, post-gymnasium vocational education and training at level three are delivered through Vocational Training Schools and Vocational Apprenticeship Schools under the Manpower Employment Organisation. These schools are aimed at addressing issues such as school dropout, enhancing fundamental skills for compulsory education graduates or their equivalents, and integrating them into the labor market[15].

Innovative educational strategies have harnessed the power of game-based learning to capture students' interest and enhance their engagement in education. Game-based learning involves the incorporation of educational content within a gaming framework, allowing students to actively participate and interact with the game's mechanics to acquire knowledge and skills. Moreover, gamification is a process that integrates elements like points, rewards, badges, and competition into the learning experience, creating interactive and captivating learning environments. This approach aims to boost motivation, engagement, and active participation, taking advantage of the intrinsic appeal of games.

Developing interactive and entertaining games, primarily designed for educational purposes, is a significant step in implementing game-based learning. Serious games, designed to challenge players and test their skills, effectively facilitate learning by stimulating creativity, sparking interest, fostering discussion, and cultivating a competitive spirit for exploration in various fields.

Mobile and location-based technologies open up opportunities for embedding learning experiences in authentic environments, thereby enhancing engagement and learning beyond the confines of traditional formal education. These games can simulate real-world scenarios, such as driving a vehicle, city management, or piloting an aircraft, providing a safe space for players to experiment and make decisions without real-world consequences.

Overall, game-based learning, gamification, and serious games offer exciting prospects for enriching the educational experience and increasing student involvement[16].

## 2.5 Challenge Description

In my personal experience, the majority of educational games encountered, both during high school and undergraduate studies, failed to fulfill their essential role as games, which is to entertain, engage, and challenge the player. In retrospect, as I analyze the reasons for this, a primary factor becomes glaringly apparent to me: these were not true games. What I intend to convey is that these educational games represented various forms of basic animated interactions with clearly defined educational objectives, lacking the essential framework of actual games. They lacked game design and level design; essentially, they were gamified exercises or rather mundane tasks.

While gamification can enhance interfaces and content, making them more engaging when executed effectively, it does not transform them into genuine games. On the contrary, in my perspective, game-based learning offers a superior approach when the goal is to develop a comprehensive game with all the captivating elements of commercial games that draw players in.

Timecrax Machine is first and foremost designed to be a game. Beyond entertaining and captivating players, it also conveys historical knowledge to them seamlessly and enjoyably. History is an integral part of the game's narrative, a fundamental component for its successful completion. However, the game's scope extends further; it introduces management challenges, encourages player cooperation, provides decision-making interactions, and incorporates elements of chance.

# Chapter 3

# TimeCrax Machine

This chapter describes what the TimeCrax Machine game is, why it was created and how it works.

## 3.1 What is it?

TimeCrax Machine is a 3D online multiplayer digital game in the style of a board game for 1 to 4 players. This game was developed inspired by the work "TimeCraX: Time-travelling to learn history" [6] and aims to convey and encourage general historical knowledge to players while providing fun and entertainment.

## 3.2 Narrative

TimeCraX is a time-travel machine stumbled upon by four friends while playing explorers in the woods. These Four Inseparables, as they dubbed themselves within their secret circle, often sneaked into the woods to embark on endless adventures, assuming various roles across different historical eras. They became crusaders journeying to the Holy Land, overseas explorers, nobles defending their territories from invaders, members of militias overthrowing governments, and devoted monks evangelizing and educating.

One day, as the four soldiers advanced through the forest, they found themselves in an

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unfamiliar location. The thick and densely packed trees made navigation challenging, but they carefully pushed forward through the tangled branches. One of the soldiers, weary from their long trek, tripped and fell into the undergrowth. The others, unaware of their companion's difficulties, pressed ahead, distracted by the obstacles they encountered and vigilant for the unsettling sounds of their surroundings. Still recovering from his fall, the last soldier sought a stable footing to regain his balance. While surveying the area, he realized that what had tripped him was not a branch but rather a lever of a peculiar machine. As he managed to free his foot, the machine suddenly roared to life, with gears spinning and interlocking in a mesmerizing dance. Alone and bewildered, he cried out for his friends just as the world around him underwent a transformation. The trees vanished, replaced by the flow of a river leading to a castle that had not existed just moments before.

The machine abruptly halted, leaving the four soldiers stranded in the same spot but at different points in history. One of them held a broken lever, while the other three called out for their missing companion, examining the fractured gear now resting in their hands. [6]

## 3.3   Objective

TimeCrax Machine is a cooperative turn-based game in which each player takes sequential actions before passing the turn to the next player. The primary objective for players is to accurately position all historical events on the timeline before the time machine's structural integrity is compromised. The time machine is composed of 15 distinct components, and the conclusion of each round or an incorrect association of an event with the timeline will lead to the random malfunction of one of the time machine's components. In the event that a component already experiencing malfunction is chosen to malfunction once more, it results in the catastrophic collapse of the time machine, signifying defeat for the players. During their respective turns, each player is limited to selecting and executing only one of four possible actions:

- Buy a repair card;

- Buy an Event Card and place it on the timeline;

- Give one of their Repair Cards to another player;

- Repair a malfunctioning component of the time machine.

## 3.4   Repair Card

Repair Cards are used to fix a malfunctioning component of the time machine. You need a number of Repair Cards equal to the number of players to repair each component. In other words, if there are 3 players in game, then a total of 3 Repair Cards is necessary to restore a single component of the time machine. When in possession of at least one repair card, players have the option to provide a repair card to another player. Each player is allowed to retain a maximum of 5 repair cards.



Figure 3.1: Repair Card texture.

## 3.5 Event Card

Each Event Card features the name and an illustration of a world historical event, and the player must examine the timeline and correctly associate the Event Card with its proper place. If the player is correct, the Event Card remains on the timeline. If the player is incorrect, the Event Card goes back into the Event Deck, and one of the time machine's components malfunctions. The Event Deck consists of 7 historical Event Cards and is shuffled every time an Event Card returns to the deck.



Figure 3.2: Event Card texture.

## 3.6 Timeline

Timeline is a panel that displays a timeline with 7 slots, each of them containing a corresponding year.

Figure 3.3: Timeline panel.

## 3.7 Time Machine

The time machine consists of 15 components that collectively make the machine operate. If any of the components is selected to malfunction when it is already in a state of malfunction, it cannot be repaired, and the time machine will collapse.
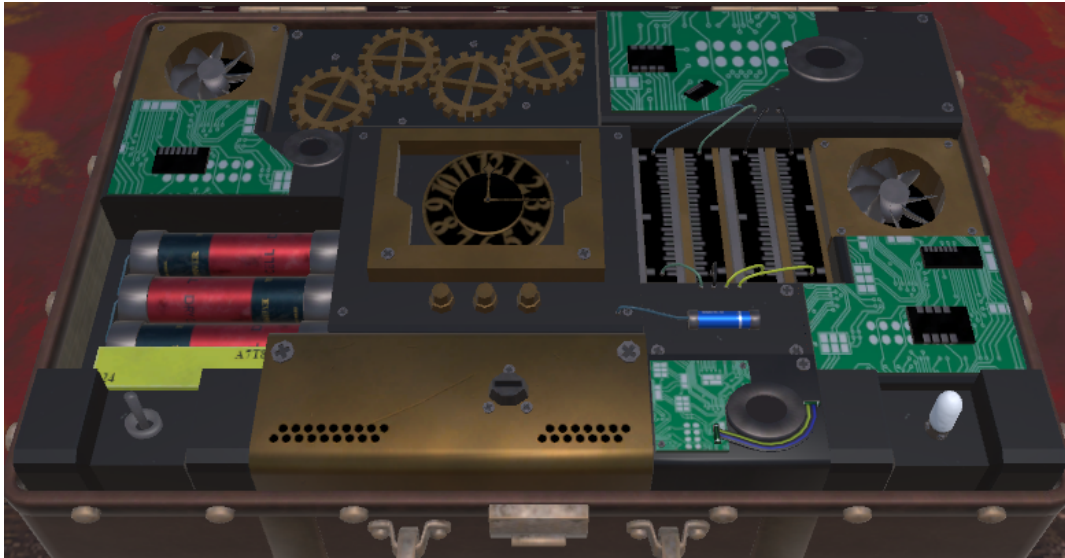
Figure 3.4: Time Machine.

## 3.8   Level Design

The game becomes more challenging as time goes on. With each new component of the time machine starting to malfunction, the probability of a malfunctioning component being selected again increases, making the chances of the time machine collapsing even higher. The players must choose their actions wisely so that, collectively, they can manage the risks while attempting to complete the timeline with historical events correctly. Players with a greater knowledge of historical events have a lower risk of making mistakes when attempting to place a historical event on the timeline, and they are rewarded when they get it right. When they make a mistake, the event card returns to the event deck, giving players a new chance to try and place it correctly, encouraging them to memorize and learn. When there are fewer players, the game becomes more challenging, as each round contains fewer actions, meaning fewer chances to place a historical event on the timeline.

## 3.9   Game Design

The entire game was built in just one scene but is visually structured into three parts: Menu, Lobby Screen, and Game Screen.


Figure 3.5: Menu of the game.

Upon launching the game, the player will be presented with the Menu, encompassing a selection of 5 options:

- **Input your name:** An input text to insert your player name.

- **Tutorial:** Shows you how to play the game.

- **Select number of players:** You can choose 1 up to 4 players.

- **Quit Game:** Exit the program.

- **Start Game:** Take you to the lobby screen.

**TimeCrax Machine** is a time machine composed of **15 pieces**. At the end of each round or when a player makes a mistake while trying to relate a historical event to the timeline, one of the pieces **will randomly start to malfunction** (it will start blinking red). If a piece that is already malfunctioning is selected again, it will collapse, and the TimeCrax Machine will stop working completely, and the game ends.

The players' objective is to correctly place all **7 historical events** on the timeline before the TimeCrax Machine stops working. Each player can take **1 action per turn,** choosing from:
* **Draw a repair card;**
* **Draw a historical event card and placing it on the timeline;**
* **Giving a repair card to another player;**
* **Repairing a piece of the TimeCrax Machine.**

After taking your action, the player must click on the '**End Turn**' button for the next player to take their action. On your turn, you can also click on the timeline panel to get a better view; this doesn't count as an action.

**Click on a player's name to give one of your repair cards to them**

**Click on the 'Quit Game' button to exit the game**

**Click on the repair card deck to purchase a repair card**

**Press 'Esc' to exit the tutorial**

**Click on the timeline panel to get a better view**

**Click on the 'End Turn' button to end your turn**

**Click on a malfunctioning component to repair it**

**Click on the historical event card deck to purchase an event card and place it on the timeline panel.**

Figure 3.6: Tutorial screen.

The Lobby Screen is a place to wait until all players are ready to start the game. In the lobby screen, you can see how many players are in the room, their names, and a log that shows who entered and left the room. When the room is full, the room creator (the first one to enter) can start the game by clicking the 'Start' button, which will take all players to the Game Screen.
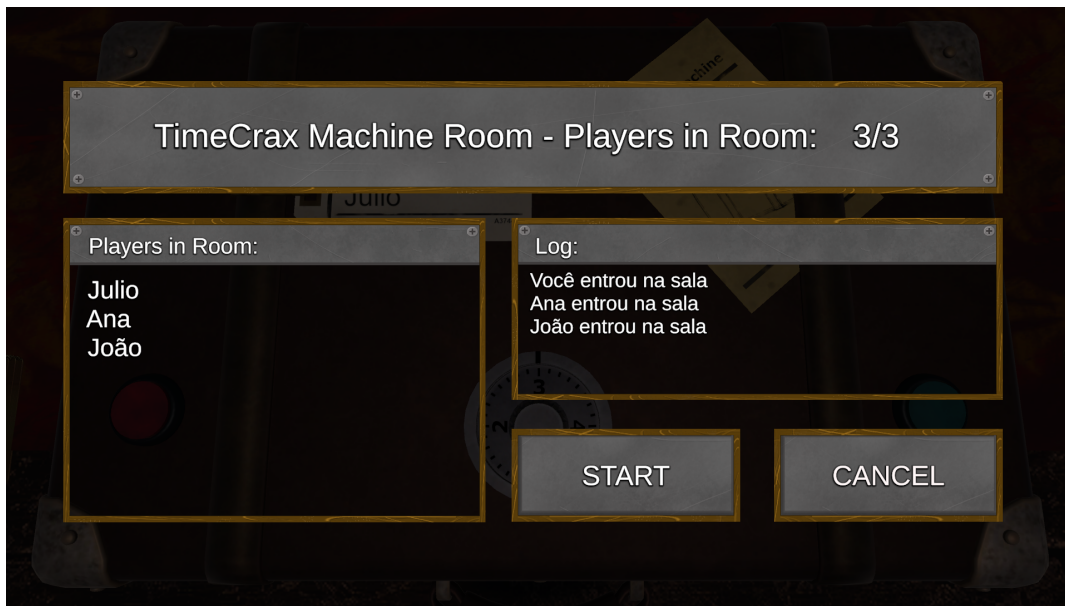
Figure 3.7: Lobby screen.

In the Game Screen the players can see all the game elements: the Repair Card Deck, the Event Card Deck, the Timeline, the Time Machine and the HUD. The HUD consists of the Quit Game button, End Turn button, and several nameplates for each of the players. On each nameplate, players can also see an icon for the Repair Card and a corresponding number indicating the quantity of repair cards that player has.

Figure 3.8: Game screen.

Every time a new round begins, players can see a notification in the center of the screen indicating the round number.



Figure 3.9: Round info.

The same happens with each turn; when a player's turn begins, a text appears in the center of the screen indicating the name of the player who is currently taking their turn.

Figure 3.10: Turn info.

When a malfunctioning component is drawn again, causing the time machine to collapse, a 'Game Over' message will appear, signaling that the players have failed, and the game has ended.


Figure 3.11: Game over screen.

When the last historical Event Card is correctly placed on the timeline, a message

saying 'You Win' will appear, indicating that the players have succeeded and completed the game.



Figure 3.12: Victory screen.

# Chapter 4

# Development

This chapter illustrates the practical development of the game, the tools employed, challenges faced, and the lessons learned.

## 4.1  Modeling Tool: Blender

Blender is an open-source and free software widely used for 3D modeling, animation, rendering, video editing, simulations, composition, and more. It is a powerful 3D creation suite that provides a wide range of tools for artists, modelers, animators, and visual effects professionals. The tool can be downloaded from the website [17].



Figure 4.1: Blender logo [17].

Utilizing my prior experience with the Blender tool, I opted for its use in crafting all the 3D assets integrated into the game. With the complete project specifications in place,

I initiated the asset development process, concurrently acquiring proficiency in Unity.

The following assets were produced: 1 card, 15 components of the time machine, 1 briefcase, 1 timeline, 1 table, 1 nameplate, 1 HUD button, 1 HUD interface, and 4 menu options. It was necessary to divide several of these assets into two or more components to facilitate animation.
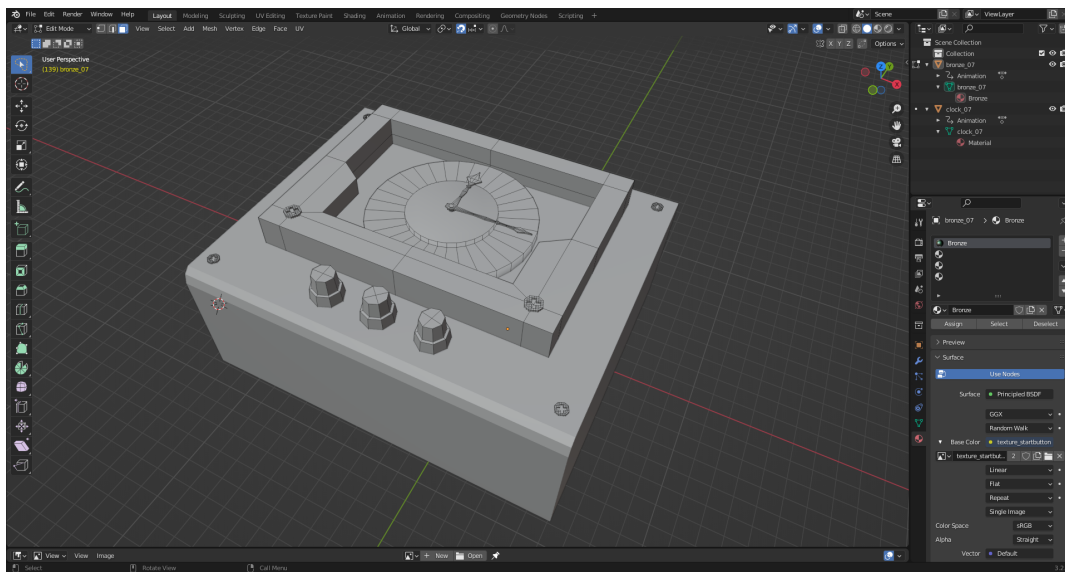


Figure 4.2: The figure represents a 3D model of a time machine component in Blender.

## 4.2  Game Engine: Unity

Unity is one of the most renowned game development engines. The term 'game engine' refers to a specific type of software that incorporates a set of programming routines enabling the design, creation, and operation of an interactive environment, such as a video game, digital experience, or film/animation. The engine can be downloaded from the website [18].
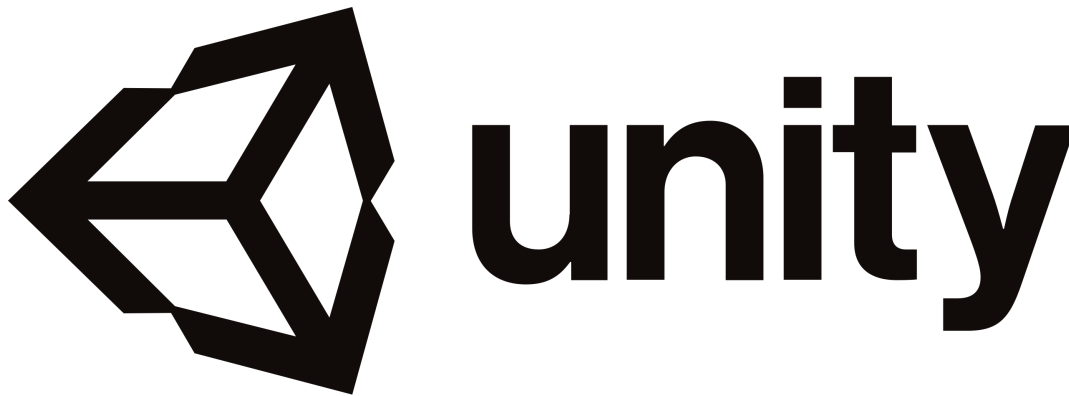
Figure 4.3: Unity logo [18].

The selection of Unity as the game engine for the development of this project stemmed from a range of considerations. These factors encompassed its cost-effectiveness as a free tool, its compatibility with the C# programming language, in which I possessed some proficiency, and its expansive user community, which facilitates the acquisition of knowledge and problem-solving.

Given my lack of prior experience with this tool, I embarked on a learning journey through online tutorials and beginner courses. However, as these courses typically do not delve into the creation of board game-style games, potentially due to their relative rarity or complexity, I encountered several challenges in adapting the knowledge I had acquired to the specific game style I intended to construct.

C# is a programming language developed by Microsoft as part of the .NET environment. It is classified as multiparadigm, features strong typing, and its object-oriented syntax is heavily influenced by C++, with elements also derived from other languages such as Object Pascal and notably Java.
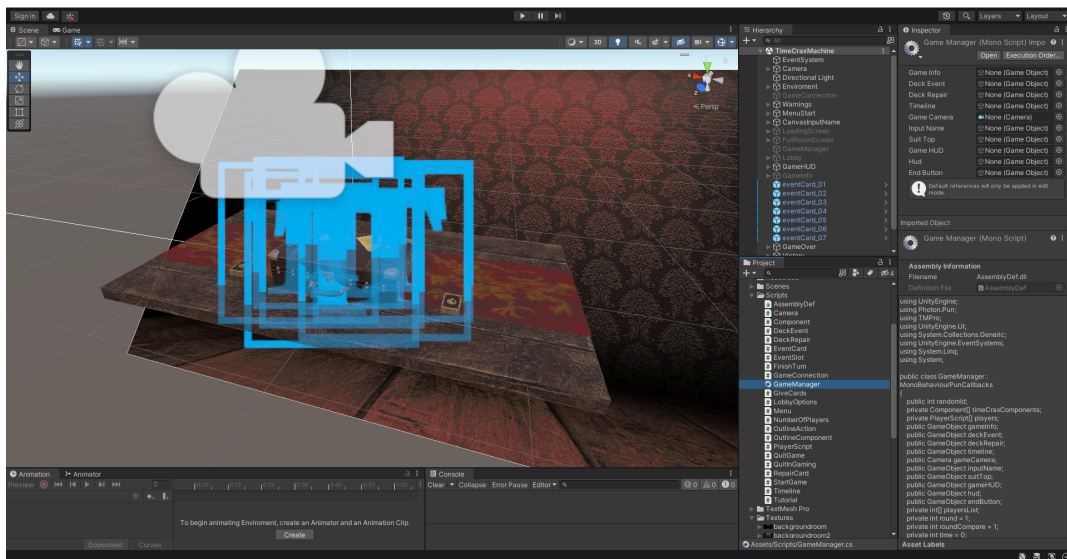
Figure 4.4: The figure represents a game scene in Unity screen.

As Unity operates on the principles of object-oriented programming, each game asset that participates in the gameplay is associated with its own class and individual script. Furthermore, various other scripts, including those responsible for managing the camera and the game itself (referred to as the Game Manager), were developed, amounting to a total of 22 scripts created.

## 4.3   Image Editor: GIMP

GIMP (GNU Image Manipulation Program) is open-source and free image editing software. It is a popular and powerful alternative to commercial image editing programs like Adobe Photoshop. The tool can be downloaded from the website [19].

Figure 4.5: GIMP logo [19].

In generating the textures, I opted for GIMP 2. My choice was based on my prior experience with the software, as well as its accessibility as free software.

GIMP was employed for crafting all the textures essential for the game's assets. Beyond just textures, GIMP was utilized for tasks like creating the background image, lobby screen, background warning screens, and general image editing.
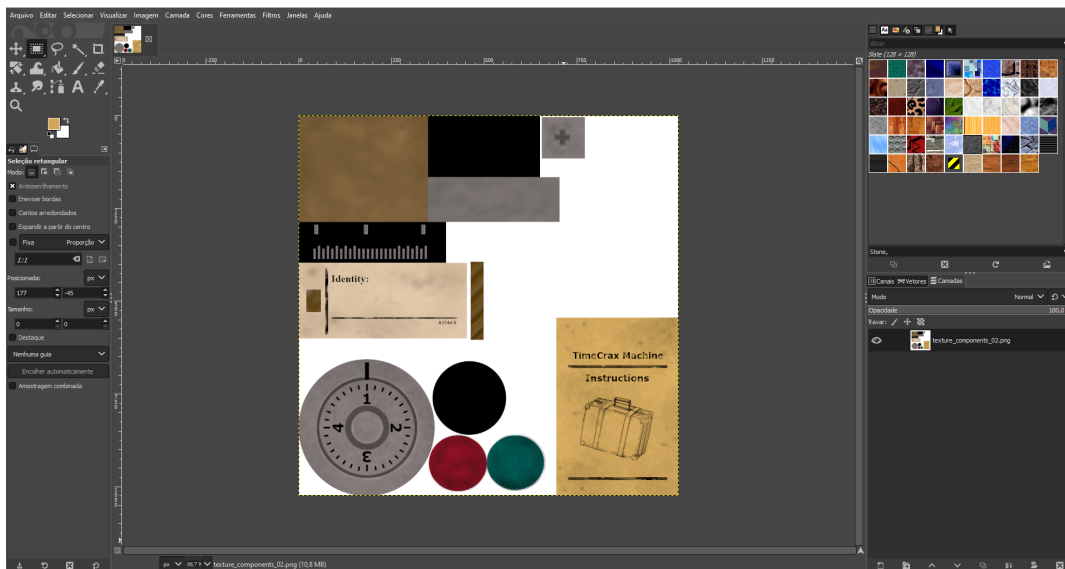


Figure 4.6: The figure represents a texture image in GIMP screen.

To generate the textures, I utilized the UV map extracted from the 3D objects in Blender. This UV mapping process involves the projection of a 3D mesh from a 3D

model onto a 2D space, streamlining subsequent texture mapping.
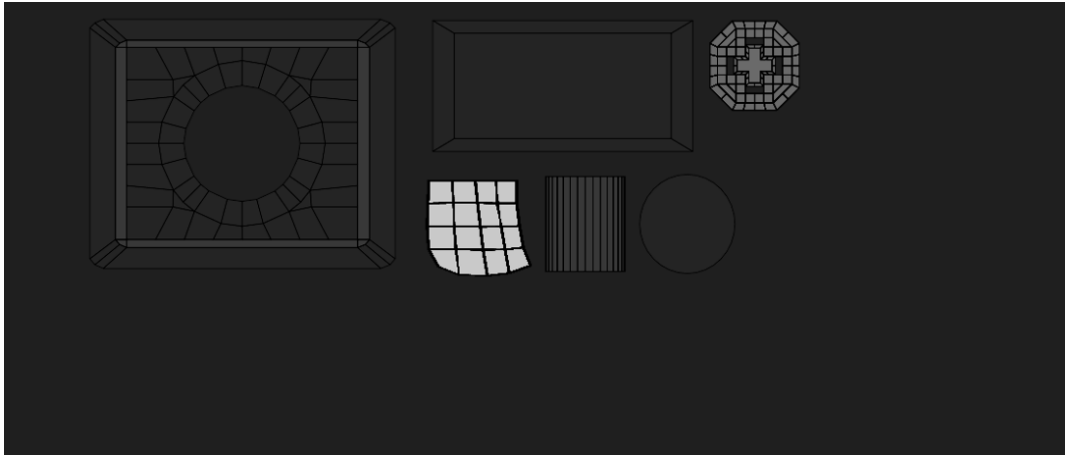


Figure 4.7: The figure represents a UV map image of a time machine component.

UV maps serve as the foundational concept in texture creation, universally applicable across various software applications. These maps are generated after modeling a polygonal 3D object and maintain the same mesh structure as the 3D object, yet all the polygons are converted into a 2D space to allow for texturing.

## 4.4   Online Connection : Photon PUN

Photon PUN (Photon Unity Networking) is an extension of Photon, a company specialized in real-time multiplayer game network technology. Photon PUN is specifically designed for integration with Unity, a popular game development engine. This extension provides a range of features and functionalities that streamline the creation of multiplayer games in Unity. You can create your account in the website [20].

Figure 4.8: Photon logo [20].

Certainly, this proved to be the most demanding aspect of the project. I initially lacked knowledge about how to establish a server that would facilitate online connections for players within the game. Subsequent to conducting thorough research on the subject matter, I encountered resources related to Photon. Upon gaining some comprehension that I could execute its implementation, I commenced the process.

The Photon Engine offers a cost-free server accommodating up to 20 simultaneous players, which adequately met the requirements for this project.



Figure 4.9: The figure represents the GameConnection script in Visual Studio screen.

There is one script dedicated solely to the lobby, but Photon is present throughout the game management, through PhotonViews, PhotonNetwork, and RPC functions.

## 4.5   IDE : Microsoft Visual Studio

Microsoft Visual Studio is an integrated development environment (IDE) developed by Microsoft. It is widely used by software developers to create applications, programs, and solutions for a variety of platforms, including desktop applications, web applications, mobile applications, and more. Visual Studio provides a range of tools and features that assist in software development, such as a code editor, debugger, project manager, version control, and integration with various programming languages, including CSharp, C++, Visual Basic, and many others. The IDE can be downloaded from the website [21].

Figure 4.10: Visual Studio logo [21].

# Chapter 5

# Experiments and Results

This chapter shows how we evaluate the players' experience and the results that we can extract from it.

## 5.1 Questionnaire

We created a questionnaire with objective questions to collect information from the players. Players were asked to play at least once and then respond to the questionnaire.

The questionnaire consists of 13 questions, which are:

- **Question 01:** Is history (in general) a topic that interests you?
  **Answers:** YES or NO

- **Question 02:** Did you manage to complete the game to the end?
  **Answers:** YES or NO

- **Question 03:** Did you manage to win at least once?
  **Answers:** YES or NO

- **Question 04:** Did you play more than once?
  **Answers:** YES or NO

- **Question 05:** Is the game intuitive?
  **Answers:** YES or NO

- **Question 06:** In your opinion, what is the level of complexity of the game?
  **Answers:** VERY EASY or EASY or MEDIUM or HARD or VERY HARD

- **Question 07:** Do you find the game's visuals appealing?
  **Answers:** YES or NO

- **Question 08:** Do you find the game's theme appealing?
  **Answers:** YES or NO

- **Question 09:** Would you recommend this game to someone?
  **Answers:** YES or NO

- **Question 10:** Did you have fun playing?
  **Answers:** YES or NO

- **Question 11:** Check which of the historical events in the game you were not familiar with.
  **Answers:** Discovery of Brazil and Battle of São Mamede and Treaty of Tordesillas and Battle of Aljubarrota and Black Death and The Fall of Constantinople and Thirty Years' War

- **Question 12:** If the game had a gameplay that delved deeper into historical events, would you find it more interesting?
  **Answers:** YES or NO

- **Question 13:** In your opinion, do games like this one facilitate the learning of history for students?
  **Answers:** YES or NO

The intention behind these inquiries is to evaluate the players' experiences, gain insights into their viewpoints and assessments of the game, and collect pertinent data to

enhance the game's quality concerning entertainment value, visual attributes, and educational efficacy. This information can prove instrumental for developers to make game adjustments rooted in player feedback and enhance its role as an effective educational tool.

## 5.2    Results

The experimental group comprised 17 participants ranging in age from 20 to 36 years, exhibiting diverse gaming preferences and skills. No specific instructions were provided regarding the rules, theme, or mechanics of the game. Each participant was requested to engage with the game at least once, and they had the flexibility to do so individually or in an online multiplayer setting.

And these were the questionnaire results:

- **Question 01:** Is History (in General) a topic that interests you?
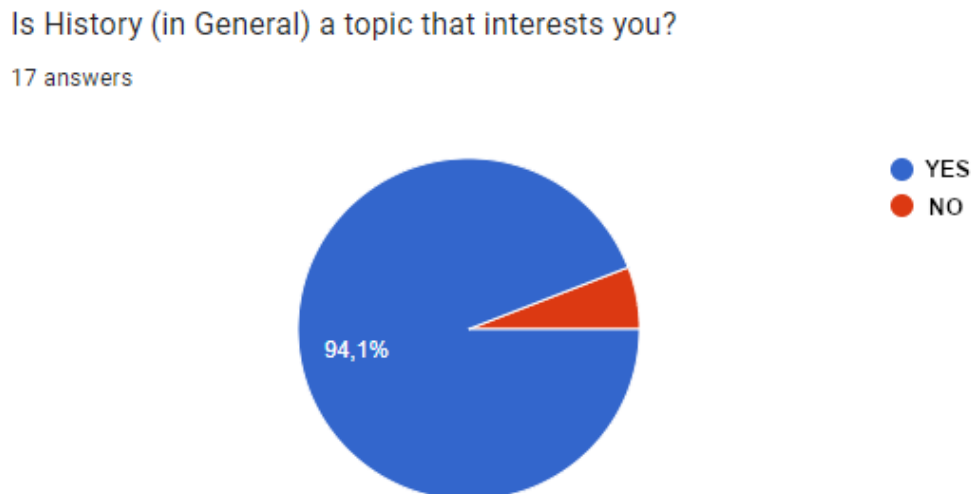


Figure 5.1: Answers to Question 01.

- **Question 02:** Did you manage to complete the game to the end?
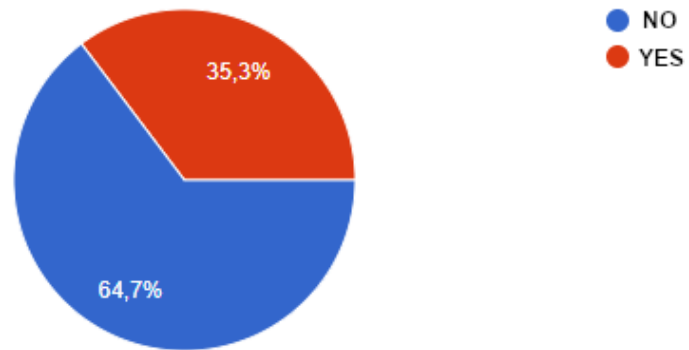
Figure 5.2: Answers to Question 02.

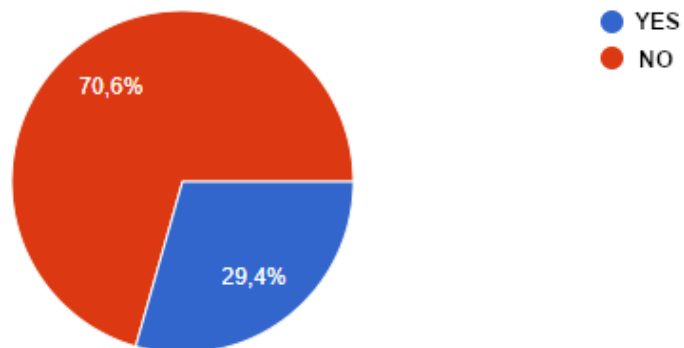- **Question 03:** How you ever managed to win?



Figure 5.3: Answers to Question 03.

- **Question 04:** Have you played more than once?

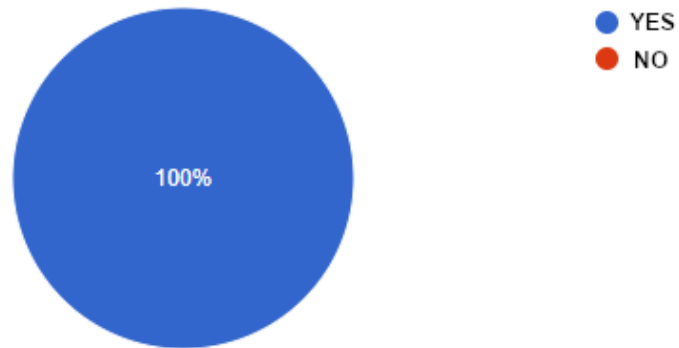Have you played it more than once?

17 answers



Figure 5.4: Answers to Question 04.

- **Question 05:** Is the game intuitive?
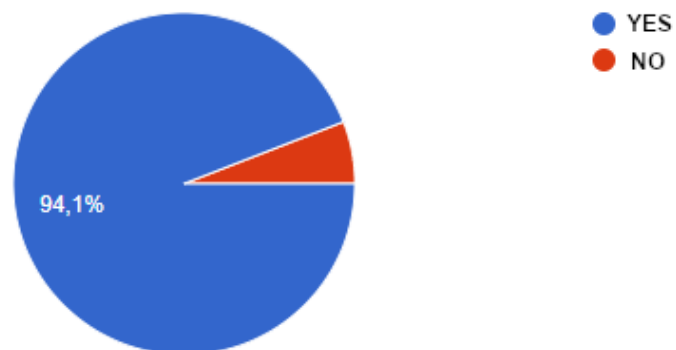
Is the game intuitive?

17 answers



Figure 5.5: Answers to Question 05.

- **Question 06:** In your opinion, how complex is the game?
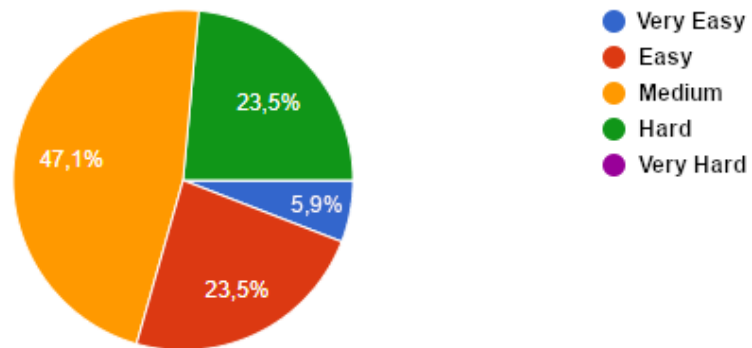
In your opinion, how complex is the game?

17 answers

- Very Easy
- Easy
- Medium
- Hard
- Very Hard

23,5%

47,1%

5,9%

23,5%

Figure 5.6: Answers to Question 06.

- **Question 07:** Does the game have a look that you like?



Does the game have a look that you like?
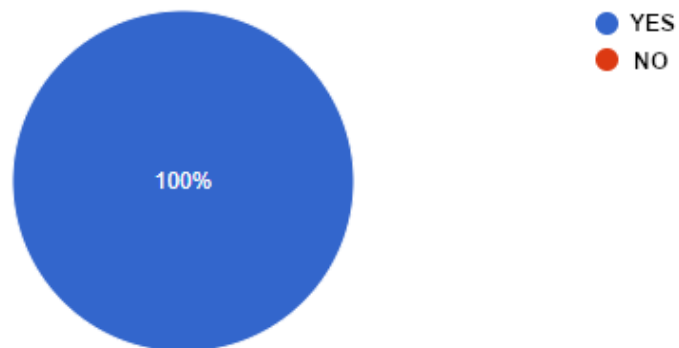
17 answers

- YES
- NO

100%

Figure 5.7: Answers to Question 07.

- **Question 08:** Does the game have a theme that you like?

Does the game have a theme that you like?
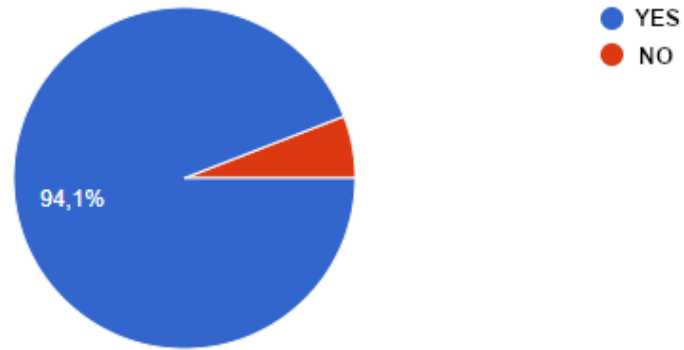
17 answers



Figure 5.8: Answers to Question 08.

- **Question 09:** Would you recommend this game to anyone?

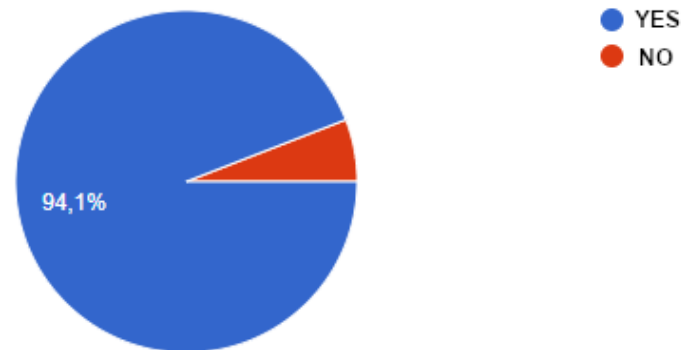Would you recommend this game to anyone?

17 answers



Figure 5.9: Answers to Question 09.

- **Question 10:** Did you have fun playing?

## Did you have fun playing?
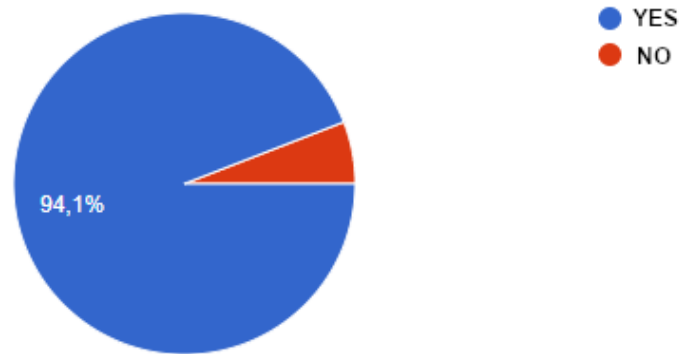
17 answers



94,1%

● YES
● NO

Figure 5.10: Answers to Question 10.

- **Question 11:** Mark which of the game's historical events you didn't know about.

## Mark which of the game's historical events you **didn't** know about

17 answers



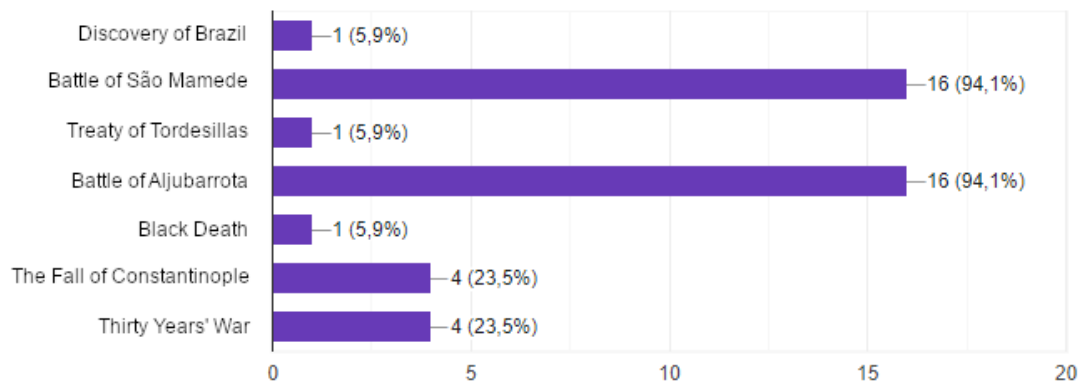| Event | Count |
|---|---|
| Discovery of Brazil | 1 (5,9%) |
| Battle of São Mamede | 16 (94,1%) |
| Treaty of Tordesillas | 1 (5,9%) |
| Battle of Aljubarrota | 16 (94,1%) |
| Black Death | 1 (5,9%) |
| The Fall of Constantinople | 4 (23,5%) |
| Thirty Years' War | 4 (23,5%) |

Figure 5.11: Answers to Question 11.

- **Question 12:** If the game had a dynamic that delved deeper into historical events, would you find it more interesting?

If the game had a dynamic that delved deeper into historical events, would you find it more interesting?
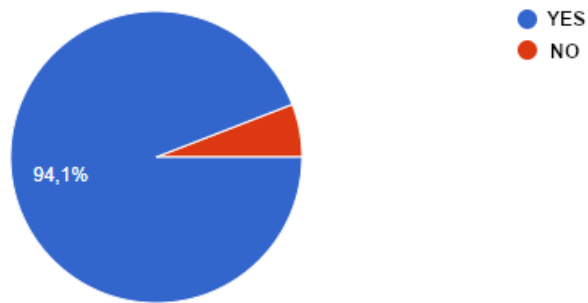
17 answers



Figure 5.12: Answers to Question 12.

- **Question 13:** In your opinion, would games like this make History learning easier for students?

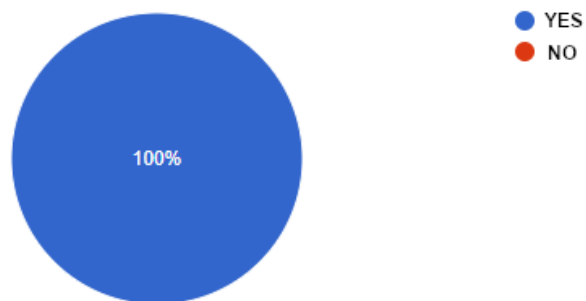In your opinion, would games like this make History learning easier for students?

17 answers



Figure 5.13: Answers to Question 13.

# Chapter 6

# Conclusions and future work

This chapter concludes this research and development work, providing an opportunity to reflect on the results achieved and envision the directions that can be taken in the future.

## 6.1 Conclusions

Creating a complex game with the intention of entertaining, providing fun, and educating is a challenging task. With limited time, knowledge, and resources, it becomes almost impossible. However, I believe that this work can be a starting point for something that truly has the potential to excel in achieving its objectives.

Educational games represent a promising approach in the field of education. The convergence of technology and learning has made it possible to create dynamic, interactive, and personalized educational experiences, ushering in a new paradigm in the teaching and learning process.

However, the development of successful educational games is not without its challenges. Striking a careful balance between entertainment and learning is crucial to ensure that educational objectives are met. Furthermore, it's essential to keep the content up-to-date and aligned with educational curricula.

As we continue to explore the potential of educational games, it's important to remember that they are not a one-size-fits-all solution but rather a valuable tool that can

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enhance education. They should be used in conjunction with other pedagogical strategies, making the most of what technology has to offer.

Ultimately, educational games open the door to a future of more engaging, motivating, and effective learning. As we continue to innovate and refine this approach, we can provide future generations with truly transformative education.

## 6.2   Future Work

This project demonstrates considerable potential for future development. There exist multiple opportunities for refining the game's mechanics, level design, and visual elements. This includes the incorporation of additional animations and visual effects to enhance player feedback concerning in-game actions.

A noteworthy enhancement would encompass the introduction of more historical events and the implementation of a dynamic timeline that adjusts to accommodate new events. This approach would ensure that players encounter fresh challenges and acquire additional knowledge in each playthrough. A more comprehensive exploration of historical events with the introduction of new rules and challenges to the game would significantly contribute to both the gameplay experience and the educational aspect. The possibilities for further enriching and expanding this project are abundant.

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