Chapter 9
Rethinking History Teaching:
A New Multiplayer Digital Games Platform to Overcome the Challenges of Engagement

João Paulo Sousa
https://orcid.org/0000-0002-9005-084X
CeDRI, SusTEC, Instituto Politécnico de Bragança, Portugal

Julio César Leal de Faria
CeDRI, SusTEC, Instituto Politécnico de Bragança, Portugal

Rogério Tavares
CeDRI, SusTEC, Instituto Politécnico de Bragança, Portugal

Rui Pedro Lopes
CeDRI, SusTEC, Instituto Politécnico de Bragança, Portugal

ABSTRACT

This work introduces a new multiplayer digital game called TimeCraX, which aims to improve history education by making it more interactive, engaging, and fun. It highlights the challenges of traditional learning and how digital games can overcome them by utilizing gamification and game-based learning. The TimeCraX game platform is designed to be cooperative, allowing students to work together to complete a challenge based on a historical timeline. The goal is to promote learning through practical experience, encouraging critical thinking, and developing collaboration and teamwork skills. The article discusses the multiplayer platform architecture of TimeCraX, which includes authentication modules, team and student

DOI: 10.4018/979-8-3693-8322-3.ch009

rankings, matchmaking, and reporting tools, all aimed at providing teachers with the tools to monitor student progress and create balanced student groups based on specific criteria. The article concludes with a discussion of the next steps for the game's development, including a play session with students to evaluate the platform's effectiveness.

INTRODUCTION

Nowadays, 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 take 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 (Fogarty et al., 2011). These educational changes have occurred in various ways, including some that were imposed and formalized by institutions, while others emerged more informally but consistently (Duarte, 2013). 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 (Blumberg & Fisch, 2013; Boyle et al., 2011; Mayer, 2016, 2019). Furthermore, introducing technological resources and games in the classroom can make the learning process more playful and motivating for children, allowing pedagogical guidance on their appropriate use and raising awareness of potential issues associated with excessive and unsupervised usage (Ramos & Segundo, 2018). The next section will review the main concepts and technologies and how they can contribute to creating multiplayer games, motivating them to participate in learning activities, and improving their understanding of content. A description of the specifications for the new version of TimeCraX will follow this. The article closes with final considerations on the work presented and future work.

BACKGROUND

Using games in teaching has proved to be an important tool in the learning process (Barba-Martín et al., 2020; Mendieta et al., 2023). Students are more engaged and motivated when learning through didactic games, as they create a collaborative and

motivating environment. In addition, games allow students to apply the knowledge they have acquired nearly, developing skills such as logical reasoning, problem-solving, and teamwork (Hinterplattner et al., 2019). As a result of this playful approach, information is retained more effectively, improving teaching effectiveness. Thus, games are a pedagogical strategy that promotes active participation of students and enhances their learning. This experience of integrating digital games into teaching is described by Bianchessi and Mendes (Bianchessi & Mendes, 2019), in which the authors use Kahoot! in history teaching to demonstrate improvements in learning when new concepts are connected to the student's existing relevant knowledge within their cognitive framework. Also, Nunes (Nunes, 2022) underscores the significance of choices and critical thinking in human life and relates them to the gaming experience. It accentuates how digital games can be effective educational tools, especially for Generation Z students.

Gamification

Gamification uses game principles, mechanics, and design elements in non-gaming contexts, often implemented through digital platforms (Luo, 2022). Its purpose is to solve problems, stimulate engagement, and motivate people to achieve specific goals. This methodology provides an interactive and playful experience, reinforcing participants' feelings of autonomy, competence, and interaction. 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 various contexts (Antal-Berbecaru et al., 2023). Its significant impact in various sectors has reshaped traditional engagement approaches, especially in education (Christopoulos & Mystakidis, 2023). Games and gamification-based evaluation and intervention hold significance due to various factors. Gamification can enhance the appeal and enjoyment of tasks, facilitating behavior modification and increasing adherence to interventions. It also effectively engages individuals who may be introverted or easily distracted, leading to greater engagement and improved communication (Saud et al., 2023). The strategic use of gamification can make learning more enjoyable, elevate engagement levels, and ultimately yield improved student outcomes (Rincón-Flores et al., 2019). When applied in human resource management, gamification can enhance job satisfaction, increase engagement, and boost overall performance (Sanmugam et al., 2015). In the context of assessment, gamification can significantly increase engagement and participation (Yıldırım, 2023).

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 (Zheng et al., 2024). Video games have the potential to facilitate learning due to their enjoyable, engaging nature and interactive user interfaces (Dondio, 2024). The Greek educational system delivers post-gymnasium vocational education and training at level three through Vocational Training Schools and Vocational Apprenticeship Schools under the Manpower Employment Organization. These schools aim to address issues such as school dropout, enhance fundamental skills for compulsory education graduates or their equivalents, and integrate them into the labor market (Triantafyllou, 2022). Developing interactive and entertaining games, primarily designed for educational purposes, is a significant step in implementing game-based learning (GBL). 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 (Dondio, 2024). Game-based learning has gained extensive acknowledgment as a proficient educational and training instrument (Zheng et al., 2024). In the last ten years, academia and edutainment domains have experienced a notable upswing in attention towards serious games, GBL, e-learning, and gamification (Allan et al., 2024). These concepts exhibit significant intersections and frequently incorporate common elements. In practical terms, discerning between games and "artifacts with game elements" can be challenging, emphasizing the complex interconnections among these educational methodologies (Shaheen et al., 2023).

Multiplayer Turn-Based Game

Turn-based games typically involve a structured sequence of actions each player takes in a turn-based manner, as in a traditional game of chess, where one player must wait for the other to finish their turn before playing their own. So, the gameplay of a digital turn-based game can be summarized as follows:

- Turn Structure: In a turn-based game, players take turns to make their moves or perform their actions. This could involve moving characters, attacking enemies, using items, or casting spells. In a digital game like Honkai Star Rail (MiHoYo, 2023), the player controls four characters who attack one or more enemies, after which the enemies fight back in a structured order.
- Action Selection: Players select from a set of available actions during their turns. These actions can vary depending on the game but commonly include movement, combat, defense, item usage, or special abilities. In Total War, the

player advances with his troops, chooses weapons, and monitors senate votes, among other actions.

- Planning and Strategy: Turn-based games often require strategic planning as players need to anticipate their opponent's moves and plan their actions accordingly. In Honkai Star Rail (MiHoYo, 2023) the player needs to study the enemies, and choose the best team with the best healers or damage dealers, to complete the missions. This strategic element is a key part of the gameplay experience.
- Resource Management: Many turn-based games involve managing resources such as health points, magic points, ammunition, or other consumable items. Players must decide how to allocate and use these resources effectively. In Sid Meyer´s Pirates! (Firaxis Games, 2004), players choose how to invest the money to improve their pirate ships; in Rome's Total War, (Creative Assembly, 2004) they decide if they will increase or decrease taxes so that the population can have more children and thus provide more soldiers or more money to pay the government bills.
- Turn Order: The turn order can be determined by various factors, such as character speed, player input, or a predefined sequence. Some games may allow for simultaneous turns or have variations in turn order based on specific game mechanics. Sometimes, it is a good idea to provide more speed for some characters so that they can make more moves, but this can break up the team's structured order, so the player must improvise to solve the lack of life or energy that the change in order may have caused. In Honkai Star Rail (MiHoYo, 2023) single-target damage characters usually get more speed so that they can attack more often, but this can change the team order, so they don't get the amount of energy they need to stay alive.
- Feedback and Resolution: After each player completes their turn, the game provides feedback on the actions' outcomes. This could involve displaying damage dealt, effects applied, or other consequences of the player's choices. The SimCity franchise (Arts, 1989) took this feedback from an investment and city growth spreadsheet. It was common for some players to print out these spreadsheets and display them on the notice board to show how well they performed as mayors of their digital cities.
- Win Conditions: The game typically has specific win conditions that players aim to achieve, such as defeating all opponents, reaching a particular objective, or fulfilling certain criteria. For example, players must complete the mission in less than ten turns with all the characters alive and with more than 20,000 points to get all the rewards.
- Strategic Depth: Since the resources are limited, turn-based games often offer a high degree of strategic depth, requiring players to consider their moves

carefully and plan several turns ahead. Some characters are better at long missions, and others are better at missions with fewer enemies.

- Adaptability and Decision-Making: Players must adapt to changing circumstances, make effective decisions, and react to their opponent's actions during the game. In the most difficult missions, players of Star Trek Timelines (Disruptor Beam, 2016) need to balance the team by choosing even the characters who won't be able to fulfill their part but will allow the others to progress to the end.
- Variety of Game Types: Turn-based it's not a genre by itself but a kind of gameplay that can be found in various genres, including role-playing games (RPGs), strategy games, tactical games, and more, each with its own set of mechanics and rules.

As we can see from the examples above, turn-based games exploit strategic thinking, while real-time games exploit quick decision-making and motor coordination approaches.

Multiplayer Architectures

Network models for multiplayer games delineate the architecture and design facilitating communication between information sources and destinations, whether between a client and server or among peers. In this context, a server, the entity determining the current state of the world, receives information from clients, entities sharing their version of the game or world state (Ali et al., 2009). The challenge addressed by multiplayer network models involves implementing net code solutions to deliver a consistent experience to all connected players across various devices. Two prevalent models are the client-server and peer-to-peer models. The client-server architecture involves a server hosting game logic and providing information to clients, who, in turn, can send data such as inputs and actions (Torreao, 2013). Within this model, any provider of information or services is labeled a server, while service requesters and receivers are referred to as clients. The server is typically a dedicated game server, focusing on simulating the game state and relaying information. Players may assume a server (or host) role in a peer-to-peer topology. The peer-to-peer model connects players directly without a central server. Unlike client-server models, which designate a server holding the authoritative state, each player's device in a peer-to-peer model is responsible for executing game logic and negotiating with others (Yahyavi & Kemme, 2013).

Turn-based multiplayer games can be a powerful tool for fostering student collaboration, critical thinking, and strategic decision-making (Gunter et al., 2008). By integrating these games into the educational environment, students can apply the knowledge they have acquired in a practical way while developing teamwork

and communication skills (Hinterplattner et al., 2019). Furthermore, turn-based multiplayer games' interactive and competitive nature can stimulate student engagement, encouraging them to participate in learning activities actively. In summary, the gameplay of a turn-based game revolves around strategic decision-making, structured turn order, resource management, and achieving specific win conditions. This type of gameplay provides a different experience than real-time action games, emphasizing tactical planning and critical thinking.

TIMECRAX GAME DESIGN

Game design can be defined as the formal methods utilized in the specification and planning of a game's content and features (Gunter et al., 2008). Game designers produce game specifications that demonstrate the initial look and feel of the game interface and identify system behaviors for rules of interaction and procedures for gameplay and game controls that users will navigate in the virtual world (Rankin et al., 2008).

Storytelling

TimeCraX is a time-travel machine stumbled upon by four friends while playing explorers in the woods (Lopes et al., 2015). 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 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 a peculiar machine's lever. As he freed his foot, the machine suddenly roared to life, spinning gears and interlocking in a mesmerizing dance. Alone and bewildered, he cried out for his friends just as the world around him transformed. 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 historical

points. One of held a broken lever while the other three called out for their missing companion, examining the fractured gear now resting in their hands.

Mechanics

TimeCraX Machine is a cooperative turn-based tabletop card game in which each player takes sequential actions before passing the turn to the next player (Figure 1).

Figure 1. TimeCraX game screen.

Based on the story of TimeCraX and the game mechanics, the main objective for players is to work together to complete the challenge imposed by the Timeline. They must correctly position historical events in the timeline slots before the time machine's integrity deteriorates. The machine, which is shared by all, is fragile and, as time progresses, it begins to collapse. If they fail to solve the puzzle within the given time, the players will be trapped forever in different moments of history.

Cooperation is essential for success, as each player must use their historical knowledge to minimize errors and save time. Every mistake compromises the machine's structure, making it harder to proceed. Therefore, uniting efforts and maintaining clear communication among players is key to winning the game, restoring the timeline, and escaping the eras to return to the present.

The TimeCraX Machine is divided into two main components: the Timeline and the Time Machine. The Timeline (Figure 2) is a panel featuring seven slots, each representing a specific historical year. The game's objective is for players to fill these

slots with the correct event cards, thus completing the historical timeline so they can travel through time. A player's historical knowledge reduces the likelihood of timeline placement errors and earns rewards for accuracy. Misplaced events return to the deck, offering another opportunity for correct placement and promoting learning.

Figure 2. Timeline Panel.

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. If 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.

Repair Cards are used to fix a malfunctioning component of the time machine. You need several Repair Cards equal to the number of players to repair each component. In other words, if there are 3 players in the game, then a total of 3 Repair Cards is necessary to restore a single component of the time machine. When pos-

sessing at least one repair card, players can provide a repair card to another player. Each player is allowed to keep a maximum of 5 repair cards. When this number is reached, the next repair card must either be used to repair the time machine or given to another player. This means that the difficulty can increase in games with more players, requiring a greater collaborative effort to gather the necessary repair cards.

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 returns to 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. Time Machine.

As the game progresses, the difficulty increases. With each new malfunction in the time machine, the likelihood of that faulty component being selected again rises, elevating the risk of a total breakdown. This is a multiplayer game where players work together against the machine, and each one must make strategic decisions. Their collective efforts must balance managing these growing risks with accurately placing historical events on the timeline. If any one player succeeds, they all win and return to the present. However, if just one player fails, they will all be trapped in time forever. Following the initial playtesting scenarios, the platform could incorporate other difficulty mechanisms to enhance the challenge. One option is introducing a timer for each round or the entire game, which would increase pressure on players, forcing them to make faster and more strategic decisions. Another enhancement could involve stricter penalties for errors, such as deducting more time from the timer or disabling additional time machine components, raising the stakes and difficulty. Additionally, random events could be implemented, such as sudden malfunctions

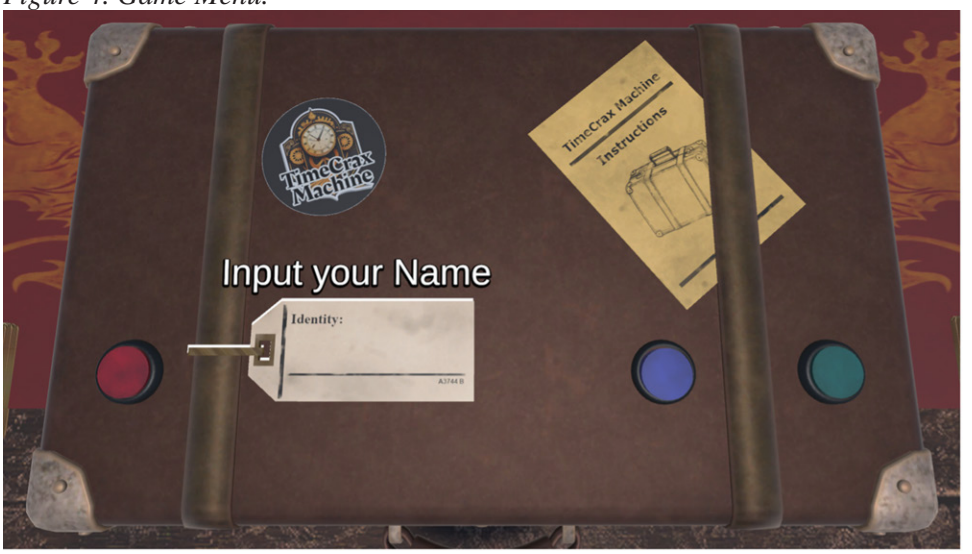
in the time machine or changes in the order of historical events, adding unexpected challenges and testing players' adaptability.

ACTUAL GAME DESIGN

The entire game was built in a single scene but is visually structured in three parts: Menu (Fig. 4),

Lobby Screen, and Game Screen.

Figure 4. Game Menu.



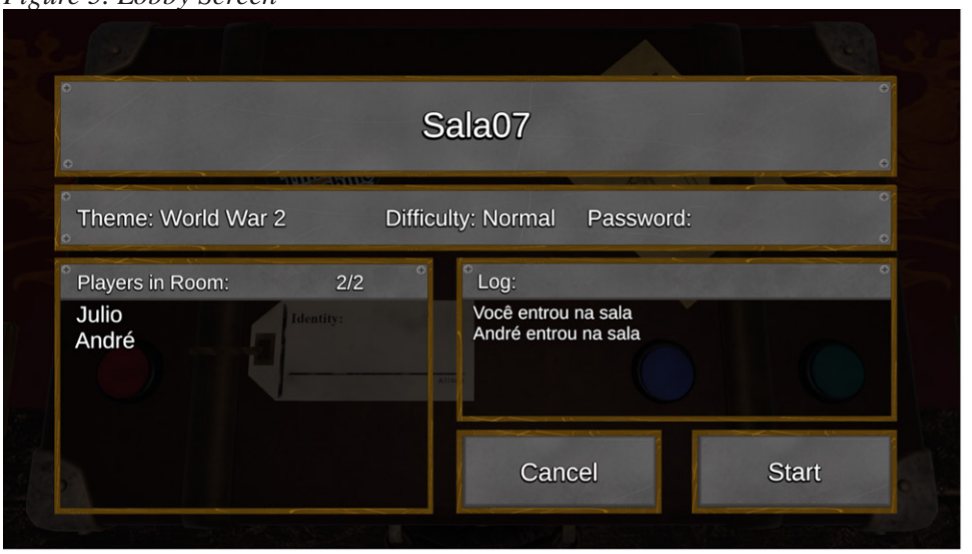
Upon starting the game, the player is presented with the Menu, which includes a selection of 5 options:

- Enter your name: A text field for entering the player's name.
- Tutorial: Shows how to play the game.
- Select the number of players: You can choose between 1 and 4 players.
- Exit the game: Exits the program.
- Start game: Takes you to the lobby screen.

The lobby screen (Fig. 5) is where you can 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 has entered and left the room. When the room is

full, the room creator (the first to enter) can start the game by clicking the “Start” button, which will take all players to the game screen.

Figure 5. Lobby Screen



On the Game Screen (Fig. 6), 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 Exit Game button, the End Turn button, and various identification plates for each of the players. On each identification plate, players can also see an icon for the Repair Card and a corresponding number indicating the amount of Repair Cards the player has.

Figure 6. Game Screen and Round Information

Players can see a notification in the middle of the screen indicating the round number whenever a new round starts. The same happens with each turn; when a player's turn starts, a text appears in the mid of the screen indicating the name of the player who is taking their turn. When a faulty component is drawn again, causing the time machine to collapse, a “Lost in time!” message indicates that the players have failed and that the game has ended. When the last historical Event Card is correctly placed on the Timeline, a message saying, “You're back!” indicates that the players successfully completed the game.

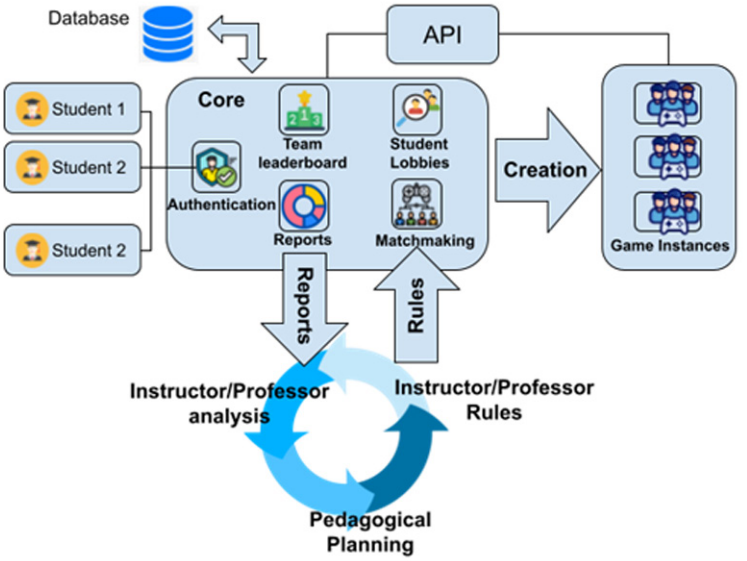
DIGITAL TIMECRAX MULTIPLAYER SPECIFICATION

The main goal of this platform is to develop a framework that enables the creation of multiplayer games for students as a tool for engagement and learning, integrating with TimeCraX, which is currently under development and presented in the previous section. The platform will be used in History classrooms, adapted for cooperative activities and problem-solving, where students must work together to solve challenges. Additionally, it will offer teachers tools to closely monitor students' progress throughout the activities.

The fundamental requirements of the platform are that it should support the creation of groups of students who will be thrown into individual game rooms that allow for a multiplayer game session. Based on these requirements, the proposed platform is

organized into two main blocks (Figure 2): the Core and the Game Instances. The Core comprises five modules that interact with each other: Authentication, Team Leaderboards, Students, Matchmaking, and Reports.

Figure 7. TimeCraX Multiplayer platform architecture.



Matchmaking

The Matchmaking module's function is to create cohesive and balanced groups of students, thus promoting an environment conducive to collaboration and teamwork. The matchmaking system uses the rules set by the teacher to form groups that have an ideal combination of talents, skills, and group dynamics. Some examples to be considered in the matchmaking algorithm:

- Score-Based Grouping (Skill-Based Matchmaking): This algorithm groups players with similar skills, using a score that represents their level of performance in the game. This score can be calculated based on match history, such as wins, losses, and individual scores (Zook, 2019). The Elo system, used in games such as chess and League of Legends (Véron et al., 2018), is an example of a scoring system that could be adapted for TimeCraX.

- By ability: Grouping students based on their individual skills in certain subjects, allowing them to play together to support each other and develop their competencies.
- By interests: Form groups based on students' interests, making it easier to play games on topics that motivate them and get them more involved in learning.
- By performance: Group students according to their academic performance to support those struggling and more advanced challenges to those who excel during the game.
- More examples (Joshi et al., 2012; Oakes & Guiton, 1995; Olugbara et al., 2015; Störmann et al., 2010) can be used directly or adapted in the matchmaking module.

Adaptation to the scoring system:

- Defining Relevant Metrics: metrics for evaluating performance include:
  - Number of historical events correctly positioned.
  - Time taken to complete the timeline challenge.
  - Number of time machine failures.
  - Level of collaboration between players (e.g., number of repair cards shared).
- Assigning Weight to the Metrics: Determining the relative importance of each metric in calculating the overall score. For example, correctly positioning historical events might be more important than the time taken to complete the challenge.
- Teacher Interface: Allowing teachers to view student scores and, potentially, adjust the scoring system to align with their educational objectives.

Other considerations can be considered when developing the matchmaking module to ensure a balanced and enjoyable player experience. The system must account for the learning curve of new players, allowing them time to grasp the game's rules and mechanics. Additionally, it should be carefully balanced to maintain motivation for all participants, particularly those with lower scores, to prevent discouragement. Finally, the module should balance rewarding teamwork and recognizing individual performance, fostering collaborative play and personal skill development. By addressing these considerations, the matchmaking system can create fair, engaging matches that cater to players of all skill levels and play styles.

Team Leaderboard

The Team Leaderboard module offers a method to monitor and compare the performance of participants or teams over time, typically in games or competitions. In this context, the benefits of a Team Leaderboard include:

- Motivation and Competition: It fosters healthy competition among teams, encouraging them to enhance their performance and collaboration.
- Feedback and Learning: It provides clear feedback on team strengths and weaknesses, enabling them to identify areas for improvement.
- Continuous Engagement: The ability to track progress and compare performance with other teams increases student interest and involvement in the game.

Reports

The main objective of the Reports module is to provide teachers with information about student progress, both individually and as a team, so they can guide the learning process and adjust the matchmaking rules. Information to Include in Reports:

- Individual Performance:
  - Overall game score: Allows tracking the student's progress over time.
  - Number of historical events correctly positioned: Indicates the student's historical knowledge level and ability to apply that knowledge in the game.
  - Average time per round: Reveals the student's reasoning speed and ability to make strategic decisions under pressure.
  - Types of mistakes made: Help identify areas where the student needs more support, such as specific historical periods or critical concepts.
  - Repair cards used and received: Demonstrates the student's ability to collaborate and manage resources effectively.
- Team Performance:
  - Overall team score in games: Allows comparison of different groups' performance and identifies teams needing additional support.
  - Total number of events correctly positioned: Indicates the team's overall effectiveness in solving the challenge.
  - Total game time: Shows how quickly and efficiently the team works together.

- Communication and collaboration: A more advanced feature is to create a mechanism to evaluate the quality of communication and cooperation among team members.

Student Lobbies

The Student Lobbies module brings students together after matchmaking and before starting matches or between matches. Just like in the Lobby of a game, students/players can configure game options before the start of the match (e.g., team name, avatar, etc.).

Bringing it all together

The platform's operation can be described in three main phases: setup, where teachers customize the game, and students register; game cycle, featuring intelligent matchmaking and virtual lobbies; and monitoring, with detailed reports for pedagogical decisions and feedback.

Initial setup:

- Teacher Registration: The teacher registers by filling out their profile and creating virtual classrooms.
- Player Profile Creation: The teacher invites students to register on the platform, during which each student creates a player profile that will be stored persistently in a database.

Loop game:

- Login and Presence Status: Upon logging in, the student's presence status changes to “online,” indicating that they can participate in games.
- Matchmaking Rules Definition: Based on performance reports, affinities, and individual preferences, the teacher establishes a set of personalized rules to guide the matchmaking process.
- Matchmaking Authorization: The teacher determines whether matchmaking will occur automatically or require authorization for each new game.
- Group Formation and Lobbies: Using the defined rules, the matchmaking module forms groups of students who are then directed to lobbies where they wait for the game to begin.
- Game Instance Creation: Once the group is formed and ready, the platform creates an instance of the TimeCraX game, adding the players to that game instance.
- Game Loop: Students play TimeCraX collaboratively in the created instance while the platform monitors individual and team performance.

- Leaderboard Updates: At the end of each game, the Team Leaderboard is updated with each team's overall performance, while the Player Leaderboard reflects the individual performance of each player. All scores are stored persistently in a database.

Monitoring and individual feedback:

- Detailed Reports: The teacher accesses detailed reports on students' performance, both individually and as a team.
- Adjustments and Interventions: Based on the reports, the teacher can adjust the matchmaking rules, adapt their teaching strategies, provide personalized feedback to students, and intervene in situations that require attention.

FINAL REMARKS

Multiplayer games can play a significant role in teaching, as they can provide a playful and interactive environment that stimulates learning more effectively. In addition, multiplayer games can provide opportunities for students to develop skills such as collaboration and teamwork, problem-solving and critical thinking, encouraging communication, and making the learning process more engaging and motivating.

This paper showed how we approached the design and implementation of a platform that supports the creation of multiplayer games based on rules derived from a pedagogical analysis based on the history of individual or team performance of students/players in these games. We are currently finalizing a prototype that uses the architecture presented in section 4.2, the TimeCraX Machine; this vertical slice is a 3D online multiplayer digital game in the style of a board game with up to 4 players that aims to convey and encourage general historical knowledge to players while providing fun and entertainment. Future work will involve finalizing the implementation details of the game, conducting a session with a group of students, and evaluating their learning experiences to assess the platform's effectiveness. Although the platform was initially designed for teaching history, which may restrict its applicability to other disciplines, efforts will be made to extend its use to a broader range of subjects.

REFERENCES

Ali, A., Ismail, A., & Bade, A. (2009). *An Overview of Networking Infrastructure for Massively Multiplayer Online Games*. https://www.semanticscholar.org/paper/An-Overview-of-Networking-Infrastructure-for-Online-Ali-Ismail/887b374b1010ca23a01bb89b71e40fd31e34ce92

Allan, R., McCann, L., Johnson, L., Dyson, M., & Ford, J. (2024). A systematic review of 'equity-focused' game-based learning in the teaching of health staff. *Public Health in Practice, 7.Public Health in Practice (Oxford, England)*, 7, 100462. Advance online publication. DOI: 10.1016/j.puhip.2023.100462 PMID: 38283754

Antal-Berbecaru, A., Larchen Costuchen, A., & Dev, S. (2023). Survey Gamification: Engaging Generation Z. *Computers in the Schools.Computers in the Schools*, 1–25. Advance online publication. DOI: 10.1080/07380569.2023.2271486

Arts, E. (1989). *Jogos SimCity™—Site Oficial da EA*. Electronic Arts Inc. https://www.ea.com/pt-br/games/simcity

Barba-Martín, R. A., Bores-García, D., Hortigüela-Alcalá, D., & González-Calvo, G. (2020). The application of the teaching games for understanding in physical education. Systematic review of the last six years. *International Journal of Environmental Research and Public Health, 17*(9). *International Journal of Environmental Research and Public Health*, 17(9), 3330. Advance online publication. DOI: 10.3390/ijerph17093330 PMID: 32403272

Bianchessi, C., & Mendes, A. (2019). Ensino de história por meio de jogos digitais: Relato de aprendizagem significativa com games. *Revista Tempos e Espaços em Educação*, 12(29), 13. DOI: 10.20952/revtee.v12i29.9660

Blumberg, F. C., & Fisch, S. M. (2013). Introduction: Digital Games as a Context for Cognitive Development, Learning, and Developmental Research. *New Directions for Child and Adolescent Development*, 2013(139), 1–9. DOI: 10.1002/cad.20026 PMID: 23483688

Boyle, E., Connolly, T. M., & Hainey, T. (2011). The role of psychology in understanding the impact of computer games. *Entertainment Computing*, 2(2), 69–74. DOI: 10.1016/j.entcom.2010.12.002

Christopoulos, A., & Mystakidis, S. (2023). Gamification in Education. *Encyclopedia*, 3(4), 4. Advance online publication. DOI: 10.3390/encyclopedia3040089

Creative Assembly. (2004). *Total War: Rome*. Total War. https://www.totalwar.com/

Disruptor Beam. (2016). *STAR TREK TIMELINES*. STAR TREK TIMELINES. http://www.startrektimelines.com/

Dondio, P. (2024). Does Playing Video Games Give a Child an Advantage in Digital Game-Based Learning? *Lecture Notes in Computer Science (Including Subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics), 14475 LNCS*, 223–233. *Lecture Notes in Computer Science*, 14475, 223–233. Advance online publication. DOI: 10.1007/978-3-031-49065-1_22

Duarte, A. S. de C. (2013). *A utilização das TIC no ensino e aprendizagem da história* [masterThesis]. https://repositorio.ul.pt/handle/10451/10334

Firaxis Games. (2004). *Sid Meier's Pirates! [PC]*. Sid Meier's Pirates! [PC]. https://firaxis.com/

Fogarty, L., Strimling, P., & Laland, K. N. (2011). The Evolution of teaching. *Evolution; International Journal of Organic Evolution*, 65(10), 2760–2770. DOI: 10.1111/j.1558-5646.2011.01370.x PMID: 21967419

Gunter, G. A., Kenny, R. F., & Vick, E. H. (2008). Taking educational games seriously: Using the RETAIN model to design endogenous fantasy into standalone educational games. *Educational Technology Research and Development*, 56(5), 511–537. DOI: 10.1007/s11423-007-9073-2

Hinterplattner, S., Skogø, J., & Sabitzer, B. (2019). *Beyond the game: Exploring winning strategies with gifted students. 2019-October*, 325–331. *Scopus.*, 40. Advance online publication. DOI: 10.34190/GBL.19.116

Joshi, M., Manoj, L., Oludayo, O. O., Modiba, M. M., & Virendrakumar, C. B. (2012). Automated matchmaking of student skills and academic course requisites. *Proceedings of the CUBE International Information Technology Conference*, 514–519. DOI: 10.1145/2381716.2381814

Lopes, R., Tavares, R., & Mesquita, C. (2015, November 13). TimeCraX: Time-travelling to learn history. *Conference: SBGames 2015 - XIV Simpósio Brasileiro de Jogos e Entretenimento Digital*. SBGames 2015.

Luo, Z. (2022). Gamification for educational purposes: What are the factors contributing to varied effectiveness? *Education and Information Technologies*, 27(1), 891–915. DOI: 10.1007/s10639-021-10642-9

Mayer, R. E. (2016). What Should Be the Role of Computer Games in Education? *Policy Insights from the Behavioral and Brain Sciences*, 3(1), 20–26. DOI: 10.1177/2372732215621311

Mayer, R. E. (2019). Computer Games in Education. *Annual Review of Psychology*, 70(1), 531–549. DOI: 10.1146/annurev-psych-010418-102744 PMID: 30231003

Mendieta, C. H. A., Jara, J. P. C., Taco, C. E. C., Sánchez, R. P. S., & Pumagualle, M. L.-R. V. (2023). Innovative Educational Technology: The Impact of an Interactive Video Game on History Teaching for Basic Education Students and its Link to Cultural Identity in Migration Contexts. [Scopus.]. *Migration Letters : An International Journal of Migration Studies*, 20, 475–490.

MiHoYo. (2023). *Honkai Star Rail [PC, PlayStation 4, PlayStation 5]*. Honkai Star Rail [PC, PlayStation 4, PlayStation 5]. https://hsr.hoyoverse.com/pt-pt/

Nunes, V. A. (2022). *Descobrindo o passado: O uso do rpg digital como artefato para mobilizar o conceito de empatia histórica*. Universidade do estado do Rio de Janeiro 2022.

Oakes, J., & Guiton, G. (1995). Matchmaking: The Dynamics of High School Tracking Decisions. *American Educational Research Journal*, 32(1), 3–33. DOI: 10.3102/00028312032001003

Olugbara, O. O., Joshi, M., Modiba, M. M., & Bhavsar, V. C. (2015). *Automated Matchmaking to Improve Accuracy of Applicant Selection for University Education System* (arXiv:1507.02439). arXiv. https://doi.org//arXiv.1507.02439DOI: 10.48550

Ramos, D. K., & Segundo, F. R. (2018). Jogos Digitais na Escola: Aprimorando a atenção e a flexibilidade cognitiva. *Educação & Realidade*. https://doi.org/DOI: 10.1590/2175-623665738

Rankin, Y. A., McNeal, M., Shute, M. W., & Gooch, B. (2008). User centered game design: Evaluating massive multiplayer online role playing games for second language acquisition. *Proceedings of the 2008 ACM SIGGRAPH Symposium on Video Games*, 43–49. DOI: 10.1145/1401843.1401851

Rincón-Flores, E. G., Montoya, M. S. R., & Mena, J. (2019). *Engaging MOOC through gamification: Systematic mapping review*. 600–606. *Scopus.*, 600–606. Advance online publication. DOI: 10.1145/3362789.3362831

Sanmugam, M., Zaid, N. M., Mohamed, H., Abdullah, Z., Aris, B., & Suhadi, S. M. (2015). Gamification as an educational technology tool in engaging and motivating students; An analyses review. *Advanced Science Letters, 21*(10), 3337–3341. *Scopus.* Advance online publication. DOI: 10.1166/asl.2015.6489

Saud, S., Aeni, N., & Azizah, L. (2023). *Engaging the EFL Students in Online Class Through Gamification. 2736*(1). *Scopus.*, 090007. Advance online publication. DOI: 10.1063/5.0170648

Shaheen, A., Ali, S., & Fotaris, P. (2023). Assessing the Efficacy of Reflective Game Design: A Design-Based Study in Digital Game-Based Learning. *Education Sciences*, 13(12), 1204. DOI: 10.3390/educsci13121204

Störmann, S., Von Der Borch, P., & Dimitriadis, K. (2010). Online matchmaking enables large-scale individual mentoring. *Medical Education*, 44(5), 492–493. DOI: 10.1111/j.1365-2923.2010.03663.x PMID: 20374458

Torreao, V. de A. (2013). *Comparison between client-server, peer-to-peer and hybrid architectures for MMOGs*. https://www.semanticscholar.org/paper/Comparison-between-client-server-%2C-peer-to-peer-and-Torreao/3fb797609e219abdd9723d41aea37c19179afcf9

Triantafyllou, S. (2022). *Game-Based Learning and Interactive Educational Games for Learners – An Educational Paradigm from Greece*. DOI: 10.33422/6th.icmrss.2022.10.20

Véron, M., Marin, O., & Monnet, S. (2018). Matchmaking in multi-player on-line games: Studying user traces to improve the user experience. *Proceedings of Network and Operating System Support on Digital Audio and Video Workshop*, 7–12. DOI: 10.1145/2578260.2578265

Yahyavi, A., & Kemme, B. (2013). Peer-to-Peer Architectures for Massively Multiplayer Online Games: A Survey. *ACM Computing Surveys*, 46(1), 1–51. Advance online publication. DOI: 10.1145/2522968.2522977

Yıldırım, Ö. (2023). Assessment Based Games and Gamification. In *Digital Games and Gamification in Education* (pp. 143–153).

Zheng, Y., Zhang, J., Li, Y., Wu, X., Ding, R., Luo, X., Liu, P., & Huang, J. (2024). Effects of digital game-based learning on students' digital etiquette literacy, learning motivations, and engagement. *Heliyon, 10*(1). *Heliyon*, 10(1), e23490. Advance online publication. DOI: 10.1016/j.heliyon.2023.e23490 PMID: 38187224

Zook, A. (2019). Building Matchmaking Systems. In *Data Analytics Applications in Gaming and Entertainment*. Auerbach Publications. DOI: 10.1201/9780429286490-3