

TimeCraX: Time-travelling to learn history

Rui P. Lopes* Rogério Tavares+ Cristina Mesquita~

*Instituto Politécnico de Bragança, Informatics Department, Portugal
 +Universidade Federal do Rio Grande do Norte, Arts Department, Brasil
 ~Instituto Politécnico de Bragança, Social Sciences Department, Portugal

Abstract

The work described in this paper, focus on the conceptual development of an educational game for History learning. One of the challenges for this task is to avoid a logical sequentialization of historical events, giving the player an opportunity to contact with a reality in construction. Another challenge is that the game should have a cooperative mechanics. According to this model, players are on the same side and win, or lose, together [Vasel and Phillis 2012]. To cope with these challenges, we choose to ignore one of the basic rules of game design [Adams 2014], taking the role of a hero to the player and giving him the role to assist the other players. An analogy can be made with an astronaut, supported by a team on earth with different functions and personalities. According to the cooperation proposal, players should work together to repair a time machine allowing a safe return to the present, collecting materials and information necessary to keep it working and preventing breaking the spacial-temporal continuum. We seek player engagement, allowing them to make decisions, feel tension and assume risks, and, at the same time, exchange information between them, associated to the game narrative. We hope that this approach builds a collaborative learning context, responsibility for the decisions and collaborative teamwork to achieve a common goal: to win.

Keywords: history learning; timeline; educational game

Authors' contact:

{rlopes, cmmgp}@ipb.pt
 +rogertavares@gmail.com

1. Introduction

History teaching should contribute to strengthening the critical attitude necessary to the development of an operative citizenship. It is important that students build a perspective of human societies, when in contact with the knowledge of history in basic education, considering the spacial-temporal context and the understanding of the diversity and the dimensions that contribute to the historical phenomenon. In this context, for the student to understand the past, it is important that he can organize it chronologically, building a narrative that

allows him to understand it and make it intelligible [Schmidt and Cainelli 2009]. One of the instruments that allows the sequencing of history and the connection of events is the timeline. Used in history classes, this instrument can be organized in different dimensions, namely, social, economic, political, religious, cultural. The multi-dimensionality inherent to the learning and understanding of history demands that the student organizes vast and broad content, build connections between the events and concepts and understand the chronological sequence that also characterizes them.

History is not a collection of time bound facts. It is not enough to know, by heart, the kings, dynasties, discoveries, battles, important characters' names and others. It is important that the student is able to build a reasoning process that allows him to analyze and understand the change and continuities of humanity through time [Prangma et al. 2008]. The learning process resorts to pedagogical instruments that provide assistance to change within the student. One of these instruments, with particular value to history learning, is a multi-dimensional timeline, allowing the student to organize and build a logical sequence of historical events.

In this paper, we propose a game designed and developed around the concept of the timeline, allowing 2 to 4 players to collaborate in structuring a sequence of related events. The game uses cards to implement a collaborative mechanics, in which the players assist other players in surviving a degrading time machine and bringing them back safely in time without breaking the time-continuum.

2. History Learning in Basic Education

Teaching history is a complex process since it involves the construction of a particular domain of knowledge, which analyzes changes and continuities of human issues over time. This implies that the development of historical knowledge also involves developing a structure that incorporates the notion of time

Among researchers there are some points of discussion centered on the curriculum that must be taught and learned by students of basic education. These conceptual lines have nurtured some debates about the

relevance of the content and about the teaching and learning strategies that promote the development of historical thinking and the significance of this knowledge into the school curriculum.

As VanSledright [2004] highlighted, discussions about the curriculum focuses on three big questions: (i) what are the objectives and purposes of teaching history? This question involves the reflection about why we must teach and learn history; (ii) what is historically significant to be taught? That implies choosing and determining, in the vastness of historical knowledge, the most relevant topics and events; (iii) what are the best strategies to help students to construct this specific knowledge which is so blurred of their reality.

At different times and in different countries the objectives and purposes of teaching history have focused on political socialization of their citizens. This approach reflects the assumption of teaching history as an instrument of power, assuming the ideas of the main political class and as a way of inculcating nationalist values that reproduces an ideological perspective of the subject. From the 80s of the 20th century emerges another tendency sustained in several studies [Dickinson and Lee 1978; Schemilt 1984; Lee and Ashby 1987] that demonstrated that teaching of history should serve to development students' historical thinking, the interpretation of the historic narratives in a holistic approach, and to identify and reflect about cultural, economic, ideological, political changes, transition and permanence.

Regarding this, Levstick and Barton [2011] have captured the assumptions of a new emergent history and social studies education in their description of the responsibilities of the modern history and social studies student citizenship.

Students have to learn what it is to ask and answer historical questions - how to find information, how to evaluate sources, how to reconcile conflicting accounts, how to create an interpretive account. And students certainly must learn what the authentic application of historical knowledge looks like. They must see how history can explain the present and they must see this in the most authentic of ways - through the comparison of conflicting ideas about the nature and significance of the past. (p. 14)

Define the nature of substantive historical knowledge has been another point of consideration. Since the 80s that has emerged an orientation that emphasizes a more open and flexible learning design, focusing on management processes of learning appropriate to the purposes and to the diversity of the students, as opposed to a concept of curriculum taken as rigid list of contents, inherited from times where the school was going to a socially defined group. This approach is unthinkable for today's researchers in the context of education for all and with the increasing amount of knowledge available in the information society that characterizes the last decades [Roldão

1998]. The factual aspect of history is no longer valued. The simple description of events and of historical characters' actions gives place to an integrationist approach, appealing to a holistic view of the historical phenomena, that also captures the social, economical, political and ideological interconnected dynamics. In addition, the analysis of history from a space and time dynamics is founded on topics that help students making meaning about the changes and differences in lifestyles, ideology, social and economical relations in different cultures, spaces and over the time.

In recent decades, educational research has focused on the processes of learning and teaching that involves analyzing and understanding how students build their knowledge. This has implications to the teaching process. In this framework, also the teaching of history has broken with traditional models that dictated the conceptions and teaching methodologies for years [Barca 2001; VanSledright 2004]. The studies of historical cognition developed in several countries including Portugal [Barca 2001], have clarified some issues related to how children and youth build historical reasoning and chronological thinking.

For example, the Project CHATA (Concepts of History and Teaching Approaches) developed with children from 07 to 14 years developed by Ashby and Lee [1994] intended to "map changes" in students' ideas about history between the ages of seven and fourteen years. The project focused on second-order procedural understandings like evidence or cause.

In this project the authors identified children and young people's ideas in terms of historical understanding, categorizing them in the following phases and cluster ideals: the baffling past; the 'divi' past; the ignorant past; generalized stereotypes; everyday empathy; restricted historical empathy; contextual historical empathy.

Preliminary results of the research on the progression of students' ideas about historical evidence and its relationship to the past indicate that naive views of history begin with the understanding that the past is simply a given. As students grow more sophisticated in their understanding, this simplistic view is abandoned, though history remains relatively inaccessible. They follow this with the belief that the past is determined by stories people tell about it. As sophistication grows, students note that reports on the past are more or less biased. This idea gives way to noting that the viewpoint or perspective of a reporter or storyteller becomes important. Finally, students develop an understanding that it is in the nature of accounts to differ, because varying reporting criteria are used by storytellers and chroniclers [VanSledright].

In the next subsections we'll present some studies about of chronological thinking. These studies have pedagogical implications in the teaching practices of history.

2.1. How children build chronological thinking

Chronological thinking is an indispensable tool to structure a historical narrative and to give meaning to a sequence of events. It is not a natural skill, so the conscious inclusion of tasks stimulating that skill in teaching is crucial [Lorenc et al. 2013].

Without chronology, a set of events would be meaningless since both singular events and the historical phenomena can only be properly interpreted if appropriately presented on a timeline, that means in a broader context. Different researchers emphasize that chronological thinking is one of the major features of historical reasoning and it is not restricted to knowledge of dates [Baker 1995]. Lorenc et al. [2013] from a literature research, noted that the concept also covers the following aspects: (i) distinguishing between the past, present and future; (ii) identifying temporal structure in a historical narrative; (iii) introducing temporal order to student's historical narrative; (iv) measuring and calculating calendar time; (v) creating a timeline; (vi) interpreting data presented on a timeline; (vii) explaining change and continuity; (viii) comparing alternative periodization models; (ix) distinguishing eras and periods by capturing their characteristic features, intuitive awareness of time.

According to Prangmsma, Van Boxtel and Kanselaar [2008] a chronological frame of reference is the knowledge base that is used when reasoning about the past. It consists of knowledge about: (i) historical phenomena, (ii) temporal and causal relations, and (iii) concepts describing phenomena and relations. The authors refer that research has shown that pupils have difficulty developing a coherent chain of events, and that the schemas pupils use are too general to offer ready slots to fit the specific information that they might have gleaned. Besides, the specific information is too sparse to be useful in connecting it to more general information. Likewise, pupils have particular difficulty forming a notion of complex historical developments and structures. From the literature, the researcher captured three different components of the chronological frame of reference.

The first component of a chronological frame of reference consists of different historical phenomena: the events, structures and themes of an era. Events, structures and themes are specific classes of historical phenomena that may require different types of representations. Narratives, for example, often represent events. Such narratives can be textual, but they can also be visually represented, for example in a timeline or a comic strip [Prangmsma et al. 2008]. The second component of a chronological frame of reference is knowledge of relations between historical phenomena: temporal relations and causal relations. Temporal relations can be represented by a timeline. Constructing timelines can help to sequence events, and to develop

awareness of duration and 'key dates' or landmarks. Dawson [2004] emphasizes both the active construction of timelines (instead of looking at completed ones) and the inclusion of images rather than just words and dates. However, a timeline with dates or periods and textual descriptions of historical phenomena only visualizes temporal relationships. It does not show the underlying cause [Prangmsma et al. 2008]. The third component of a chronological frame of reference is knowledge of concepts used to describe phenomena and relations. The use of historical terminology is an important part of history learning, and it involves both methodological concepts, such as change, continuity and causes, as well as substantive concepts, such as Portuguese Expansion or feudalism. Understanding the big picture requires generalization through a range of abstract concepts. Domain specific concepts are tools to question, think about, describe, analyze, synthesize and discuss historical phenomena [Prangmsma et al. 2008].

Despite the abstract nature of historical reasoning, research in many countries [Hoodless 1996; Levstik and Barton 1996; Simsek 2007] suggests that even the youngest children understand the concept of time and can distinguish past and present, especially with issues of social history. Likewise, as Dawson [2004] and Wineburg [2001] noted, the development of chronological skills at primary school is necessary to build a sophisticated historical reasoning. The need to develop these skills arises from the fact that their development is neither a natural process, nor the result of child psychological development.

The study of Lorenc et al. [2013] noted that lower secondary school students have difficulty in sequencing events and are frequently unable to solve problems that require more sophisticated chronological skills. Even when students can demonstrate the prerequisite knowledge, they are unable to use and interpret it to solve problems. Therefore, it is logical to conclude that a change to the methods of teaching chronological skills is needed in the classroom.

Another study, using action research methodology, was developed by Şimşek [2007], with a group of fifth grade students. The main purpose was to improve historical time concept and chronology perceptions among fifth grade students. Students' interests, reactions to educational methods and materials (e.g., timelines, photographs, old household tools, collections, and so on) were used. According to the findings, preparing historical timelines by the help of individual timelines, old photographs, and examining old household tools not only attracted the interest of children towards history but also provided positive contribution in academic aspect on their historical time and chronology perceptions. At the end of the research, it was observed that historical time concept could be taught to children from the very early ages with suitable methods and approaches by using historical time tools.

2.2. Timeline to build chronological thinking

Dawson [2004] states that timelines play an important part in understanding chronology. The author refers the following key points to be considered using timelines in classroom: pupils need to construct timelines for themselves, not just look at completed ones; pupils' sense of duration will be helped if each century on a timeline is a different color, thus emphasizing the number of units; pupils find it harder to get a sense of the passage of time from colorless timelines, even when they show dates and events; many pupils benefit from physical activities which require them to stand on a timeline and 'move about in history', gaining a sense of how far it was from one date to another by simply walking across the timeline; we often use timelines as introductions, to place in time an event about to be studied, but pupils may gain more from re-visiting the timeline after the topic has been studied and they have some understanding of it. This is also the occasion to make effective connections across time to other events; timelines are more likely to be successful in reinforcing chronological knowledge and understanding if they contain visual images rather than simply words and dates; pupils can find timelines more interesting and memorable if they focus on real individuals.

Also Fillpot [2010] state that timelines help students understand the chronology of historic events, and help students situate newly encountered events and figures in relation to those they've already studied. They provide a visual aid for identifying cause and effect relationships between events, and a visual prompt to activate student prior knowledge. They allow students to recognize how historic events; eras and topics overlap in time. Use them to categorize similar or related events into themes, eras, and topics, and to help students compare elements in different time periods.

3. Game Types

Playing games is something that has been with humans since the dawn of civilization. Recent research has been demonstrating that game play contributes to faster reactions as well as to increasing the brain activity, allowing people to live longer and delaying dementia.

3.1. Educational games

The use of games in education aims to make acquisition of concepts more accessible, providing abstractions that allows the students to repeat and simulate learning situations. Teaching institutions and the Ministry of Education have been considering and adopting strategies to increase and stimulate students' learning and autonomy.

Much of the learning process happens through experimentation, which also contributes to building a diversified set of skills and competences. Much of the experimentation is done through games, providing a

safe environment for simulation and practice [Robertson and Howells 2008]. Moreover, games also appeal to students, motivating them to spend more time and energy playing and learning either collaboratively, as a team, or on his own. This learning effort also improves their ability to make relations and use the knowledge in new situations.

Commercial and Off-The-Shelf (COTS) games, regardless of the ludic purpose, can also provide valuable learning experiences to students. By playing, students face obstacles and situations that stimulate learning, both in and outside the learning context [Linehan et al. 2011]. Games such as Sid Meier's Civilization or World of Warcraft can provide a challenging and motivating world that require analyzing, planning, communication skills and others, contributing to improving the problem solving abilities of players. On the other hand, games can be specifically designed to convey traditional content in a different, nontraditional, form. Even the choice and evaluation of games allows building learning skills through the recognizing and adapting the objectives to the learning purpose [Bellotti et al. 2012; Tannahill et al. 2012]. On the other hand, games can be specifically designed to convey traditional content in a different, nontraditional, form [Yerby et al. 2014].

COTS games clearly provide opportunities for learning. Although typically associated to the development of soft-skills, such as language, analytical or communication, they also promote planning, collaboration, problem solving and even concepts learning. Games such as Monopoly grasp basic economy concepts and real estate value. Other simulation games, for example, are used by the military to train soldiers on combat missions that could not be completely replicated in the physical world [Annetta 2010]. Virtual worlds, such as Second Life, provide three-dimensional environments used more for social interaction, disregarding specific skills or content.

The weakness of the previous type is that there is some difficulty in covering mandated content areas. This requires the design and development of specific, custom made, games. Traditional teaching methods are essentially based on the transmission of content and this approach is frequently used to design educational games. As a consequence, many games lack in either fun or on educational benefit [Bruckman 1999].

It seems obvious that an educational game is simply not a collection of content organized in a nontraditional way. Educational games should follow the same principles that makes entertainment games intrinsically motivating [Whitton 2007]. As mentioned above, some of these principles include the existence of medium and long term goals organized as increasingly complex levels, they should require the player to make decisions and take actions, provide immediate feedback, include a reward system for achievements, gradually teach the

player new skills necessary to overcome more challenging obstacles [Klopfer et al. 2009].

3.2. Competition Games

There is the perception that games are very competitive. However, competition is only a type of challenge provided by games. People play because they like to be challenged [Adams 2001; McFarlane et al. 2002], and the competitive players are a fraction of the whole group.

“The deterministic gameplay allows the core gamer to move swiftly through the early, easy levels, and get up to the harder ones where the real challenge is. [...] Core gamers give up on arcade games once they become tired of the gameplay or they reach a point beyond which they simply cannot improve [...] and since he now knows how to beat it, the challenge is gone” [Adams 2001].

“The completion of the challenge marked the end of the child’s interest” [McFarlane et al. 2002].

Aitkin [2004] refers three main types of challenges players may face: complexity, competition and conflict. These are sorted according to the growing difficulty of overcoming an adversary, being the conflict challenges the most adverse and the competition the least.

When considering as adversarial factor to overcome a human opponent, on the other side there is the overcoming of the environment that, in games, is the game world. Considering that a game is formed by these two main elements, characters and environment, which are the base for the narrative, mechanics and motivation, they are also the base of competition.

Adams and Rollings [2010] consider the game world in four main dimensions: physical, temporal, environmental and emotional. The physical dimension is characterized by four properties: spacial dimensionality, scale and boundaries. According to the same author, these dimensions, together with the temporal, can be described numerically, because of their relation with the game space. On the other hand, the other two dimensions, both the environmental and the emotional, are more subjective.

The characteristics of the environmental dimension are the base for the art and audio, according to their main characteristics, the cultural context and the physical environment. The emotional dimension is not only related to the emotions of characters, but also and “more importantly, with the dimensions that the game designer intends to cause in the player”.

According to the above, the game world is technically disconnected from the characters, in particular from the adversaries. In the detailed descriptions of Adams, only the last subjective dimensions touch the characters, although reminding us

that they are less important than the effect we expect from them.

The literature concerning the game world is somehow scarce, when compared with the references about characters. These is broad and widely available, focusing several aspects and themes, such as poetic of Aristotle, manuals for writers, arte, psychoanalysis, anthropology, speech, theater and several technics, arts and sciences to build a fictional human being, historical or documental.

Returning to the types of adversarial challenges, some games are focused towards environmental issues and others are focused towards the adversary characters. In the middle lays the balance between both environmental and characters.

“Challenges based upon complexity are the least adversarial and require the player to understand the complex behavior of the game world. Challenges based upon conflict are the most adversarial and require the player to understand the complex behavior of their opponent. Between complexity and conflict in adversarialness are challenges based upon competition, and these require the player to understand both the game world and their opponent” [Aitkin 2004].

Some examples make understanding these issues better. Flight Simulator is a game that includes the challenges: know the airplane, know how to fly it, know the land strip and the airport, to be able to take off and to land the airplane, know the communication with the control tower and use it, know geographical coordinates and be able to interpret them. Once these knowledge and skills are consolidated, use them in several airplanes and different airports. There is no narrative, no adventures, no turnarounds, no super-powers, no battles and, even so, it is a grate game, with millions of players around the world. All the challenges are in the game world. It requires to learn hundredths of commands, communications, interfaces and use them at the right time. Designers, such as Crawford (1982) and Wright (2000), describe these games as electronic toys, where the player defines the goals he intends to achieve.

In a different approach, the challenge emerges from the conflict. Counter Strike, the famous team based first-person shooter or Gears of War, Call of Duty or others are remarkable examples. There is a huge difference in the game world with the Flight Simulator. In these games, the game world is very simple. As an example, lets consider one of the best known sets of Counter Strike: the Italy level. A gate, a village with a few streets, a building holding hostages. The street in front of the building is below a window, where terrorists usually place a sniper. The counter-terrorists start by throwing grenades through the windows, assuming that there are people there waiting to kill them.

The challenge of this game lays in knowing the behavior of the adversary. The game world is so simple that it is quickly learned. Every Counter Strike turn last,

in average, 4 minutes, so it is common to play several matches. The most difficult aspect to learn is the behavior of the adversary. Once this has been assimilated, the team gathers to change tactics or strategy. This is one of the reasons these kind of games are popular: one match is hardly similar to another. Even if the tactics are well known, like the openings in chess, factors as the skills, failures and even luck, influences the results, that can change in fractions of a second.

Another example are the simulation games, such as the racers. The skills and knowledge of the pilot are used to beat other players. Most of the sports games are also of the simulation type and provide a simple game world: a football field, a boxing ring, a tennis court. The challenge, once again, is the skills of the player against the skills of the adversary.

The competition games are the last type. These games seek an appropriate balance between the game world and the adversary players. This challenge takes shape when all the players have the same goals, but cannot overlap with the others. A common example are the board games, such as Monopoly. The player is not allowed to take the money from the other players directly, so he uses resources, such as rents and loans to get others resources for himself.

3.3. Collaborative Games

A competition game is simply not the opposite of the collaborative game, as we usually think. Collaborative games join the players around a common goal. In collaborative board games, the players play to beat the board, such as in Jumanji, or to beat another player, acting as a traitor, such as in Battlestar Galactica. In digital games, players split tasks, like in Minecraft, or play together to achieve specific goals, such as opening a pizza restaurant in The Sims Online. In this case, it is necessary four characters, and each player has only a maximum of three, so he has to convince others to work with him.

Normally, the challenge of this game is complexity, with players working together against the environment, such as a board, that gets more complicated at each turn.

A good example is Game Office, from the Brazilian designer Fabiano Onça. As players work together to maintain the balance on the Earth's ecosystem, this will get more polluted and disorganized, at each turn. If the players succeed in working and deciding together, sharing strategies, the balance is maintained. Otherwise, the Earth collapses and all the players loose the game.

¹ <http://www.ciberbit.pt/Products/Wonabit.aspx> (last accessed in July, 2015)

² <http://store.steampowered.com/app/4760> (last accessed on July, 2015). Mods: <http://www.rometotalrealism.org/> (last accessed on July, 2015)

TimeCraX assumes the challenges by complexity. Since the adversary is the game and the players should form a team to combine skills and knowledge to beat the system there is no role of the adversary. However, the rules and goals present a rich scenario for an educational card game, trying to both convey specific content knowledge and be fun to play. The process should not start by simply connecting the content. Content should be an inner part of the game, integrally linked with the game-play. This require the definition of the learning objectives and the identification of specific parts that can be made part of the story or a set of challenges.

We created the game as a learning experience for history for students of the 5th, 6th and 7th grade, following a collaborative mechanics.

4. Related Work

History has always been a popular theme for games. Although not specific for history learning, the romance, battles, heroic deeds provide epic narratives that appeal to the player. Portugal 1111, from the Portuguese company Ciberbit, recreates the conquest of the Portuguese territory, under the Moorish rule. It is the first commercial game produced in Portugal, in 2004, in partnership with historians from the University of Coimbra. The goal is to conquer territory and, at the end, the castle¹.

Rome Total Realism is a set of mods for the game Rome Total War (Creative Assembly, 2004). These modifications increase the game realism, adding over 1000 playable factions with historical details of weapons, uniforms, campaigns, with realistic maps and combat formations similar to the ones used at that times. These mods give the possibility to use the game as a simulator of historical events².

Revolution is a mod to NeverWinter Nights, by The Education Arcade initiative, from the MIT. This modification allows the players to know the details of the American Revolution, when in contact with an historical virtual community. The game is played during class, with the duration of 45 minutes, approximately³.

There are also several board games, focused on the history of Portugal. Aljubarrota, from the game designer Gil d'Orey, tries to reproduce the battle with the same name and, in addition teach curious military strategy facts. Caravelas II, from the same designer, takes the player through unknown seas, collecting spices, precious metals and others, reproducing the beginning of the Portuguese empire. Reconquista!, from the

³ https://en.wikipedia.org/wiki/Neverwinter_Nights (last accessed on July, de 2015). <http://teachinglearningresources.pbworks.com/w/page/62244816/Educational%20Games%20Online> (last accessed on July, 2015).

designer Javier Romero, is a two-player simulation of the Christian reconquest of Iberia from the Muslim Moors. The game *O Quinto Império* (The Fifth Empire), from the designer David Mendes, is a board game to remember or learn history content from the 2nd cycle of the basic education. The player can represent the role of several historical characters, such as D. Afonso Henriques, Luís de Camões, D. Maria II or Amália Rodrigues and recreate the great journeys, adventures and Portuguese conquests all over the world.

5. TimeCraX

TimeCraX is a turn based collaborative card game for 2 to 4 players. Players will have to work as a team to finish the game before the time machine breaks down. Each turn, the players draw a number of “malfunction cards” and “event cards”. Each malfunction card represents a failure in the time machine. The first will turn into gray the corresponding piece of the machine. The second will destroy it completely, unless a repair card is collected.

The event cards present the challenge to the players. They can be of the *timeline* type, to be sorted correctly in a timeline according to the dimension it belongs to (science, society, historical characters and sovereign), or of the *resources* type, to buy repair cards to fix the machine. It is currently being implemented for Android tablet and iPad.

5.1. Objective

The game starts with a time travel of a single player to a random period in history. Each travel degrades the time machine, preventing to be used again until completely repaired. The team of players has to work together to repair the machine and allow the player to safely return to the present time without changing the course of history. If the machine breaks down completely, the mission has failed and history ends in chaos.

5.2. Narrative

TimeCraX is a time machine, discovered by chance, when four friends were playing explorers in the woods. The dark and damp environment provided a more real scenario for the adventure than the four walls of their room. The Four Inseparable, as they called themselves within their secret circle, sneak up there whenever they can, to live endless adventures, representing characters of several periods and deeds. They were crusaders, travelling to the holly land, explorers of overseas, counts, dukes or kings that defend their territories from the invader, militias that overthrow governments, monks that, aware of the importance of their mission, evangelized and instructed.

Certain day, the four soldiers realized that they were in an unknown place in the forest. The thicker and dense trees made running more difficult, so they carefully

advanced between the branches. The last soldier, tired of the long march, tripped and fell in the foliage. The remaining, unaware of the difficulties of their companion, proceeded, distracted by the obstacles they constantly face and attentive to the threatening sounds of the surrounding. Still recovering from the fall, the last soldier seeks a solid support to get back on his feet. While looking around, he realizes that what made him trip was not a branch, but a gear (lever?) of a strange machine. As soon as he succeeds freeing his foot, the machine starts buzzing, while the gears spun and fit in a mesmerizing way. Lonely, he started to yell for his friends, as the surroundings change before his eyes... the trees disappear and a river starts flowing towards a castle that didn't exist a moment before.

The machine stopped and, at the same place in different historical periods, one soldier was holding a broken lever and three soldiers were calling for the missing soldier, as they inspect the gear that, broken, was lying in their hands.

5.3. Playing TimeCraX

TimeCraX is played on a set made of 20 cards (or tiles) arranged as a rectangle, representing a time machine. Since the game is played in a tablet, the set is placed automatically (Figure 1).



Figure 1: Initial game set.

In addition to the main set, there are four tool cards, represented on the right, a malfunction deck and an event deck. These will be presented by the game at the appropriate turn, by sliding a panel from the edge of the tablet.

The game is played on turns, starting with a random player and following to the left. On every turn, three things will have to be done:

1. Take up to 3 actions;
2. Draw 2 event cards;
3. Draw malfunction cards depending on the difficulty level.

Take up to 3 actions

It is possible to take up to 3 actions at the beginning of the turn. The teammates are encouraged to discuss and give advice concerning the actions to take. These actions can be to (1) fix the time machine, (2) give repair card, (3) capture a repair tool, (4) place card in the timeline.

Fixing the time machine can be performed by simply flipping the broken piece (card) from gray to color. A repair card can be given to another player that, when in possession of four repair cards, can exchange for a repair tool. The repair tool allows repairing up to 3 time machine pieces, delaying the end of the game. Finally, the player can also place an event card on the timeline. When the timeline is complete, the game ends in victory.

Draw 2 event cards

The event cards deck has several categories, namely science, society, historical characters and sovereign (Figure 2).



Figure 2: Event cards.

The event cards are to be placed in a timeline, according to the category and correctly sorted. If the card is wrongly placed, it returns to the player's hand and the turn is missed. The game ends when the timeline is complete (victory) or when the time machine is completely broken (defeat).

The deck also contains repair cards, collected to exchange for repair tools. Four equal cards are necessary to get a repair tool card (Figure 3).



Figure 3: Malfunction and repair card.

Draw malfunction cards

In each turn, the player draws a number of malfunction cards corresponding to the difficulty level, up to 3. For each malfunction card, the corresponding card in the time machine is flipped, meaning that the piece is malfunctioning (Figure 4).

Malfunctioning pieces can be fixed by any player at the beginning of the turn. However, if a second malfunction card appear, the piece is totally destroyed and cannot be repaired.



Figure 4: Game set with several malfunctioning pieces.

5.4. Timeline

The timeline is where the players place the event cards. It has four categories, namely, science, to sort cards related to scientific achievements and technological advances, society, representing the structure and concepts of the community, historical characters and sovereign (Figure 5).



Figure 5: Timeline view for placing event cards.

The cards have to be placed sorted according to the time the event happened. If the player fails, the card is returned to his hand, and he loses turn. If the card is placed correctly, the players are one step closer to winning the game.

6. Conclusions

History learning is a complex process, particularly among basic education students. Because of that, several instruments are used, to provide abstractions and tools for the student to be able to build an adequate reasoning of historical events.

The timeline and games do not provide historical reasoning by themselves, although these pedagogical instruments work as vehicles to the construction of that knowledge. It is necessary to complement their usage with the narrative and the reflection about what happened, why did it happen and the consequences of that events.

We believe that the game described in this paper allows the student to create moments, in classroom or autonomously, for connecting with historical knowledge in a more relaxed and ludic experience. The influence of this game must be verified in an educational environment, comparing the development of the chronological thinking and historical reasoning in classes that use the game as educational strategy with traditional classes.

References

- ADAMS, E. 2001. Replayability, part 2: game mechanics. *Gamasutra*, http://www.gamasutra.com/features/20010703/adams_pfv.ht.
- ADAMS, E. 2014. *Fundamentals of game design*. New Riders, Berkeley, CA.
- ADAMS, E. AND ROLLINGS, A. 2010. *Fundamentals of game design*. New Riders, Berkeley, CA.
- AITKIN, A.L. 2004. Playing at Reality: Exploring the potential of the digital game as a medium for science communication. .
- ANNETTA, L.A. 2010. The “I’s” have it: A framework for serious educational game design. *Review of General Psychology V. 14*, N. 2, 105–112.
- BAKER, J. 1995. The Importance of Chronology in Teaching History. *Social Studies Review 34*, 2, 24–27.
- BARCA, I. 2001. Educação histórica: uma nova área de investigação. *Revista da Faculdade de Letras 2*, 13–21.
- BELLOTTI, F., BERTA, R., DE GLORIA, A., ET AL. 2012. Designing a course for stimulating entrepreneurship in higher education through serious games. *Procedia Computer Science 15*, 174–186.
- BRUCKMAN, A. 1999. Can Educational Be Fun? *Game Developer’s Conference*.
- DAWSON, I. 2004. Time for chronology. *Ideas for developing chronological understanding’in Teaching History 117*.
- DICKINSON, A. AND LEE, P. 1978. Understanding and Research. In: A. Dickinson and P. Lee, eds., *History Teaching And Historical Understanding*. Heinemann.
- FILLPOT, E. 2010. History in Every Classroom. In: K.A. Woestman and R.G. Ragland, eds., *The Teaching American History Project: Lessons for History Educators and Historians*. Routledge.
- HOODLESS, P. 1996. *Time and timelines in the primary school*. Historical Association, London.
- KLOPFER, E., OSTERWEIL, S., SALEN, K., GROFF, J., AND ROY, D. 2009. Moving learning games forward: obstacles, opportunities, and openness. 56–56.
- LEE, P. AND ASHBY, R. 1987. Children’s Concepts of Empathy and Understanding in History. In: C. Portal, ed., *The History curriculum for teachers*. Falmer Press, London ; New York.
- LEE, P. AND ASHBY, R. 1994. Progression in Children’s Ideas about History. Project CHATA (Concepts of History and Teaching Approaches: 7 to 14). .
- LEVSTIK, L.S. AND BARTON, K.C. 1996. ‘They still use some of their past’: historical salience in elementary children’s chronological thinking. *Journal of Curriculum Studies 28*, 5, 531–576.
- LEVSTIK, L.S. AND BARTON, K.C. 2011. *Doing history: investigating with children in elementary and middle school*. Routledge, New York.
- LINEHAN, C., KIRMAN, B., LAWSON, S., AND CHAN, G. 2011. *Practical, appropriate, empirically-validated guidelines for designing educational games*. ACM Press, New York, New York, USA.
- LORENC, J., MROZOWSKI, K., ONISZCZUK, A., STANISZEWSKI, J., AND STARCZYŃSKA, K. 2013. How is chronological thinking tested? .
- McFARLANE, A.E., SPARROWHAWK, A., AND HEALD, Y. 2002. Report on the educational use of games. .
- PRANGSMA, M.E., VAN BOXTEL, C.A.M., AND KANSELAAR, G. 2008. Developing a ‘big picture’: Effects of collaborative construction of multimodal representations in history. *Instructional Science 36*, 2, 117–136.
- ROBERTSON, J. AND HOWELLS, C. 2008. Computer game design: Opportunities for successful learning. *Computers & Education 50*, 2, 559–578.
- ROLDÃO, M. DO C. 1998. *Evolução das Metodologias e Práticas de Ensino da História no Sistema Educativo Português*. Instituto Camões e Associação de Professores de História.
- SCHEMILT, D. 1984. Beauty and the Philosopher: Empathy in History and Classroom. In: A. Dickinson, P. Lee and P. Rogers, eds., *Learning History*,. Heinemann, 39–84.
- SCHMIDT, M.A. AND CAINELLI, M. 2009. *Ensinar história*. Scipione, São Paulo (SP).
- SIMSEK, A. 2007. The Improvement of Chronological Perceptions among Fifth Grade Students: A Quasi-

Experimental Study. *Educational Sciences: Theory and Practice* 7, 1, 610–615.

TANNAHILL, N., TISSINGTON, P., AND SENIOR, C. 2012. Video games and higher education: what can “call of duty” teach our students? *Frontiers in psychology* 3, June, 210–210.

VANSLEDRIGHT, B.A. 2004. What Does It Mean to Think Historically ... and How Do You Teach It? *Social Education* 68, 3, 230.

VANSLEDRIGHT, B.A. *History - LEARNING, TEACHING OF*.

VASEL, T. AND PHILLIES, G. 2012. *Modern Perspectives on Game Design*.

WHITTON, N. 2007. Motivation and computer game based learning. *ICT: Providing choices for learners and learning*, 1063–1067.

WINEBURG, S.S. 2001. *Historical thinking and other unnatural acts: charting the future of teaching the past*. Temple University Press, Philadelphia.

YERBY, J., HOLLIFIELD, S., KWAK, M., AND FLOYD, K. 2014. Development of Serious Games for Teaching Digital Forensics. *Issues in Information Systems* 15, Ii, 335–343.