Games for e-Learning

Carlos Vaz de Carvalho
Graphics, Interaction and Learning Technologies, R&D
Instituto Superior de Engenharia do Porto
Porto, Portugal
cmc@isep.ipp.pt

Abstract:

Games can be instantiated for learning as they involve mental and physical stimulation and develop practical skills – they force the player to decide, to choose, to define priorities, to solve problems, etc. Immediate reward (and feedback) is a major motivational factor, whether it is translated as game entities (life, power, new levels, etc.) or as neurological impulses (happiness, feeling of achievement, etc.). Games can be social environments, sometimes involving large distributed communities. Serious Games are specifically designed to change behaviors and impart knowledge. The objective of the project TIMEMESH is to evaluate the use of Serious Games for learning history, culture and social relations. An extensible, online, multi-language, multi-player, collaborative and social game platform for sharing and acquiring knowledge of the history of European regions is being developed.

Keywords: Serious Games, e-Learning, Games, Distance Learning

I. INTRODUCTION

A Game is a particular context where users (players) have structured or semi-structured goals (with victory as end goal) that they try to achieve by overcoming challenges. At the same time, they have to respect a set of rules that are created in reference to that restricted environment. Failure to follow these rules constitutes a crime or mistake and implies a punishment or penalty. Games can involve one player acting alone, two or more players acting cooperatively, and, more frequently, players or teams of players competing between themselves [1].

Computer games have different types or genre and are played through a computer, on a standalone or networked form. They are highly interactive products, synchronous or asynchronous. These technologies, together with the different modes of interaction and communication, allow different participants, who have similar interests, to play together through ICT tools [2]. Playing a computer game generates a series of events that, in retrospect, will outline a narrative, but carry emotions, pleasures and challenges unique to the reading of that narrative. It is therefore possible to get a convergence of games and learning in three distinct areas: training (professional and social context); formal education (classroom and school context), non-formal education (outside the school context).

According to Mark Riyis, the use of games for learning is effective due to the following characteristics: they are motivational, they are cooperative and they meet educational objectives, they allow the resolution of
problematic situations, they allow the application of concepts in practical situations, they are interdisciplinary, they favor oral expression and cultural awareness, respect for others, teamwork and cooperative learning [3].

The pursuit of knowledge through interaction and cooperation among players is enhanced, according to [4], by the very same structure of the game when played in groups. Thus in a context of the classroom, a game can strongly reinforce socialization, can support dialogue and exchange of ideas. It is an exercise in dialogue, group decision and consensus [5], supported by environments of simulations and practices, experiences and creativity enhancers, participation, research and integration [6].

Educational games can be quite simple or can be rich learning environments and complex microworlds, because they provide an imaginary world to be explored by the player. To Papert, children develop better cognition by discovering themselves the specific knowledge, becoming thus the active constructor of their knowledge and that is promoted by games [7].

Serious games can be defined as “a mental contest, played with a computer in accordance with specific rules, that uses entertainment to further government or corporate training, education, health, public policy, and strategic communication objectives” [8] or as “Games that do not have entertainment, enjoyment or fun as their primary purpose.” [9]

It is mentioned by a few researchers that there is limited use of serious games in formal education. This has mainly to do with social concerns and stereotypes about the relation of games and entertainment: you're playing so you're not learning. Therefore, institutions normally do not venture into a potentially conflict situation by using Serious Games. Other pragmatic issues may relate to physical and cost barriers, hardware and license cost, access (for online games), maintenance and support, teachers' confidence in using the game for a specific curriculum goal, etc.

Furthermore, games may not be an effective teaching tool for all students. Failure is the norm in games, repetition and exploration is how players learn. This contrasts with oriented learning discrete chunks of information. Squire found that about 25% of students withdrew from his study, which used Civilization (an historical simulation game) to teach geography and history, as they found it too hard, complicated and uninteresting [10] while another 25% of the students (particularly academic underachievers) loved playing the game, they thought it was a “perfect” way to learn history.

II. TIMEMESH

Generically, the aim of the project is to adapt, develop and integrate innovative ICT based content, services and pedagogies for a very well defined audience: secondary students. TIMEMESH focus on the use of Serious Games for this purpose - the use of Serious Games for learning is currently very much oriented to an adult audience so the project is innovative in that aspect.

Three game scenarios were chosen according to the Curricular programmes of partner countries and are based on cultural and historic realities of different European eras: the Maritime Discoveries, the Industrial Revolution and the Second World War. The scenarios provide an historical context that allows students to better understand the process of how Europe has been shaped and restructured as a result of history and will
help students understand the formation and evolution of the countries and regions. Scenarios emphasize the cooperation between European countries to strengthen the notion of European citizenship. This understanding is expected to assist students to identify and respect cultural diversity. TIMEMESH will also evaluate if the game does in fact contribute to any of the planned objectives.

The Learning Outcomes for the game are aligned with the official Curricular Aims for History learning, in each of the partner countries. In particular the British Programme of Study states that: "History fires pupils’ curiosity and imagination, moving and inspiring them with the dilemmas, choices and beliefs of people in the past. It helps pupils develop their own identities through an understanding of history at personal, local, national and international levels. It helps them to ask and answer questions of the present by engaging with the past.

History […] encourages mutual understanding of the historic origins of our ethnic and cultural diversity, and helps pupils become confident and questioning individuals."

Therefore, the main Learning Outcomes for the game are:

- Understanding and using appropriately dates, vocabulary and conventions that describe historical periods and the passing of time.
- Developing a sense of period through describing and analyzing the relationships between the characteristic features of periods and societies.
- Building a chronological framework of periods and using this to place new knowledge in its historical context.
- Understanding and respecting the diverse experiences and ideas, beliefs and attitudes of men, women and children in past societies and how these have shaped the world.
- Analyzing and explaining the reasons for, and results of, historical events, situations and changes. Considering the significance of events, people and developments in their historical context and now.
- By playing the game, young students will also be prepared for future challenges in a competitive, technology-based society where the skills for continuous learning are required.

They will also be better prepared to find good sources of information, to cooperate with peers and to integrate into the European digital society.

The project will also be important to positively discriminate the use of technology by women. There are two different avatars that players can choose, a male and a female one to allow for better identification. The design of scenarios includes collaboration aspects rather than competition ones. Scenario challenges are also mainly based on strategic and logic puzzles and interaction with game characters rather than technicalities. Therefore it is expected that by removing issues that demotivate girls the project might eliminate negative bias towards technology and ensure that technology adoption by boys and girls is equal.

\textit{A. Pedagogical Approach}

The project is based on a different pedagogical approach, where games become important educational tools. They promote the collaboration between children and their knowledge of history, geography, culture and
social relations. But they will also be integrated in a larger community of learning that includes all the schools belonging to the project.

B. Game Concept

The main game concept is that the player notices something is wrong with their current time period; E.g. Newspapers are in a different language. This is the trigger event for a specific scenario action. The player then learns of a past event or sequence of events in history that somehow happened differently and changed history. This event or sequence of events can be explained by a short narrative and is the basis for a game scenario. Each trigger event leads to a different scenario. The player/team of players chooses what scenario he wants to play in the beginning of the game. The structure of the game will allow adding new scenarios to the framework.

1) World War II Scenario

In September, 1940, Hitler was preparing England’s invasion which finally aborted. He postponed it till next Spring and it never happen. In our story he was successful because his plans were never intercepted - the German code was never broken because the ENIGMA machine was not available - England was successfully invaded. The player must go back and make sure that the Enigma machine codes were delivered as historically factual. The player knows that this was the fundamental event because the cleverness of the German code engineers and the unbreakability of their cryptographic system is pointed out. For this scenario a set of Learning Outcomes was established:

- Knowledge about the second world war in general. Focus on events at the start of the war. Focus on religious and other persecutions. Focus on main characters (Hitler, Churchill, etc.)
- Understand what a war really means in terms of loss of lives and impact on a "normal", everyday life.
- Understand basic cryptographic mechanisms Realize that people can behave strangely under pressure Understand co-operation between the different countries (passing information, etc.), movement between countries, life in wartime, and the importance of technology advancements to the war effort.

As it is clear from the previous set of objectives, learning outcomes are related to different competences.

2) Maritime History / Discoveries

The concept of this scenario lies on a change in History that caused Madeira not being colonized by Portugal. When the first navigators were coming back from the Island discovery, some maps were stolen from Portugal and Madeira became a pirates/corsair base. Due to the balance of forces in Europe, it later became an independent country which has now nuclear power and is threatening Europe. Players must go back and restore historical correctness. The learning outcomes for this scenario combine Historical aspects with notions related to politics, governance and maritime technology:

- Understand the role of Discoveries and Maritime trade in the development of Europe
- Become aware of major maritime navigation instruments and sciences (Maths, Astronomy, etc.)
- Understand political balancing between neighboring countries
Become aware of life in the 15th and 16th centuries

3) Industrial Revolution

The basic History twist in this scenario is related to the fact that the Mines Act (law that limited the age and hours that kids could work, therefore heavily ruling against child labour) was not approved by the English Parliament therefore kids are still working today. Player must go back and make sure it is approved. The Learning Outcomes for this scenario are related to aspects in technology, social awareness and parliamentary systems:

- Become aware of life in the Industrial Revolution time.
- Understand the role of the Industrial Revolution in the development of Europe
- Understand principles of Parliamentary democracies.

III. ASSESSMENT OF LEARNING

A crucial aspect to measure is the actual, effective impact that the game will have on learning. Therefore, this process will be thoroughly evaluated and assessed to ensure the best use and the production of guidelines for its replication. Several steps were defined in the evaluation methodology.

A. Alpha testing

The objective of an Alpha Testing procedure is to simulate an actual operational testing and is performed by members of the development team that have not been involved in the development of the particular features to be tested. Alpha Testing allows anticipating internally problems that would only be detected by external testers in the Beta Testing phase. This stage is more rewarding if qualitative data collection is used because it provides richer information. A protocol was established for the implementation of the Alpha Testing:

1. For each scenario:
   a. Identify participants (staff from partners) which have not been involved in the development (at least 4 elements)
   b. Have participants playing the scenario and trying to finish it
   c. Participants should
      i. Measure how much time it took to finish each scene
      ii. Identify learning outcomes addressed. Check if they match watch was proposed
      iii. Identify other learning outcomes that should be addressed
      iv. Assess if the game is motivating. Identify problems
      v. Assess if the graphical environment / usability is adequate. If not, identify the issues
      vi. Report on the project forum

B. Beta testing
Beta testing comes after alpha testing and it is planned to release the game to a limited audience outside of the consortium. The target group is composed of teachers familiar with the subject and with the technology that can assess pedagogically and technically the prototype so that further testing can ensure the game has no faults or bugs. In this stage a mix of qualitative and quantitative information will be collected, because there is still interest in receiving rich comments but there is already a relatively important number of people evaluating the game that can provide statistically valid results. The protocol for this stage is the following:

2. For each scenario, each partner has to:
   a. Identify participants (teachers from associated partners: at least 2 per partner)
   b. Have participants playing the game and trying to finish it
   c. Participants should
      i. Measure how much time it took to finish each scene
      ii. Answer the questionnaire
   d. Interview the participants using the semi-structured interview guide
   e. Report the results

The questionnaire is meant to provide a quick data filling tool for the beta testers. This way they are able to report immediately their impressions, just after finishing the scenario. It is based on a mixture of adapting heuristics for evaluating playability of games, heuristics for usability evaluation for history educational games and educational effectiveness factors.

C. Final Stage

For the final evaluation, the quality space aggregates the dimensions – Functionality; Efficiency and Adaptability. The Functionality dimension reflects the characteristics related to its operational aspects. It aggregates two factors: easy of use and content’s quality. The Efficiency dimension aggregates five factors: audiovisual quality, technical and static elements, navigation and interaction, originality and use of advanced technology. Through this dimension we measure the system’s ability for presenting different views on its content with minimum effort. The Adaptability dimension is the aggregation of five factors: versatility, pedagogical aspects, didactical resources, stimulates the initiative and self learning and cognitive effort of the activities.

IV. CONCLUSIONS

Originally the game was meant to be played autonomously by the students, in their leisure times. However a few exploratory learning activities, based on the game scenarios, were created to facilitate teachers work. That led to the game also being used in the school context, during classroom time. In fact each scene (each scenario has four different scenes) is designed to be completed in about 45 mnts which is the ideal duration for a classroom period. As such we’ve witnessed the appropriation of the game by teachers for their curricular purposes.
In total, the game has been played by over 1,000 users. About half of these players used the game as part of school activities in different European countries (England, Portugal, Spain, Slovenia, Estonia). The other players are kids who played the game on their own, outside of any curricular activity. Every usage of the game in schools has been evaluated to assess the student’s motivation, interest and satisfaction (an evaluation methodology was developed and it is described in [4]). Their level of attainment of the learning objectives was also assessed.

In general, students are not enthusiastic about History and they don’t think they are overly competent in it. It is interesting to see that boys are not as confident of their History knowledge as girls but they actually like it more and find it more fun than girls. Boys are also clearly more used to play games.

Students’ reaction to the game was very good. However, the game was not as attractive to boys as it was to girls. Probably due to the larger experience with games that boys have, they had higher expectations concerning the game. They would also expect to have much more support during the game. One of the aspects that clearly showed the interest of the students was the fact that after they played the game in school they would login again later to try to complete the remaining scenes and scenarios. That showed us that they were really challenged by the game. A special event was organized to have students from different countries to collaborate. This event was the real experience of how the game can be used to encourage players from different cultures to play with one another. It proved that in order to successfully organize and carry out such an event all the possible problems have to be taken in consideration and tested beforehand otherwise it can happen that in a series of unfortunate events students cannot fully experience the game.

It was concluded that students were satisfied with the game and played the game collaboratively helping each other. They were disappointed when they realized that the team they played with could not answer their questions and needed help from administrator. This means that the Time Mesh game is really constructed in a way that requires collaboration and can be used as example of how collaboration can be encouraged. It is not expected that the project results will dramatically change the way schools teach the areas covered by the project, but it is intended that the project will demonstrate that learning through serious games can be a valid alternative and that serious games can be an effective learning tool.

ACKNOWLEDGMENT

The SEGAN Network (519332-LLP-1-2011-1-PT-KA3-KA3NW) has been funded by the European Commission, under the Lifelong Programme, KA3 action.

REFERENCES

2. R. Batista, C.V. Carvalho, Funchal 500 Years: Learning Through Role Play Games, Proceedings of the 2nd European Conference on Games Based Learning, , October 2008
4. Andrade, F. Possibilidades de uso do RPG. Available at: http://www.historias.interativas.nom.br/educ/rpgtese.htm
5. Marcatto, A., O que é o RPG?. Available at http://www.alfmarc.psc.br/avent_edu_o_que.asp
8. Chen, S., Michael, D., Serious Games: Games that Educate, Train and Inform. USA, Thomson Course Technology. 2005
10. Squire, K. D. Replaying history: Learning world history through playing Civilization III. Indiana University, Bloomington, IN. 2005