Designing an experiential educational game for the investigation of aspects of the Greek revolution

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Abstract

The Greek Revolution, the war of independence by Greek revolutionaries against the Ottoman Empire between 1821 and 1830, is a major event in Greek History. It is clear that the use of new technologies as teaching tools goes hand in hand with the new demands of the educational community for the implementation of new teaching methods, such as collaborative teaching, but also with the new educational conditions that have been strongly determined by the pandemic, such as distance learning. Education must be responsive to the needs of the times and it is indeed important to be close to students' needs. Under this notion we propose a serious educational game that employs pedagogical techniques to enhance both the level of historical knowledge and the skills of the players/ students. On each mission players will encounter problems and challenges faced by the actual pioneers of the Greek revolution, combined with related historical information. Those involved will utilize multifaceted information for the events and will be actively confronted with dilemmas regarding the conduct of the Greek Revolution. The current work presents the process of developing the serious game "BYRON", in the light of the software development processes and the pedagogical framework that supports the game development.

Keywords - Cultural Heritage, History, Greek Revolution, Gamification, Serious Games, Informal Learning

I.   Introduction

The 21st century is characterized by the extended involvement of people on the production and "consumption" of digital data, especially in the form of multimedia content. In this context, computer games have evolved to become one of the most familiar and widespread forms of digital content, by further enhancing the active involvement of their players. It comes to no surprise that systematic scientific research has been carried out on the deployment of computer games as a means of a new type of historical documentation and representation that utterly alters the way History can be perceived by the general public. Moreover, digital games as a modern means of knowledge mediation are capable of presenting under judgment what has happened in the past, while, in the form of "serious games", they employ pedagogical techniques to enhance both the level of knowledge and the skills of the players. Our present work proposes a design methodology for the development of such an educational gaming tool, utilizing well-established behavioral and cognitive learning models to form an innovative approach to the Greek revolution. Thus, the educational content will be coupled with game mechanics following principles of the persuasive technology.

Despite the abundance of literature about the types, elements and results of gamified applications, a standard methodology for developing an educational one, does not exist yet. So, we chose to design a gaming application running on modern computing devices and targeting mainly students, without neglecting the general public, based on existing models of persuasive technologies, gaming methodologies and cognitive processes. The players/students, by "traveling back in time", will be immersed in a collection of scenarios/missions, based on and reflecting on real historical events ranging from 1821 AD to 1827 AD. On each mission they will encounter

problems and challenges faced by the actual pioneers of the Greek revolution, combined with related historical information. They will have to choose carefully among a set of limited available resources (representing the main operational roles) to mobilize and involve for the mission accomplishment. Depending on the selected mix of resources and user's actions during the game, the mission will either succeed or fail; in the case of failure the player will be hinted on the reasons of failure, before repeating the mission with a different setup. User's actions and decisions through the game will also reflect, on a positive or negative way, on the availability and operational skills of the available resources. Players will understand in this way, the difficulties of such a venture and learn about possible forms, actions, driving forces and interactivity of different social groups.

The two major challenges during the game design and implementation are to achieve an optimal balance between the educational scope and the gaming experience - the outcome should ideally be a "serious game", that serves the educational purposes but yet still a game which the players will enjoy to play, and to transform historical events and complex concepts and interactions of the Greek revolution, backed-up by educational methodologies, into popular mock-ups, simulations or actual game genres, such as role-playing (RPG), strategic, shoot 'em up and platform games, which enjoy a vast popularity among players.

II. Aim of the Study

The structure of the educational scenarios follows the design of the digital game "BYRON". In particular, four training scenarios have been designed for each of the respective four missions of the digital game. Each training scenario is directly related to the plot of the mission and enables students to make use of the digital learning environment; it provides the teacher with the possibility of adapting his activities, which he does by taking into account the characteristics of the classroom and the specificities of his students. For each stage we proposed specific and tailored made educational activities.

The main innovation of this approach lies in the fact that a digital game is becoming a new form of cultural product, inseparable to history, by unfolding narratives and "playful" situations. Contrary to conventional narratives, the game will not just be limited to the presentation of an event, but a whole sequence of possible events, forming an integrated experiential educational system. Thus, it imposes a multi-dimensional task by presenting the past as a non-linear representation of time, while enabling the involved player to realize the potential possibilities of his game-character. Moreover, the immersion and active involvement of players will form a fundamental prerequisite for understanding the actual content.

The overall contribution of the game in the learning process is defined by the gained experience through the engagement and immersion in the game itself, the deeper reflection, the problem solving and goal achievement challenges, the analysis of an existing situation and finally the so-called self-evaluation tasks. If we combine the previous features with those of constructivism theory, that is, the building of knowledge during a digital game, then the later gains a special added value through the continuous challenges and active involvement of students / players that lead to knowledge. Following the development of the game, a testing and evaluation period has been planned in order to provide feedback for further enhancements.

III.   Development of the game

Requirements and Development Tools

With the exception of big game studios, having the vast resources and technical expertise to develop a game from scratch - a complex and demanding project - it is common practice in the game industry, especially in the case of small working groups with limited resources, the use of game development software tools/platforms, known as "game engines".

For the development of the "BYRON" game, the "Unity" [1] game engine was chosen as the most suitable for the task, by complying with all the important criteria and requirements of the project:

- State-of-the-art game engine, integrating all the cutting edge features found on modern 2D and 3D games/projects.
- A proven through the years, solid solution, with excellent support by the company and an impressively large community of developers, making it a future-proof choice.
- A relatively smooth learning curve, considering the complexity of the targeted projects.
- A wide collection of available resources/assets, such as 3D models, animations, frameworks, code, which can significantly reduce the development time.
- Support by industry-standard 3D design and modeling tools (e.g. Blender 3D, Maya, 3DS Max).
- Mulit-platform project deployment (Windows, MacOS, Android, Linux).

Beside Unity, additional external software tools were used for some of the project's tasks, e.g. Adobe Photoshop for image and texture editing, Audacity for digital sound processing (dialogues, sound effects etc).

"BYRON" targets mainly primary and secondary school pupils, which are used to playing commercial, entertaining digital games of high quality and production cost, running on powerful and expensive hardware (CPU, GPUs), either in the form of high-spec personal computers or gaming consoles. Most of these AAA quality, commercially successful games, feature production budget, development teams and procedures which are on par with those of blockbuster movies, costing often several hundred millions $ US [2].

Thus, not only "BYRON" targets a very demanding user-base, but also, a serious game inevitably sacrifices part of its entertaining purpose, for the sake of its educational dimension. For these reasons, strong emphasis has been put during the development on creating a game with the implementation quality expected by modern games, while keeping hardware requirements reasonably high, so the game can run on personal computers with typical configuration as those found in most homes or school labs.

Game Structure

On the user interface side, the game follows a typical approach, by featuring an easy to use menu, through which users can access any section/part of the game. The game follows the paradigm of a book, divided in parts and chapters. Players have direct access to all of the game

sections right from the beginning, instead of gradually unlocking parts of the game as the player proceeds - a common practice in many games. This approach, allows teachers for random/non-linear access to any part of the game, while teaching the corresponding aspect of the Greek Revolution.

The requirements of the game and the educational scenarios, have lead to the adoption of two popular game genres for the implementation of the game's missions, namely "Real-time strategy game" and "First Person Action / Adventure game".

Many of the most commercially successful games fall into one of the above game-genres, so the targeted users (pupils) are expected to be familiar with the mechanics, and the game-play of such games, significantly reducing the time required to familiarize with the gaming environment of "BYRON".

Real-Time strategy based missions
All the missions involving ground battles have been implemented as real-time strategy games (Figure 1). The player must accomplish a series of tasks involving: collecting resources, constructing infrastructures, summoning military forces, organizing military camps and defense infrastructures, fight battles etc. It's a quite thoughtful style of game focusing on strategy and management of resources, rather than on action.

Figure 1: Real-time strategy based, mission battleground

For the development of the battle-missions, a Unity add-on (asset) was utilized: RTS Engine [3], a framework for the development of real time strategy games providing all the necessary infrastructure and functionality such as:

- mission, resources, units (forces) and buildings management
- resource collection, building, fighting tasks
- camera movement and management
- NPCs (Non playable characters) management / computer controlled enemy forces.

Custom programming code has been added on every mission, adjusting a series of critical mission parameters (resulting finally in victory or defeat), in response to player's strategic decisions, based on real-life, historical dilemmas Greek rebellion forces faced. By a try-and-fail process, the player gradually learns about the social forces involved & the tactics/strategic decisions made, leading Greeks to win crucial - for the establishment of the revolution - battles.

First person action/adventure missions.

The rest of the game's missions are implemented as first-person, action/adventure games. The player watches the action in first-person,"through the eyes" of the controlled character, providing an immersive gaming experience. The user must navigate in historical locations, participating in missions highlighting the most important aspects of the Greek revolution: crucial political procedures and the role of the press, the Philhellenism intellectual movement and diplomacy on the success of the revolution. In order to provide a convincing historical environment, game locations and objects have been designed with reference to the corresponding historical ones (Figure 2).

Figure 2: Designing game buildings and locations with reference to historical ones

The mission-control is implemented with finite state machine (FSM) mechanics. A Unity game object is placed on every mission's scene, implementing a FSM (Figure 3) and controlling the game progress. At every given moment, the mission is on a certain state and the user must complete a set of informative/educational actions, interactions, quizzes and puzzles in order to proceed on the next mission part/state.

Figure 3: A Finite State Machine controlling the mission progress

Development cycle

The implementation of each part of the game starts with the development of a detailed script, documenting every aspect of the mission, the plots and possible different mission flows depending on player's actions. The scenario, along with historical documentation (e.g. documents, drawings, diagrams, engravings), consist the base material for the design and implementation of each mission's elements: locations, characters, objects, animations, textures, sound effects, dialogues, narratives.
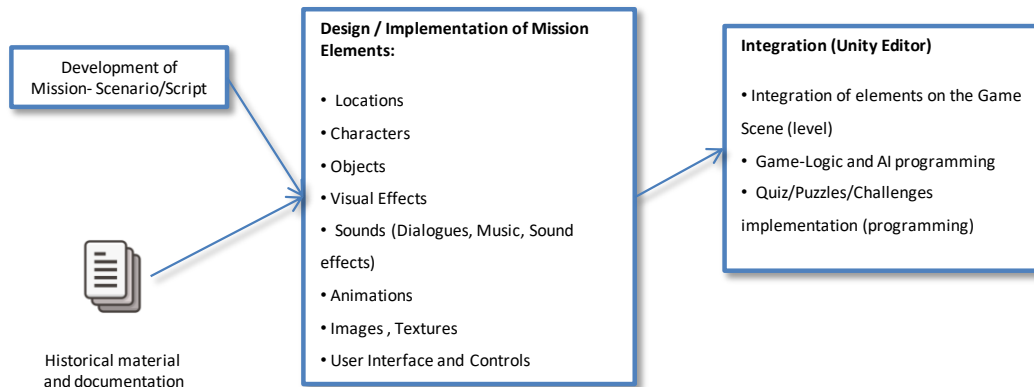
Figure 4: Development Cycle

The elements (assets in Unit's terminology) are then used to compose the game scene in Unity's integrated editor. The gaming logic, artificial intelligence (AI), interactions and handlings, puzzles and quizzes have been implemented with C# code - the programming language supported by Unity. Visual programming techniques are also utilized by the integration of the "Playmaker" [4] Unity add-on/asset, which provides visual scripting tools for accessing the Unity's Application Programming Interface (API).

IV.   Educational Scenarios

In recent years, the use of new technologies as teaching tools has gone accordingly with the new demands of the educational community for the implementation of new teaching methods (i.e. collaborative teaching), but also with the new educational conditions that have been strongly determined by the pandemic, such as distance learning. One question that arises is whether and to what extent a digital game is able to meet modern educational needs and coexist with traditional teaching methods. Education must listen to the needs of the times and integrate new teaching methods such as educational digital games with a serious purpose in the classroom, which enable the teacher to take an interdisciplinary approach to knowledge by studying a subject from different scientific perspectives in a multifaceted and in-depth way.

It is also particularly useful to integrate digital games into the learning process, because they have features that modern learners - the so-called "digital natives" - are familiar with from online tools: learning by doing, immersive personalisation, direct feedback, active discovery and new kinds of understanding. Consequently, students are more easily and directly driven to literacy, as the instructional content of a digital game with a serious purpose motivates and prompts students/players to learn. Therefore, the digital game works supportively, giving through a modern approach to knowledge a new dimension to the learning process.

The digital educational game offers its users the form of playing (*"παίζειν"*) that has the power to stimulate their interest & immerse them to such an extent that they wish to stay in the playful space for a long time, exploring it & learning, just as they do when they play commercial games.

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Based on the main assumptions/values on which the theories of educational design of educational activities are based, according to Smith & Ragan [5], it is necessary to clearly formulate the theme/central idea that will run through the educational activity as a whole and the educational goal it will serve. Also, an educational activity is considered successful if it is effective in terms of knowledge acquisition, efficient in terms of the time it takes to carry it out and engaging in terms of the extent to which it motivates students and encourages them to persevere in carrying out the activities. The educational design of activities essentially attempts to answer three main questions, what are the learning objectives for an educational intervention, what is the strategy by which they can be achieved and finally how to evaluate the success of the proposed educational activity [6].

Introductory educational activities have also been designed, based on the plot of the four missions of the digital game. Under that notion, the proposed introductory activities:

1. Contribute both to understanding the content and objectives of each mission and to reconstructing the historical context.
2. The student is able to return to them and complete them during the game and to consult them after completion.

Therefore, the purpose of the introductory educational activities before the playing process is not only to motivate and inform students about the subject matter of the Greek Revolution, but also to challenge them to recall all the relevant knowledge and skills that they must already possess as students in order to respond adequately to the educational activity.

It is widely understood that the learning activity is an essential part of the predetermined, daily teaching process, but it is of particular importance since, within it, students are involved as researchers in order to find solutions to the problems that arise and formulate them in oral or written or any other descriptive way [7], using digital educational tools.

Another parameter that was taken into serious consideration during the design of the specific educational activities of the digital game "BYRON" is the enhancement of the students' cooperation in groups (collaborative teaching) in order to develop teamwork spirit and healthy competition in the classroom. Through play and competition between groups, students develop a strong motivation to participate in the lesson and the ability to cooperate effectively with each other. This ability to collaborate expands their social skills and each student's acceptance of the "different other." It also develops a sense of fair play and the management of both the frustration of defeat and the exultation of victory [8].

V.   Introductory activities

As presented in the previous section, we propose two examples of indicative activities based on the educational digital serious game "BYRON":

1st Example

Second introductory activity: Getting to know the power players - role description. The second activity focuses on trying to get to know the personalities and actions of the agents of power who undertook the planning and organization of the Greek Revolution and played a leading role in the first military encounters with the enemy.

Proposed activity

Based on the suggested sources, please find information on the power structures of the Greek Revolution and their contribution to its preparation and organization. Then record them in the form of words/phrases and/or topic sentences by filling in the corresponding role cards:

Figure 5 - Indicative example of an audio playback for the role presentation activity.

Figure 6 - Indicative example of student creation (group collaborative method)

Using the Blabberize web platform [9] and using the data from the description tabs above regarding the power brokers of the Greek Revolution, give "voice" to the roles so that they can present themselves (Figure 5 and Figure 6).

2nd Example

Topic: "The beginning of the revolution and the first military successes"

Proposed activity

First activity: Digital historical map: *Valtetsi-Trikorfo-Tripolitsa-Dervenakia.*
The first activity uses the digital map technique (storymap) enriched with historical data, historical quotes/sources, maps, hyperlinks, multimedia files.

Figure 7 - Digital Map technique through the Knightlab application [10]

Proposed activity

Based on the suggested sources, please find information on the power structures of the Greek Revolution and their contribution to its preparation and organization. Then record them in the form of words/phrases and/or topic sentences by filling in the corresponding role cards.

Then, through the conceptual map, the students-players are able, alongside the game, to outline the historical personalities who took part in the first military operations of the Revolution, to identify the characteristics of the two opposing sides - strengths and weaknesses - so that in the game they can choose the appropriate power players who will help them to form alliances, negotiate and resolve any problems and challenges that will arise in the process of playing.

3rd Example
Topic: Web-Quest "Dervenakia"

Proposed activity
The realization of a Web Quest aims at the successful use of strategies, which enhance the students' external motivation for learning, as well as the development of their critical thinking through the assignment of tasks, whose solution requires a high level of thinking and perception. Figure 8 distinguish the illustrative example of the use of this platform for the development of an educational scenario.
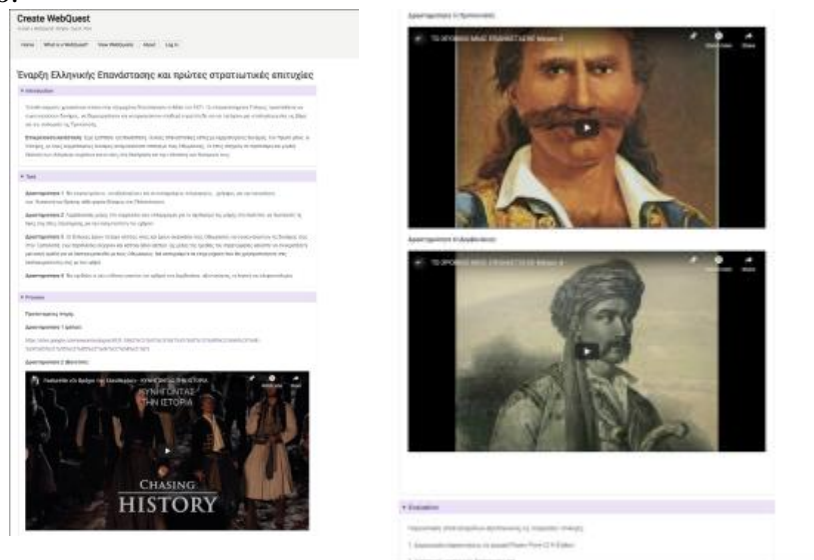
Figure 8 - Digital paradigm in strategy development through Web Quest.

Finally, through the Web Quest - an activity, which is proposed to take place after the completion of the level of "Dervenakia" - the student/players have the opportunity, after having successfully completed the track in the game, to evaluate, within their group or in the classroom, the strategies that were applied for the planning of the specific military confrontation, the opinions, positions and arguments expressed by the selected power players that led to the right decisions for the successful outcome of the game.

VI.   Evaluation
Once the design phase of the training scenario is completed, the implementation of the training scenario in the actual course follows, either in the face-to-face or distance learning model. In

collaboration with the students, the teacher integrates the digital game "BYRON" into the course of the lesson, having an important tool for understanding and carrying out each task of the game through the educational scenarios with the proposed educational activities. During the evaluation phase, the teacher, together with the students, are asked to fill in respective questionnaires which refer to both the first two missions of the digital game "BYRON" and the educational scenarios based on the game's development.

The purpose of the evaluation of the first two missions of the digital game "BYRON" and the accompanying educational scenarios through questionnaires is to inform the research team in detail about the responses of the teachers and students, which were given during the first test of the game, about the content of the discussions and the data left by playing the game. In this way the project team will be able to investigate any problems that developed during the game, to come up with possible corrections on the content in the game, as the modification of key problems is a key prerequisite for the development of the game. Undoubtedly, evaluation is an essential process to support decision making to restructure and improve the game and educational scenarios, contributing to effective learning and providing better learning outcomes.

VII.   Results

Following the development of the game, a testing and an evaluation period has been planned in order to provide feedback for further enhancements. The game will be evaluated in two phases, before and after the completion of the game development and students and teachers will fill-in the respective questionnaires. The game itself is a process of self-evaluation, as the player's development in the game depends on the degree of understanding of the historical context.

Observing the overall answers given by students related to the educational scenarios for the first two missions, it has been found that positive elements are originality, variety of historical topics and their immersion with existing literary genres and texts, which were evaluated as an excellent assistance for the understanding the role power players had in the Greek Revolution, the historical events and the strategies followed by the characters of the game, as well as democratic procedures such as voting.
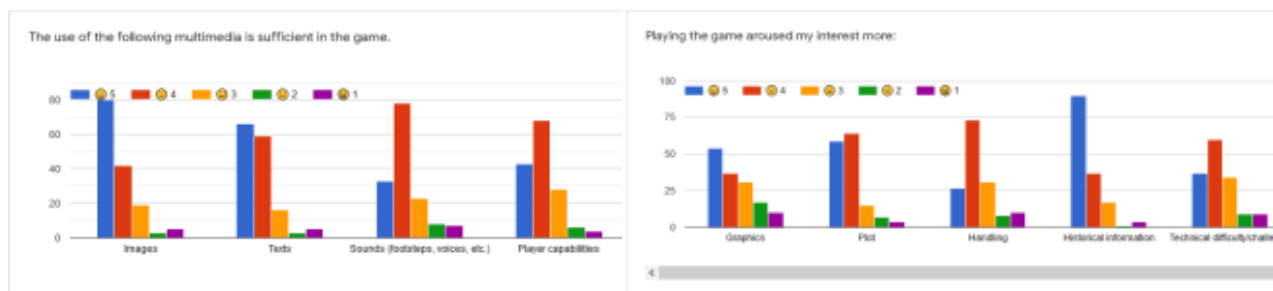

Figure 9 - Challenge of interest to players from multimedia.

The systematic effort to integrate multimedia into the game, attracted the interest of the students, and scored high which is shown in Figure 9. Also, the answers to the teachers' questionnaires reveal the systematic involvement of students in the teaching practice, which promotes self-activity and initiative on behalf of students (Figure 10).

Figure 10 – Creativity and historical adequacy of the Game.

VIII.　　Conclusions

The proposed experiential game aims at students within the Greek middle school community. The game itself, along with the proposed activities, comes to converse creatively with the plot from the first mission of "BYRON". The activities in particular consist of educational tools with which students gradually progress in understanding the parameters set by the mission in order to achieve the intended goal, namely a clear understanding of how the rebellious Greeks organized and prepared themselves and how they led to the outbreak of the Greek Revolution.

On the other hand "BYRON" consists of historical journey that immerses players/students into the social factors that form the historical context of the Greek Revolution.We developed a 3D scenery similar to the historical evidences which describe the areas in which the first wars of the rebellious Greeks took place, so the students/ players are given the opportunity to map the region, to understand the geophysical characteristics of the areas in question. Furthermore, and along with the work of educators, pupils are able to examine the distances between one area and another, to look for maps and integrate them into the plot in conjunction with the provided historical sources through the formal and informal programme of the Hellenic middle school.

Furthermore, from the developer's point of view, the implementation of every part of the game consists of a self-improvement. Programmers are inmmersed into interdisciplenary context, related to historical and social studies through the fundamental material prepared that they got into for the first time. In summary, we strongly believe that all the participants (students, testers, educators and developers) act as role-players within the game, which can better understand the problematic behind the events revolutionary Greeks faced in terms of decision making and battle planning.

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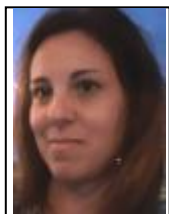
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