





# Studying the Ancient Civilizations on the Balkan Peninsula Through Serious Game and Storytelling

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**Abstract.** This paper presents a new serious game, exploring the multilayered archeological excavations in the town of Aquae Calidae (from Latin, ‘warm waters’), situated in the Burgas mineral baths region. The history of Aquae Calidae (Therma, Thermopolis) is related to the famous hot mineral springs at the site and covers a long period of time from the 1st millennium BCE to the XVIth century CE. It is linked with events of the history of Ancient Greece, Roman and Byzantine times, Medieval Bulgarian period, The Crusades and the Ottoman period, and was visited by famous historical figures. The rich history of the place makes it possible to develop educational games, related particularly to the ancient civilizations. Through immersing in the virtual three-dimensional reality of the ancient complex, and playing intuitive educational mini-games, students from elementary schools improve their knowledge and understanding of the ancient civilizations on the Balkan peninsula.

**Keywords:** Serious games · Storytelling · Cultural heritage · eLearning

## 1 Introduction

In the technology-enhanced education, new approaches, methods, and tools for innovative learning process, are introduced. They assist the teacher in educating more efficiently by stimulating the desire to learn, and the creative and the logical thinking of the learners, thus improving different abilities and competencies.

This paper presents the design process of a new serious game, exploring the multilayered archeological excavations in the town of Aquae Calidae (from Latin, ‘warm waters’), situated in the Burgas mineral baths region. The history of Aquae Calidae (Therma, Thermopolis) is related to the famous hot mineral springs at the site and covers a long period of time from the 1<sup>st</sup> millennium BCE to the XVI<sup>th</sup> century CE. It is linked with events of the history of Ancient Greece, Roman and Byzantine times, the Medieval Bulgarian period, The Crusades and the Ottoman period, and was visited

by famous historical figures. The rich history of the place makes it possible to develop related educational games.

Through immersing in the virtual three-dimensional reality of the ancient complex, and playing intuitive educational mini-games, students from elementary schools improve their knowledge and understanding of the ancient civilizations on the Balkan peninsula. The playing learner initially encounters the Thracian ruler Rhoemetalces II, king of the Sapaeans and the Odrysian Kingdom from 18 to 38 CE, who tells the story of the creation of the temple of the goddess Demeter near the magical springs of Aqua Calidae. The player visits a hall with artefacts of Thracian treasures from the period, and, in gaming mode, acquires crucial aspects of the Thracian culture and civilization. The game development is related to the heyday of Aqua Calidae under the rule of the Roman emperors. In the beginning of 1st century CE, Emperor Nero issues a decree for the initiation of building of the Roman *thermae* at Aqua Calidae, in the Thracian province, where the water was believed to be magical.

During the development, the storytelling and serious games methods are used in a suitable learning scenario, for better understanding of the historical facts and recreation of the era. The combination of these methods contributes to a more efficient education, stimulating the desire for learning, curiosity, creative and logical thinking, and to the development of diverse abilities and competencies of the learners. To address these issues, the mini-games quizzes and puzzles inspire the Aqua Calidae game players to carefully gather the pieces of educational content providing the necessary information.

## 2 New Pedagogical Approaches for History Study. Serious Games and Storytelling

In most of the reviews of the history and studies of the “serious games” [1–3], the term is accepted as introduced by C. Abt in his book “Serious games” [4], where it is presented as a “game having explicit and carefully crystallized educational purpose, as the main goal is not entertainment”. From another point of view, by using the entertainment, serious games can elicit significant engagement from learners and further the effectiveness of the learning process [5]. In the digital era, edutainment [6] became accepted as a useful combination of traditional content and teaching methods in the context of new technologies [7, 8].

Activities in grades 1–4 for studying ancient history and civilization are mainly based on methods such as storytelling, demonstrations, guided-discovery, simulations, games, etc., which are typical for the study of Humanities in this stage of education. The educational environment has rapidly changed. Modern technology allows new possibilities for the development of innovative methods, scenarios, and tools for deeper understanding, for attracting attention, for applying learning-by-doing, and learning-by-authoring, as well as creative thinking, which are little represented in traditional education [9, 10]. A survey of the publications about computer games and serious games, shows a game-based approach to learning, as used across many different curricular areas, to be enjoyable and motivational for the players [11], although the question “does gamification work?” still needs more empirical answers from the educational area [12]. Following the idea of “making learning fun”, seven factors

presented in serious games: challenge, curiosity, control, fantasy, competition, cooperation and recognition, endorse the intrinsic motivations of students for learning [5]. Serious games can assist, facilitate and support very well the affective goal of the learning process for acquiring new knowledge, skills, and/or attitudes by the students after a learning episode [13].

The increased interest in the positive impacts and outcomes of the serious games and the use of term interchangeably with “games for learning”, is illustrated by a literature overview of impacts and outcomes of serious games [14]. At its most basic, historical games studies can be defined as ‘the study of those games that in some way represent the past or relate to discourses about it’ [15]. The education is presented as personal, fun, collaborative, relevant, multimodal, technical and open-minded in the contemporary trends, where “gamification should be treated like a tool: very efficient and precise, but above all, comprehensive” [16]. All serious games in cultural heritage and history learning can be used at school (except the ones located in exhibitions or used for augmented reality visits), but only a few of them are adapted for a specific students’ level or curriculum [13], although the game-based learning approach might be effective in facilitating students’ 21<sup>st</sup> century skill development [17]. The use of computers and video games for teaching history at school resulted in a shift from a traditional teacher-centred learning environment to a student-centred environment with much more activity and engagement by them [18]. The digital game-based learning seeks to maintain a balance between learning and games elements [19, 20]. Like small group work, primary source analysis and historical role-plays and simulations, the serious educational games can be included among the other student-centred methods of history studying [21]. The “serious games” method is accepted as a research, pedagogic, and evaluative tool in the technology-enhanced education and generates good levels of comprehension and unconscious processing of content of relatively great difficulty [22].

Digital storytelling as a practice of using digital technologies to tell a short story [23] is used in a number of contexts and for different purposes [24–26]. The genre of digital history is often associated with the telling of personal stories, often of cultural or historical significance to the author [27]. Such stories often focus on interesting experiences or memories of some past event, or present overcoming personal and collective challenges or achieving goals [24]. With regard to historical education, two important types of digital stories can be identified - those that inform or instruct and those that explore historical events [23]. Classroom practice, which combines the use of digital media with the art of history – using both the skills and preferences of digital students and the inherent human interest in history – is a potentially powerful pedagogical environment [28]. Digital storytelling can be used to engage, inform, explore and transform and thus lend itself to educational contexts [29]. The nature of the engagement goes beyond simple entertainment, although the value of entertainment in an educational context is not to be underestimated, and the use of digital storytelling in the curriculum can provide real educational benefits [26]. Firstly, the multimedia nature makes the content of the digital story more accessible to technology-oriented students, many of whom are alienated from traditional textual forms [30], and, secondly, the combination of text integrated with visual images improves students’ understanding [31]. The visual component helps to place the story in a recognizable context.

According to Bruner's theory of situational knowledge, this increases the time during which students are able to retain and understand information [28], as well as allows students to better organize information into manageable pieces.

The new serious game, exploring the multilayered archeological excavations in the town of Aquae Calidae, follows the ideas of the game “The Thracians”, previously developed by the team [32, 33], in the frameworks and models for interactive learning content, based on the serious games and storytelling [34–36]. The main goal of interactive game-based educational practices is for students to learn the concepts, facts and specifics of history, civilization, and traditions of the people living on the Balkan Peninsula. The best practices, assessing the effectiveness of digital game-based learning are widely investigated in [37]. A version of the game “The Thracians” was tested in classes with 9–11-year-old students (third and fourth grade). At the end of the game, students answered 22 questions in an anonymous survey. It was found that students show great interest in telling stories, and thus, in games that introduce them to culture and history in this novel way. After the game and the analysis of the questionnaire, a special session was organized with the history teachers to clarify the results achieved by the students in their class. The discussion was based on the ten main obstacles to the application of games in education [38]. As a conclusion, we could point out the need to include such resources in the learning process, and to implement “learning +” through such games, in order to provide opportunities to expand and deepen the knowledge of students, especially in the humanities [39].

### 3 Aquae Calidae Game Presentation

#### 3.1 Game Interior

The hot mineral springs, known in Roman times as Aqua Calidae, were a revered location for the ancient Thracians. With its temple and the sanctuary of the Three Nymphs, it was an attractive place for worship. Since the middle of the first millennium BCE, the area was first controlled by the Odrysian Kingdom, and then (since the middle of the first century BCE) by the Sapaeian kingdom – a Roman vassal state [40]. After the annexation by the Roman Empire and the creation of the new Roman province Thracia in the middle of the first century CE, the Romans further improved the site with new baths and temples.

The game is designed to assist the students in their understanding of the ancient Thracian culture and civilization, by letting them explore the Aqua Calidae mineral baths. The player moves through halls, mirroring the architecture of the ancient Thracian burial mounds. By observing the digitally recreated artefacts from the period and by solving the necessary mini-game puzzles, the player advances further, and ultimately reaches the main hall – a rectangular room with a mineral water pool in the middle (Fig. 1).



**Fig. 1.** A screenshot from the Aqua Calidae game – The main hall with the mineral water pool.

### 3.2 The Game Content, Scenario and Gameplay

The game avatar is seen from a third-person perspective and explores the map with the help of the assigned keyboard keys for movement and the mouse cursor for adjusting the camera view. The different objects and artefact found on throughout the halls are activated with a cursor click. These objects could be of two types - visual (*i.e.*, text, maps, pictures) educational content and mini-games, which must be solved to allow further progression. The activation of the educational content provides the information, needed later for solving the mini-games. The mini-games are designed to challenge the students' knowledge award it (*i.e.*, with unlocking new areas of the map, or giving additional information, required for the successful solution of other mini-games). Thus, along with the short-term goals of progressing through and completing the game, the interdependence between the informational and playable components also strives to achieve the long-term goal of improving the students' knowledge on the subject. Already visited locations and puzzles, and the information they have provided, remain available for consultation.



**Fig. 2.** A screenshot from the Aqua Calidae game –A mini-game requiring solution for further advancement.

Figure 2 provides a glimpse into the gameplay. To open the iron grate door, the player roll (by clicking) the wooden cylinders, so that they spell correctly the name of the Thracian ruler pictured on the left (“CEBT” – Bulgarian for “Seuthes”), a piece of information, already gathered from previous exploration. The additional content, that could be seen in the next hall includes a map of the Thracian tribes on the Balkans on the left, an Orpheus mosaic on the right, and the puzzle required to open the door to the next level at the end of the hall.

### 3.3 Game Core

The game is web based, so no installation is needed and users can play it using any device having a modern web browser and mid- to high-range graphic card (PCs, Smart TVs, smartphones, tablets, VR devices, *etc.*)

The 3D engine is based on one of the most popular, stable and well documented libraries for 3D in web – THREE.JS. Using the WebGL technology and HTML Canvas API, the engine is able to utilize the graphic card of the device with great efficiency.

The programming language used for the web development is JavaScript (ES2020 standard). In order to serve the game optimized and compatible for most browsers, the code is bundled, minified, and polyfilled using WebPack 5.

One of the main technological objectives is to serve the game as fast as possible, to consume less resources (hardware – CPU, GPU, memory; network load, especially for devices with limited connection). Thus, every game asset – textures, 3D objects and other media are compressed and optimized, properly scaled or sampled. Lazy-loading technologies are also applied.

Depending on the device (mobile phone, desktop, tablet, *etc.*), users can also choose between the following graphic modes.

**Standard Mode.** Suitable for all kind of targeted devices. The player can use any convenient input – mouse, gamepad, keyboard. For touchscreen devices, on-screen controls are implemented (Fig. 3).



**Fig. 3.** Standard mode.



**Anaglyph Mode.** Suitable for all screens (especially large ones) using anaglyph glasses (passive glasses with cyan/red filter, filtering different image for the left and right eye). With this stereoscopic technology the user can feel the depth of the objects and can acquire more realistic view of the scene and the artefacts. The drawback of anaglyph technology is that the cyan and red filters can distort the color palette of the view (Fig. 4).

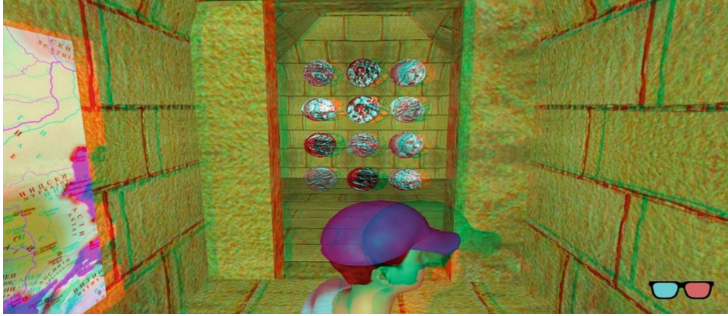


Fig. 4. Anaglyph mode.

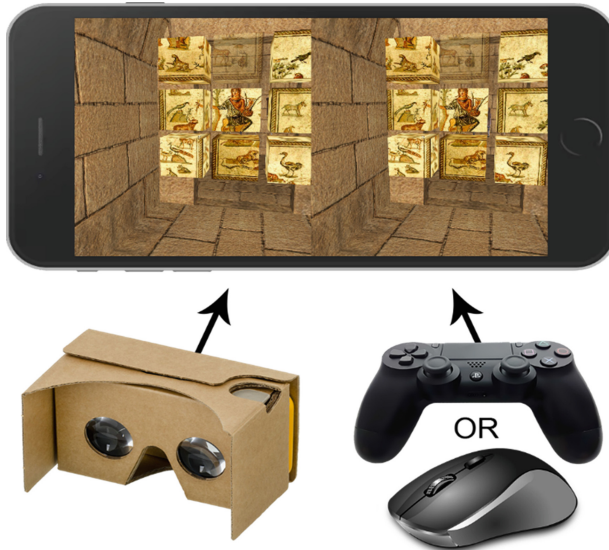


Fig. 5. Virtual reality (VR) mode.

**Virtual Reality (VR) Mode.** Another stereoscopic technology, providing two different images for the left and the right eye, without color or any other distortions (Fig. 5). The technology can be consumed using mobile phone and VR glasses, or using another VR device. Our VR implementation is not based on the Google (WebVR, WebXR) or

Apple (ARKit) implementations. It is based on standard web browser APIs and technologies like Gamepad API, DeviceOrientation API (using the device sensors – gyroscope and accelerometer). The stereoscopic effect is achieved using two scene cameras recording from two points – for the left and the right eye. The player can use bluetooth mouse, gamepad, or any other pointing device to control the game.

## 4 Conclusion

The integration of ICT in the primary school (grades 1–4) ancient history curriculum allows – by means of game playing, interactive interface, visualization, video, and animation – presentation of the material in a fun and accessible way. It makes it easier to explain connections, relationships, and influences among ancient civilizations and will improve the students’ understanding of the evolution of a civilization. The first-person point-of-view interface and the high-quality textures and graphic images, used for the creation of the game, offer an authentic and exciting exploration experience. The basic mapping of the site is augmented with realistic interactive 3D objects, avatars and light shade effects. The mini-games’ graphic outlook is designed to be smoothly incorporated in the environment. The user experience is enhanced by adequate in-game media effects. The game engine is implemented in a way that it allows other scenarios, environments, mini-games, and other assets to be easily added in a new or existing serious game.

**Acknowledgments.** This research is partially supported by the Bulgarian Ministry of Education and Science under the National Research Programme “Cultural heritage, national memory and development of society” approved by DCM №. 577/17.08.2018.

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