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Unveiling California History Through Serious Games: Fort Ross Virtual Warehouse

Nicola Lercari[1(&)], Michela Mortara[2], and Maurizio Forte[3]

[1] University of California Merced,
5200 North Lake Rd, Merced, CA 95343, USA
nlercari@ucmerced.edu
[2] CNR-IMATI, Via de Marini 6, 16149 Genoa, Italy
[3] Duke University, 112 East Duke Building, Durham, NC 27708, USA

Abstract.

Between 1812 and 1841, Fort Ross was a Russian fur trading outpost and multi-cultural colony located in the Northern California coast. Current Fort Ross is a popular California State Historic Park visited every year by over 100,000 visitors from all over the world. In March 2011, California State Parks and the University of California Merced started the Fort Ross Virtual Warehouse project— a digital scholarship initiative aimed to enhance a pilot serious game on Fort Ross developed by California State Parks Staff in the early 2000s— with the goal to explore novel ways for archiving, disseminating, and teaching cultural and historical information. After twenty-four months of development, Fort Ross Virtual Warehouse serious game is ready to be tested in a user study with elementary school students. This paper exposes key features, design solutions and game mechanics of Fort Ross Virtual Warehouse along with preliminary assessments of the game performed as an expert evaluation by the leader of the Special Interest Group on

"serious games for humanities and heritage" of the GALA Network of Excellence (www.galanoe.eu).

1 Introduction

In the last decade the joint effort of research teams, independent game companies, and cultural institutions in the development of digital-based learning tools has proved that serious games (SGs)—specifically digital games for more than just entertainment— entail novel cultural paradigms and define new ways of learning [1, 2]. One of the most noticeable outcomes of this evolving scenario is the implementation of a number of historical SGs that represent specific eras, events, or dynamics through a transdisciplinary approach which blends together computer science, archaeology, history, geography, social sciences, and the arts. This article seeks to provide designers and scholars with a methodology to employ in historical serious games as well as generate a reflection on new tools for cultural visualization and education. For example, how can we design an effective narrative-interactive gameplay that preserves historical accuracy and allows users to have fun? How can we structure an integrated point of view on the reconstructed environment that grants embodiment, playability, and situated learning? What are the features of a serious game that enhance cultural awareness and comprehension? The opportunity to test SGs as learning tools regarding American history became an interest in March 2011 when California State Parks (CSP) and the University of California Merced (UCM) started a digital scholarship initiative—the Fort Ross Virtual Warehouse (FRVW) project—with the purpose of exploring novel ways for archiving, disseminating, and teaching cultural and historical information [3]. Role-play and the employment of multimedia products and SGs are not new practices to CSP. In the early 2000s, Elizabeth Prather along with a group of CSP representatives and contractors designed and developed Virtual State Parks, a pioneering educational project that employed real-time 3D

graphics, digital storytelling, and Fort Ross as the pilot setting. The goal of this groundbreaking work was to involve students, families, and parks' visitors in the virtual discovery of California history [4]. In addition, CSP has a long experience in historical re-enactment. Specifically, the Fort Ross Environmental Living Program (ELP) has involved California students, parents, and volunteers in hands-on learning activities organized by the historical interpreters at Fort Ross (FR) for years [5]. What is innovative in FRVW is our integrated approach to the creation of a virtual learning environment based on scientific data, historical narrative, and experiential learning. Our serious game (SG) complements the pedagogical goals of the ELP with a pre-visit and post-visit virtual tool. Thus FRVW aims to enhance the comprehension of historical and social dynamics as well as train pupils on the topography of FR and the location of its main points of interest (POIs). In addition, FRVW grants access to an in-game repository of primary historical sources—the Fort Ross Journal—and stimulates creative thinking through role-play, challenges, and rewards. The scientific nature of FRVW is determined by a realistic and accurate 3D environment that has been reconstructed using instrumental data—such as LiDAR and terrestrial laser scanning data—obtained through surveys of the topography and architecture of FR [6]. The representation of the cultural landscape and socio-economic activities performed in the SG has also been validated by the historians who work at Fort Ross State Historic Park (FRSHP) and manage the ELP. After a long phase of development—that spanned twenty-four months and involved researchers both at UCM and Duke University—FRVW SG is now ready to be tested. The main user study has been designed according to the Game and Learning Alliance Network of Excellence (GALA NoE) guidelines for SGs evaluations [7]. Elementary school students from ages 7 to 11 will start testing FRVW during the 2015–2016 School Year. The user study will involve teachers and students who participate to the ELP in California as well as pupils in Durham, North Carolina. The purpose of this study

is to evaluate how the integration of digital tools, historical simulation, and hands-on activity can improve the understanding of history, generate cultural awareness and engage young students in novel ways of learning. At the present time, a preliminary expert evaluation has been performed on FRVW by the leader of the Special Interest Group on "serious games for humanities and heritage" of the GALA Network of Excellence, as detailed in Sect. 6.

2 Related Work

The analysis of a number of digital-based games related to cultural heritage [7] suggests that historical SGs favor a realistic simulation of the past. Our findings verify the importance of realism in digital simulation as many historical SGs have been developed as 3D realistic environments [9–13]. Some games demonstrate that 3D sceneries are able to support situated cognition in a realistic/meaningful environment whether players can interact with cultural objects in their actual context [14–16]. Virtual museum and virtual tourism SGs also tend to be as realistic and accurate as possible. These last types of SGs allow players to explore accurate reconstructions of historical buildings or manipulate precious artifacts without risk of damage [15–19]. Realism per se does not make a SG validated by historians. Previous works on digital urban history show that an accurate and effective simulation of the past must rely on virtual environments implemented through the integration of documentary and iconographic sources [20, 21]. Our inquiry on SGs indicates that role-play is another fundamental feature of educational and historical game-like virtual environments [22]. Role-play increases the empathic connection between players and their virtual alter-egos, enhancing the emotional involvement of users in the simulation. Thus, the active involvement of the player in the historical simulation improves the comprehension of the causes that generated the simulated events and amends the understanding of their consequences

[11, 12, 23]. Therefore role-play is often employed in historical SGs for raising awareness about the socio-economic condition of individuals in specific historical eras [23, 24].

3 Historical Context

In the second half of the 18th century, the exploration and colonization of the North Pacific experienced an eastbound expansion of the colonial power of the Russian Empire. Since the 1760s Russian explorers and *promyshlenniki* (hunters and traders) had travelled through the Bering See and the Gulf of Alaska in search of hunting- grounds and ideal places to establish *redoubt*s (fortified outposts) [25]. In 1799 Tsar Paul I chartered the Russian American Company (RAC) with the rights to most of Alaska's natural resources, the monopoly on all foreign trade, and the management of the colonies in Russian America (Alaska). Although some RAC outposts proved to be successful and self-sufficient colonies,

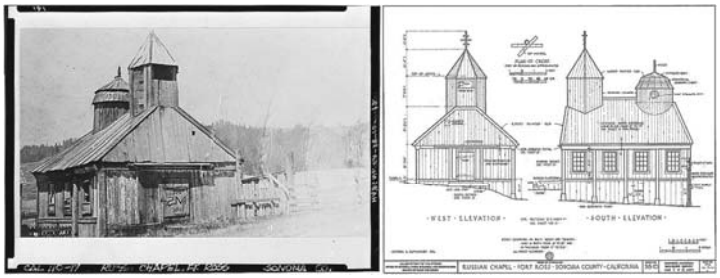

Fig. 1. Example of historical sources employed for modeling the chapel at Fort Ross - Library of Congress, Prints & Photographs Division, HABS.

other *redoubt*s required to be supplied by sea from the Russian mainland with long and expensive trips that were affecting the RAC's profit [26].

In the early 1800s the company hoped to find another center for the trade of fur located in an area that could also provide supplies to other *redoubt*s in Alaska [25]. In 1808 Ivan A.

Kuskov was entrusted to explore the Western Pacific coast and sailed towards *New Albion* (Northern California). He identified a promising location on a promontory near a centuries-old Kashaya-Pomo Native American village called *Mettini*. In 1812 Kuskov established a settlement at Bodega Bay and few months later the Russian colonists started building Fort Ross on the bluff nearby *Mettini* [26]. The initial period of sea otter hunting was very profitable. The population and number of buildings at Ross settlement had grown steadily until the second half of the 1820s (see Fig. 1). Soon, the outpost became a relatively peaceful multicultural colony whose population consisted of Russians—mainly RAC employees—Alaskan hunters with their families, Kashaya and Coast Miwok workers, as well as Russian-Native American Creoles [26].

The golden age of the Ross colony did not last for long. Despite the resources that the RAC employed to establish farms, orchards, and mills, agriculture at FR was never very profitable because the adverse coastal climate conditions. Furthermore, the overexploitation of the sea otter population soon compromised the fur trade. By the end of the 1830s, FR was no longer lucrative [26].

In the early 1840s Alexander G. Rotchev—the last Fort manager—was instructed to find buyers for everything that could not be removed and shipped back to Alaska, (see Fig. 2).

Fig. 2. Fort Ross watercolor painting by Ilia G. Voznesenskii (1841) - from the collection of the Peter the Great Museum of Anthropology and Ethnography (Kunstkamera), Russian Academy of Sciences. Coll. n˚ 1142-6.

In 1841 John A. Sutter, a Swiss pioneer and Mexican citizen, signed with Rotchev a bill of sale which transferred him the ownership of buildings, livestock, orchards, and all the non-transferable equipment located at Port Roumianzoff, the Ross settlement and the Russian American ranchos in Alta California [26]. Sutter salvaged many of the buildings and reused the materials at Sutter's Fort, an agricultural and trading colony located in the Sacramento Valley. After Sutter, the ownership of FR passed through a number of other people until the California Historical Landmarks League bought it in 1903. In the first months of 1906, FR became a California State Park, but few weeks later, a catastrophic earthquake struck Northern California and

seriously damaged a number of historical buildings at FR. Since then many of the buildings inside the stockade have been reconstructed and made once again available for public visiting. In 2012, in occasion of the Fort Ross Bicentennial Celebration, the main magasin and a Russian windmill were also rebuilt. Throughout 2012 FRSHP has been involved in a series of events and celebrations that engaged historic associations, American and Russian authorities, as well as enthusiastic visitors and students.

4 Preliminary Survey, Learning Outcomes and Game Design

The development of FRVW can be summarized in a 6-step workflow organized in the following phases: (1) Conceptualization (2) Research and Data Acquisition (3) Game Design (4) Post-processing and Modeling (5) Game development (6) Beta testing and Finalization. Our work in phase 1 has been inspired by a vast set of design guidelines, reports, and pedagogical curricula developed by CSP representatives and ELP historians [27]. Specifically the newly implemented ELP Clerk curriculum encouraged us to design the playing character (PC) Vasilii Starkovskii—the FRVW's protagonist—as a RAC apprentice clerk who arrived at Fort

Ross in the first half of 1820s to get trained and then work at the RAC Warehouse [28].

The conceptualization of our SGH has been facilitated by the analysis of qualitative and quantitative data related to FRVW potential users that we received as results of a focus group and a survey conducted in 2008 by an independent research firm on behalf of CSP. The purpose of this analysis was to include the educators who participate in the ELP in the preparation of the SG. Specifically, the focus group involved 14 instructors of different ethnicities who have been teaching 3th, 4th, and 5th grade courses in Northern California for a period of 3–10 years. Prior to the beginning of FRVW design, the members of the focus group participated to a collective interview in which they could express opinions, suggestions, and concern about the potential usage of the SG with their students. However, CSP desired to draw conclusions about a larger number of teachers. Therefore, the contractor organized a survey that involved a net target population of 127 teachers. The quantitative study was implemented in the form of a questionnaire which was sent via mail to the participants. A total of 47 completed questionnaires were returned determining a response rate of 37 per cent. The surveyors objectively defined this number as relatively small but reported that the results were interesting and potentially useful [29]. This preliminary analysis addressed relevant topics such as whether the FRVW initiative would have been of interest for the educators, whether their classroom could support the usage of the SG, what timing was fitting best the educational goals, what content they would find useful, and what technological facilities were accessible to the students (see Fig. 3).

The results emphasized the teachers' enthusiasm about using FRVW—especially before the visit to FRSHP—in a formal education environment. The ideal game session length was expressed in a period between two and four hours with the possibility to re-play the game for a shorter time. In terms of

computer support the survey underlined that all the students have computer access and that the schools provide a fast internet connection with an average speed between 1 to 3 MB/s.

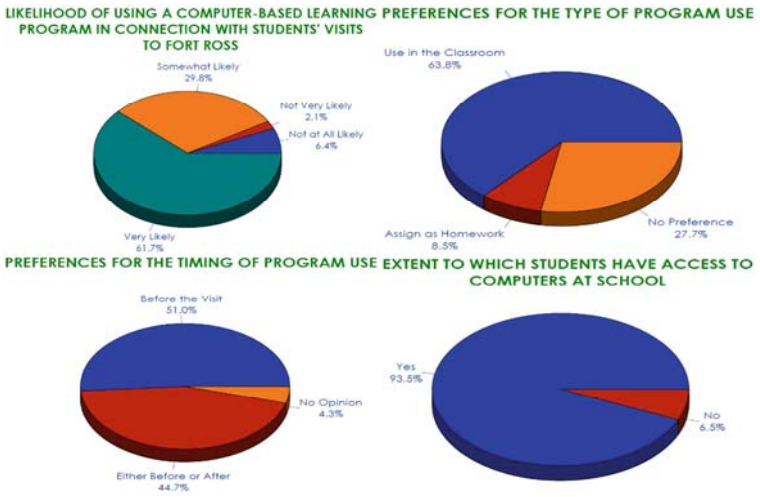

Fig. 3. Graphs visualizing results from the 2008 survey conducted among ELP teachers

The educators' feedback also expressed preference for game content such as California geography, historical role-play on cultures of Fort Ross, factors behind the establishment of the Ross colony, interaction with Spanish and Mexican California [29]. Becoming acquainted with the voice and opinion of the teachers who will use FRVW with the students taking part to the ELP, as well as learning from their concerns and suggestions helped us answer the following methodological questions: what is the best learning environment for a SG on FR? Should FRVW be a pre-visit or post visit tool? How long should a game session be? Is it more effective to develop a stand-alone or a team gameplay? As previously mentioned, the target audience of FRVW is made of students that participate in the ELP or other pupils with an interest in the History of California and the North Pacific

colonization. Therefore, we found essential to involve a number of FRHP historians, CSP staff, and ELP leaders directly in the Research and Data acquisition phase of development as well as in the Design phase and Finalization and Beta Testing phase as primary players. All these stakeholders collaborated with the UC Merced team to include in FRVW a specific learning process that could boost historical interpretation and culture awareness in elementary school students. Feedback from teachers and pupils participating in the ELP has been also taken into consideration during this second phase of development to calibrate the game on the specific needs of the end users. In order to imbue FRVW with a larger pedagogical value, we also decided to analyze content standards and regulations for K-5 education (from Kindergarten to 5th grade) which comply with the ELP's mission as well as with the guidelines adopted by the California State Board of Education (CSBE) in 1998 as a foundation of the state of California's education system [30]. The learning outcomes we designed in phase 2 are inspired by the Grade K-5 and Grade 6-8 CSBE standards.

More precisely CSBE's learning paradigm identifies 3 main categories associated to acquisition of Historical and Social Sciences analytical skills: *chronological and spatial thinking*; *research, evidence, and point of view;* and lastly *historical interpretation* [30]. Previous works specifically underline that a constructivist approach and situated learning are best practices in the implementation of educational SGs related to history and cultural heritage [13, 16, 31]. Although some critics exist to the minimal guidance associated to this learning style [32], we decided to design our SGH using a task-based, constructivist approach to pedagogy. It needs to be reported that we were confident to make this decision because the primary use of FRVW is as pre-visit tool to be used in the classroom under the direct supervision of teachers. Moreover, the learning process enabled by our SGH is complemented by an actual visit to Fort Ross State Historic Park under the guidance of the Park historians and educators. In

addition, our previous experience in the field of cultural virtual environments and historical simulation persuaded us to design a digital-based learning tool meant to educate through the synthesis of scientifically accurate cultural data and to inform through engaging interactive activity [33]. Findings and results from phase 1 and 2 persuaded us to design FRVW as a digital role-play game meant primarily for a formal education environment that could also be played from home using a web browser and Unity Web Player plugin.

In Table 1, Columns A, B, and C describe three different historical and social sciences analytical skills to be acquired by the user of FRVW. Each skill can be developed independently from one another through the achievement of 4 different learning outcomes characterized by incremental levels of complexity as described in Rows 1, 2, 3, and 4. In order to allow users to achieve such learning goals, we designed FRVW as a series of experiential activities that generates understanding of the geo- graphical and cultural information enclosed in FR virtual cultural landscape. Thus, in FRVW the exploration of the scenario is the place where users can negotiate chronological and spatial thinking skills as well as historical interpretation competences. A constructivist approach allowed us to determine that the comprehension of the FR historical context is built up from the experience of the landscape and the completion of engaging tasks and learning activities.

To foster the situated learning aspect of the game and allow users to achieve the learning goals expressed in Table 1 Column C, we also decided to include in the game an interactive catalogue of primary and secondary historical sources. This features— named Fort Ross Journal—is a pivotal element in the formal education phase of the user experience. While immersed in the digital simulation of FR historical buildings or while walking through the virtual Kashaya village, or the Russian cemetery, students and teachers can access together an in-game catalogue of

validated cultural and historical sources through the Fort Ross Journal feature.

Table 1. Skills to be acquired and learning outcomes to be achieved in Fort Ross virtual warehouse

	Skill A - chronological & spatial thinking	Skill B - research – evidence – POV	Skill C - historical interpretation
Learning outcome – Lev.1	Place people and events related to FR history in a chronological sequence and within a spatial context	Differentiate between primary and secondary sources on Fort Ross history	Summarize the key events of Fort Ross era and explain their historical contexts
Learning outcome – Lev.2	Explain how past and current FR are different, identify similarities, differences, permanence and change that reflect California history and geography	Pose relevant questions about FR history and cultures in regards to events, documents, oral histories, letters, diaries, artifacts, maps, artworks, and architecture	Identify the human and physical characteristics of the Ross colony and explain how those features form its unique character
Learning outcome – Lev.3	Develop map skills, determine the absolute locations of places and interpret symbolic representatio ns on a map of FR colony	Distinguish fact from fiction by comparing documentary sources on historical figures and events with fictionalized characters and events	Identify and interpret the multiple causes and effects of historical events that occurred at Fort Ross

Learning outcome – Lev.4	Assess the advantage/ disadvantage of the location of specific places at FR (e.g., proximity to the harbor) and understand how geographic significance	Distinguish fact from opinion in historical narratives and stories about the Ross settlement and Russian colonization of North Pacific	Conduct cost-benefit analyses of the business of the Russian American Company and Russian colonization of North Pacific

5 Game Mechanics and Reward System

FRVW has been developed using the game development ecosystem Unity 3D as a modular game in which narrative gameplay (Challenge Mode) is separate from explore gameplay (Explore Mode). In both modalities, users interact with the environment and historical characters through the Player Character (PC) Vasilii Starkovskii, a young Russian man who lived at Fort Ross and worked in the Fur Warehouse in the 1820s (see Fig. 4).

Fig. 4. Game menu screen (left); view of the Russian windmill and map feature (center); view of Vasilii interacting with a Native American NPC at the Kashaya village (right)

- *Challenge Mode* (CM) consists of a narrative-interactive gameplay which engages the player in a 1.5 h. training quest on Fort Ross history, economy, and cultures. Along the story line the protagonist Vasilii needs to accomplish a number of tasks to become a qualified RAC clerk. CM is based on 5 interactive challenges based on clerk's training tasks (e.g. doing inventory, trading items, calculating the warehouse daily balance, etc.) and related text-based quizzes to verify the acquired knowledge and skills. Moreover, CM gameplay is enriched by 7 sub-tasks that stimulate the player to explore specific locations in the scenario through the usage of the Mini-Map feature. In CM user meets 11 historically accurate Non Player Characters (NPCs) and interact with them through a text-based dialog interface. The edutainment value of CM is reinforced by 4 in-engine cut scenes—specifically in-game cinematics generated in real-time by the game engine—that provide further information about the historical context and grant a better identification of the players in the player character and narrative. In Challenge Mode, cut scene 1 and 2 also provide high quality cinematic opening and closing to enhance immersion in the narrative. CM also presents an Inventory feature, used to organize collected objects, and an Event Notifier feature which helps users to keep track of the assigned tasks and sub-tasks with notifications and memos (see Fig. 5).

Fig. 5. Inventory screen (left), interaction with NPC and event notifier feature in CM (center); detail of the badge clipboard (right)

- *Explore Mode* (EM) consists of a free-roam navigation of the FR colony that allows players to acquire spatial knowledge at their own pace without any scripted inter- action. The usage of EM is mostly useful in a formal environment where tutors and students can use FRVW together. This is especially relevant for what concerns in-context browsing of historical sources stored in the Fort Ross Journal. To avoid a potential drop of interest—caused by its non-structured navigation—EM includes a Timer feature which limits the gameplay to 20 min per session and compels the students to play FRVW repeatedly. EM differs from CM also for what concerns the interaction with NPCs. EM dialog presents the users more detailed information about the historical characters represented by the NPCs, but do not have narrative components. The Map feature is also used in EM to promote spatial learning of FR environment.
-
  - *Reward System*. FRVW's pedagogy is based on the exploration of the reconstructed cultural landscape and on the completion of training tasks. Players are motivated to learn through a scaffolded learning system based on tasks, performance assessment, and learning incentives. Specifically, in CM the clerk supervisor (NPC Mr. Khlebnikov) evaluates the player's performance and

delivers to Vasilii up to 5 competence badges as rewards for the accomplished tasks. Moreover, 2 cut scenes can be unlocked by the player as bonus features. Challenges 1 (Inventory) and 3 (Trade) are meant to stimulate the player to explore the Fur Warehouse and the Ross colony with the purpose to find, collect, and trade specific items used in the Environmental Living Program. When an item is collected, a pop-up inventory window explains pupils the artifact's features. Challenge 1 and 3 are completed when the amount of items required in the prompt is reached. Upon completion the player receives a badge from Mr. Khlebnikov. Our design associates the progression of the game to a successful completion of challenge 1 and 3. In this way we make sure that all the students receive at least 2 badges throughout the game and do not feel they are following behind. The completion of Challenges 2 (Language), 4 (Culture), and 5 (Ruble) does not entail an automatic delivery of competence badges. Such challenges are characterized by text-based multiple choice quizzes that allow the game to assess knowledge learned in previous tasks. At the end of each quiz, the player's performance is assessed through an automated evaluation script that recognizes the correct answer and assigns a score. In case of a top score, NPC Mr. Khlebnikov delivers to the player a competence badge for each successful challenge. When the score is not satisfying the player is urged to work harder and concentrate more on the learning tasks. This design produces a positive competition between players while stimulates them to replay the game in order to reach a higher score and earn all the badges. When all of the 5 challenges are completed the player is prompted to visit the Fort Commandant's house where he is congratulated by the NPC Karl Von Schmidt. There the player also receives a Diploma of Completion that makes him a fully qualified clerk. Such Diploma—customized with the player's name and earned badges—can be saved in the player's local computer. Then the game suggests pupils to print the

Diploma and bring it with them when visiting Fort Ross State Historic Park to receive freebies and congratulations from the park's staff.

6 Preliminary Game Evaluations

As previously discussed, an extensive user study of FRVW will take place in the School Year 2015–2016. However, this paper delivers a preliminary evaluation of FRVW based on the SG description template formulated by the GALA NoE [7]. The preliminary evaluation of Fort Ross Virtual Warehouse aims to describe the principles and elements to be used in the design of the actual user study. This preliminary work is based on a set of criteria that have been currently employed in the creation of the GALA repository of serious game descriptions. Currently, GALA NoE collaboratively tested and described more than 40 serious games with the aim to generate a publicly available on-line serious game catalog. The GALA NoE template provides a general description of the SG (e.g. year of release, target user, learning curve, effective learning time) and covers technological aspects of SG design and development (e.g. platform, game engine, user interface, game mechanics, algorithms, compliance to standards and interoperability); it also describes SG as a learning environment (e.g. if and how the game provides feedback, supports motivation, allows gradual learning/scaffolding, facilitates self-assessment, invites to active learning) and defines the context of use according to the design goals (e.g. if the setting is formal or informal, which are the role of the students and of the teachers, the learning goals and expected outcomes). Furthermore, the GALA NoE template provides an application- oriented analysis based on the following parameters: *effectiveness*, *efficiency*, *usability*, *diffusion*, *feedback and assessment support*, *exploitability*, *reusability in different contexts*, *motivation*, and *engagement*. Each of these parameters was assigned a value from 1 to 5, where 1 is the lowest and 5 is the highest. The following

evaluation of FRVW has been performed with a medium/high level of confidence by the leader of the Special Interest Group on "serious games for humanities and heritage" of the GALA Network of Excellence—an expert on serious games studies who was neither involved in the design of our SGH nor collaborated with the development team. The goal of this section is to provide an informed analysis of FRVW explicitly oriented on the impact of the SGH on its end users (e.g. students and teachers, or visitors and cultural mediators in a park or museum). These preliminary observations will be used as a reference in the design of the user study to be performed with elementary school students and teachers during the School Year 2015–16 with the goal to verify the effectiveness of FRVW as an educational tool.

- *Effectiveness* (efficiency in meeting the learning goals). The following considerations focus on the context of use of the game as a pre-visit application: Score: 5/5 (Excellent). The SG seeks to introduce the FR environment to the students prior to their visit to the park and to communicate historical and daily life events related to FR history. To accomplish these goals, the SG is designed as a role-play game in which the player acts as an apprentice clerk and executes daily duties. In order to make progress in the narrative, the player has to interact with objects (e.g. doing inventory of items at the warehouse) or trade with other characters (e.g. Native Americans basket waivers or Alaskan hunters). Before a new task is assigned, players are invited to explore new locations and become acquainted with the environment. In FRVW there is no facility to teleport to other POIs therefore walking through the various locations might be overwhelming. This action, though, is a successful way of having the players become familiar with FR and surrounding areas. This SGH has the potential to reach high effectiveness when it is complemented by the actual visit to the park.

- *Efficiency* (how time and resources are managed to reach the learning goals). Score: 4/5 (Good). Scaffolded learning is well supported and the employed non-mediated learning strategies are a successful way to allow users to gain spatial knowledge of the FR environment.

- *Usability* (level of easiness of use). Score: 2/5 (Needs Improvement). Player interacts with the SG by navigating the environment, collecting objects, speaking with NPCs, and accessing additional resources via user interface (e.g. journal, map, and inventory). In FRVW automatic triggering and point-and-click make interaction very simple. Selection of objects needs refinement, though, when objects are very close to player. FRVW features a WASD keyboard-based and "mouse-look" mouse-based movement control. The navigation can be challenging because the camera zooms in and out and orbits 360 degrees. This camera design allows for a better point of view on the environment, but can cause an initial discomfort in non- expert users. In addition, some usability issues are due to narrow indoor passages that make the navigation of some buildings inconvenient. The camera also needs refinement because it goes through solid objects (e.g. walls and roofs) when player leaves a building or is very close to external walls. However, these known issues are due to the current implementation and do not derive from the game design.
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- *Dissemination* (the level of circulation of the game). Score: N/A. FRVW has not been officially released yet. However, we expect a wide diffusion of the game since it is sponsored by California State Parks and it will be used in the schools that participate to the ELP. Moreover, the FRSHP is also considering an on-line deployment of the game following a pay-per-play model with a minimum subscription fee of about 1 USD.
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- *Feedback and assessment support* (capability of the game to provide performance assessment and feedback to the players). Score: 4/5 (Good). Activity assessment and feedback are provided during the challenges via the Event Notifier or the text- based dialogues with NPCs. Furthermore, a final performance assessment is provided in the Diploma of Completion which displays a badge symbol for any successfully completed challenge.
-
- *Exploitability* (learning curve, applicability to an actual learning context, role of teachers and students, need of special hardware/software, timing, etc.). Score: 5/5 (Excellent). The game has been developed for a formal education context and may entail online learning. In FRVW the learning curve is low, the interaction mechanism is simple, and pupils can start playing immediately after the initial cut scenes introduce the environment and the game goals. In this SG there is no need for special equipment. The whole session is expected to last about 1 hour and a half so that the game can perfectly fit the school schedule. Particularly noticeable is the FR Journal feature that provides teachers with useful materials for lesson and test planning as well as offers students rich and validated historical sources.
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- *Reusability* (capability of the game to be used in different contexts). Score: 5/5 (Excellent). The primary context of usage is the classroom in which the teacher acts as a mediator. However, the game is self-explanatory and provides extensive information through the Help feature, dialogues with NPCs, and inventory resources. Thus, FRVW can be also played by everyone in a private context (e.g. at home or on the web).
-
- *Motivation* (capability in motivating players to learn). Score: 4/5 (Good). The game is effective in motivating players to learn FR history. This goal is achieved through a role-play

mechanism. Narrative assigns the player a specific role within the Fort Ross community. The identification with Vasilii Starkovskii triggers interests in the daily activities of the Ross colony. This feature provides pupils with an insight on the tough life of the early pioneers in America and makes them reflect on how past and present diverge. Furthermore, the game is designed as a pre-visit tool which precedes an actual trip to FRSHP and generates positive expectations and pre-visit knowledge. This seems to be a successful choice because pupils will arrive to FR with their interests already triggered and most likely they will be more eager to acquire first-hand knowledge about the site.

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- *Engagement* (capability of engaging users in the gameplay). Score: 3/5 (Average). The narrative of the SG is good as well as the embodiment in the main character. The level of immersion in the game might be improved, especially refining the navigation and limiting the amount of text in the interaction with NPCs. Too much text is likely to interrupt the narrative flow, especially with a young audience. Voice recordings or text-to-speech technique could help to improve the dialog system or make it easier for young users to follow the narrative.

7 Conclusions

The diffusion of SGs and other computer-based scholarly practices in schools, muse- ums, parks, and other cultural institutions can be interpreted as the result of a new trend in contemporary pedagogy which promotes the integration of formal and informal education paradigms, learning-by-doing, digital simulation, narrative-interactive activities, and collaboration between learners.

Our experience in the design and implementation of Fort Ross Virtual Warehouse convinced us to value SGs as suitable tools

for teaching history, archaeology, and a variety of humanities-related topics to 21st-century students. Prensky underlines that today's pupils feel an increasing urgency to learn skills and knowledge that are immediately applicable in the real world. This need of immediacy brings students to pay more attention to what is real and practical and not just relevant [33].

The learner-centered paradigm that we used in FRVW promotes a learning-by- doing approach to education. Our method transforms historical serious games in non- mediated learning environments able to communicate validated historical knowledge to an audience of young digital natives as wells as to stimulate cultural awareness about the different constituencies of today's American society. In this paper we have demonstrated that FRVW game is a digital learning tool able to engage the players in a historically accurate training experience developed through role-play, interaction between different cultures, spatial discovery of cultural landscapes, and first-hand access to historical sources. The identification and embodiment of the player in the protagonist Vasilii Starkovskii increases the sense of presence in the historical context. This brings students to ask new questions about events occurred in the 1800s and eventually produces a better cultural awareness of the consequences of the colonization

of North America. To promote inclusiveness, the original design of FRVW included 5 player characters/profiles (a Russian clerk, a male Alaskan hunter, a female Native American cook, a Russian Militia, and a Spanish priest) to represent all the ethnicities and genders that interacted in the Ross colony. Due to budget constraints, the current version of FRVW could not include all of these story lines and PCs and was limited to the clerk narrative. Future developments of FRVW include the possibility to improve the SG as follows: implement new player characters and learning activities; reinforce the text-based interaction through text-to-speech technologies; enhance the navigation of buildings and camera controller;

redesign the Fort Ross Journal and Help features using web links, hypertext, and multimedia technologies. The upcoming user study will bring new insight on the pedagogical paradigm we employed in FRVW. The data gathered with California students— involved in the Environmental Living Program— will be compared with game analytics and post-game session data collected using FRVW in formal educational sessions. The game evaluations will present to the scientific community qualitative and quantitative data on the value of pre-visit and post visit tools for museums and historical sites. Future assessments will also provide feedback on the usage of SGs in formal educational environments side by side with traditional pedagogical activities.

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