Towards an Online Multiplayer Serious Game Providing a Joyful Experience in Learning Art History

Josef Froschauer, Max Arends, Doron Goldfarb, Dieter Merkl
Institute of Software Technology and Interactive Systems
Vienna University of Technology
Favoritenstrasse 9-11/188
A-1040 Vienna, Austria
Email: vsem@ec.tuwien.ac.at

***Abstract*—Using prevalent teaching methods, such as classroom teaching, art historical facts can be tedious to communicate. Especially when it concentrates on teaching artists names, artworks and their corresponding era of art. Knowing about the cultural-historical background of art history can play an important role in raising a student's interest in contemporary culture and cultural heritage. We propose the online multiplayer Serious Game *ThIATRO* that helps students learn art history. This playful approach is intended to not only increases the motivation to learn but also compel the player to think about, organize and use information in ways that encourage active construction of knowledge.**

I. Introduction

The curriculum for art classes in Austria's grammar schools includes two central teaching aims: to foster the the abilities in visual/applied arts and to raise the interest in art history and contemporary culture. We can see that a major part of the teaching time is focused on learning practical crafts (such as painting techniques) and theories about aesthetics and chromatics. Considering that art education is a compulsory subject until the 6th grade in grammar schools (when pupils are 16 years on average in Austria) and from that moment on an elective subject, important fields of art history are often only touched peripherally. The knowledge about artists, their artworks and the cultural-historical background of an era in art history can play an important part in raising one's interest in contemporary culture and cultural heritage. Matters are aggravated by the fact that art historical facts per se can be tedious to communicate, especially when it just concentrates on teaching artists names, artworks and their corresponding era of art. It is vital to create an entertaining and hands-on learning experience for students to learn art history.

In this paper we introduce the idea for the online multiplayer Serious Game ThIATRO that helps students learn art history. The term Serious Game describes a game designed for a primary purpose other than pure entertainment. This playful approach is intended to not only increases the motivation to learn but also compels the player to think about, organize and use information in ways that encourage active construction of knowledge. In this context, Mike Zyda created the term "collateral learning" - the learning that happens by mechanisms other than formal teaching [1]. ThIATRO seeks to:

- combine aspects of learning and fun in an immersive 3D environment to make the communication of art historical facts an entertaining experience,
- create a game-like environment that fosters a collaborative learning experience,
- raise the interest in art history, contemporary culture and cultural heritage.

The remainder of this paper is organized as follows: In the next section we present background information on recent art education approaches. Then we outline the implementation of our Serious Game. Section four describes the design ideas and game design principles for ThIATRO and finally we conclude with directions for future work.

II. Background and Related Work

Today's students represent the first generation to grow up with new technologies, such as computers and video games and all the other tools of the digital age [2]. When it comes to raise the interest in art history of a younger audience, museums are keen on presenting their collections in a more appealing and exciting manner [3]. There is no doubt that a traditional museum has the power to create an incomparable atmosphere to experience art. However, it also has limitations that include restricted display space and opening hours. In addition, static displays often do not inspire greater interest on the part of the viewer [4]. Museums leverage the visit by integrating mobile museum guides as an inherent part of the exhibition. Wakkary et al. developed a PDA-based museum guide system named *Kurio* that is aimed at supporting families visiting museums [5]. *Kurio* was designed as entertaining learning game and fosters an active and engaging museum visit. Schroyen et al. developed a mobile guide framework that facilitates the creation of mobil guides and adheres to social-constructivist principles of learning [6]. The focus of this work is to convey the message of the museum narrative by means of mobile games. The interactive learning game *Mystery at*

the museum was designed for synchronous play of groups over a two or three hour period [7]. The game encourages the visitors to think about the museum's exhibits. All this game-like approaches are centered on the communication of knowledge on-site, meaning at the museum. With regard to the presentation of artifacts on the web, Mateevitsi et al. describe a game-engine based virtual museum authoring and presentation system [8]. The system enables curators to design the virtual museum without any specialized knowledge, at minimal cost, and with good performance. The placement procedure is performed visually by clicking, dragging and scaling the artworks in the 3D world. This approach significantely facilitates the creation of an personalized museum on the web. However, the result still resembles a traditional museum and does not completely take advantage of the possibilities that Web 2.0 and Web 3D may offer for future approaches. Liarokapis et al. [9] present a system for supporting learning based on Web3D and Augmented Reality technologies. The system is targeted at increasing the level of understanding of students through interactive Web3D and AR presentation scenarios. The same authors have demonstrated the usage of these technologies in the application domain of virtual museum exhibitions [10]. We enhance this approach and suggest a 3D multiplayer game that, on the one side, acts as a Web3D exhibition platform and, on the other side, helps students to learn art history in an entertaining and motivating way.

III. Prototype of ThIATRO

ThIATRO stands for "The Immersive Art Training Online". The game is part of the project "The Virtual 3D Social Experience Museum"[1] that seeks to develop an instrument to support the bidirectional interaction between museums and visitors on a Web3D basis. The principal goal includes to provide a platform for 3D museum installations in a multi-user virtual environment. ThIATRO acts as a collaborative learning tool for art historical facts, such as artist names, paintings, eras of art history and painting styles. In detail, the player learns:

- the affiliation of an artist with an era of art,
- the painting style of a specific artist,
- and to associate an artwork to a corresponding artist.

A. Plot and Gameplay

The player slips into the role of an art thief in a fictitious scenery. The avatar is controlled from a first-person view by using the mouse and the WASD keys. The rules follow a typical *Capture the Flag* match, as known from other multiplayer games. Two teams, each having a home base, have to "capture" artwork and bring it back safely to their base. The first team that finds the picture and brings it back to the base gains the point. After the expiration of a certain time the team with the higher score wins the game. In the beginning of every round, both teams get the same assignment that provides an indication of the painting to be stolen. They can include the name of the picture, the artist or a screenshot of the painting itself. More precisely, there are three different types of assignments:

- The team has to find any picture of a specific artist (e.g. "Steal a painting by *Caravaggio*"). The intended purpose of this task is to get familiar with the painting style of an artist.
- The team has to find a particular artwork of an artist (e.g. "Steal the painting *David with the Head of Goliath* by the artist *Caravaggio*"). The player learns to connect a painting to the corresponding artist. This task is more difficult than the first one since there is exactly one artifact that has to be located on the map.
- The assignment only shows a thumbnail of the painting, without any further information. The goal is to commit the painting to the player's memory in a playful way.

It is up to the team members now to find the painting as quickly as possible and return it to the base. The game world contains different buildings that act as virtual museums, which are randomly filled with paintings after every game turn (Fig. 1). Each museum stands for a specific era in art history, both architecturally and the paintings to be exhibited in the inside. A banner on the outside indicates this era (e.g. "The Art of Baroque"). So, to find the artwork quickly, the player has to know its correspondent art movement to navigate to the correct building. For example, the virtual replica of a baroque church holds paintings by baroque artists like *Caravaggio* or *Rubens*. To add another playful element to the game, every level contains different power-ups that appear randomly on the map and can be collected by the player. These power-ups either upgrade the collector's abilities (such as "increase speed"), provide more information about the location of the picture, or allows the player for complicating the opponent's search for the artwork. Power-ups enhance the player's motivation by adding a possibility for *leveling-up*, as described in Chapter 4.

B. Data Sources

ThIATRO can be seen as an art museum that displays artwork in a hands-on way. For the game, we chose to use the *Web Gallery of Art*[2] as a well-known datasource. This data collection features information on about 18.000 different works of art by about 2.200 (mostly European) artists, covering a timespan between approximately 1100 to 1850. The *Getty Union List of Artist Names* (ULAN)[3] offers very interesting contextual information regarding artists and their relations between each other. In the scope of the "The Virtual 3D Social Experience Museum" project, we linked the WGA's image collection with the ULAN data to provide an additional layer of knowledge by putting the artworks into a broader context across their respective creators (to give an example: *Caravaggio* was influenced by *Angelo Caroselli*). The affiliations between involved actors (painters) show a diversity of routes along which an interested audience could

[1] http://vsem.ec.tuwien.ac.at

[2] http://www.wga.hu/

[3] http://www.getty.edu/research/conducting_research/vocabularies/ulan

Fig. 1. A picture gallery in the game

Fig. 3. The final level using Unity Game Engine

move, enjoy and learn about the world of culture and arts [11]. For ThIATRO and for now we limit the data to the paintings provided by the *Web Gallery of Art* to keep the game simple enough to conduct evaluations in the future.

C. The 3D World

ThIATRO is implemented in *Unity Game Engine*[4] and all the 3D models were designed with *Google SketchUp*[5]. Both tools are free (in the basic version) and allow a quick and easy implementation of a first prototype. Our goal was to create a state-of-the-art 3D multiplayer game that runs in the user's browser window without any lags. For that reason we had to pay special attention to keep the polygon count as low as possible and nevertheless give the game an unique and appealing visual style. To design an authentic scenery, we created an artificial town that resembles the inner districts of Vienna. For this reason, we started by taking pictures of typical Viennese house fronts. In a next step the horizontal perspective and distortion were corrected to get useful textures for the 3D model. For the current version we are using eleven different house-textures to guarantee that the 3D environment loads quickly and still looks diversified. In addition, we augmented this scenery with buildings from other European cities that act as virtual museums within the game and display the paintings, the player has to find.

Fig. 2. The 3D model in Google SketchUp

[4]http://unity3d.com
[5]http://sketchup.google.com

These buildings are existing models from Google's *3D Warehouse* [6], such as the neo-classical *Glyptothek* in Munich shown in Fig. 2. The 3D model of this fictitious city was then imported to Unity Game Engine that provides the functionality for the multiplayer architecture and the gameplay elements. Some lanterns, tunnels and point light sources were added to the level to arrange for a special atmosphere. The current result is depicted in Fig. 3. The first test level has a size of approximately 250x200 meters.

D. First test session

A usability test session with two adults and two juveniles showed first positive results concerning the style of the game level and the presentation of the learning content. Due to the limited number of house textures, the players remarked to run the risk of getting lost in the 3D World. We will counteract this problem by integrating a mini-map into the Head-Up-Display (HUD) and by positioning some guideposts in the level. Another point of critique referred to the HUD in general, because it blocks the players view of the paintings. So we will provide a functionality to hide an unhide the HUD at the push of a button.

IV. Game Design Principles

The goal for the design of Serious Games is the successful integration of learning objectives with the elements of entertainment, play and fun [12]. Therefore, in addition to disciplines like game design, visual artistry and programming, the design of a Serious Game also involves pedagogical concepts to become a successful mediator of knowledge. We identified three important points to be important for the success of the game: Integrating a constructivist perspective, the player's motivation and the element of fun.

A. Integrating a constructivist perspective

Learning in 3D Worlds follows a constructivist perspective. Central to the constructivist theory is the belief that knowledge is constructed, not transmitted, and the learners play an active role in the learning progress. For this reason, the player in ThIATRO is able to explore and manipulate the virtual

[6]http://sketchup.google.com/3dwarehouse

environment, talk to other players and watch the art galleries in the museum buildings. The learning content is embedded into a particular context and the learner has to actively deal with it to advance in the game. Learning occurs as an incidental consequence of the game activity, also called *stealth learning* [13]. This approach not only increases the motivation but also compels the player to think about, organize and use information in ways that encourage active construction of meaning [14]. In addition, we pay special attention that the material is organized into small and comprehensible junks to avoid overstraining the player with information. Every single game turn concentrates on one specific artifact, respectively one era of art.

B. The player's motivation

It is a challenge to entice people to play for hours. Greitzer et al. propose guidelines to keep the players motivation [14]. Leveling-up (getting better at something), clear goals, interaction with other players, and a shared experience. We took great effort to incorporate these guidelines in ThIATRO. Because our game is web-based and supports multiplayer, the last two guidelines are given by default. Leveling-up is achieved by placing *power-ups* in the 3D world which upgrade the player's abilities, as described in Chapter 3. In addition, the scores of both teams are compared after every round and the winner team receives an award. The goals of the game are explained in the beginning of the game and the current mission tasks are displayed at every time in the player's HUD.

C. The Element of fun

The most successful feature for a video game, as well as for a Serious Game, is the players enjoyment [15]. Funny elements are important for the players motivation and thus for the success of the game. For the design of ThIATRO fun is a central point. The game integrates features of commercial 3D action adventures and seeks to support a collective problem solving process. Thus, the players have to solve the missions together and, simultaneously, compete against another team. This game-like approach keeps the motivation high and makes learning an entertaining experience.

V. Conclusion and Future Work

The Serious Game ThIATRO helps students learn art history in an entertaining and playful way. Up to now, a first prototype is finished and can be played online. In a next step we will complete the implementation of the game logic and integrate the artworks from our datasources. As soon as ThIATRO is finished, it will be crucial to evaluate the game with respect to playability, level of fun and the learning effect. We plan to conduct the evaluation together with a group of students. Therefore it will be useful to scale down the the database from 18.000 paintings to a smaller set of artists/artworks of great art-historical importance. We will split up the test group into an experimental group that plays the game, and a control group that is taught using prevalent methods such as classroom teaching. In the end, both results will be compared to get an insight in the learning success of ThIATRO.

Acknowledgment

This work was funded by the FWF Austrian Science Fund, Project No. L602, "The Virtual 3D Social Experience Museum".

References

[1] M. Zyda, "From visual simulation to virtual reality to games," *Computer*, vol. 38, no. 9, pp. 25–32, 2005.

[2] M. Prensky, "Digital natives, digital immigrants," *On the Horizon*, vol. 9, no. 5, October 2001.

[3] R. Wojciechowski, K. Walczak, M. White, and W. Cellary, "Building virtual and augmented reality museum exhibitions," in *Web3D '04: Proceedings of the ninth international conference on 3D Web technology*. New York, NY, USA: ACM, 2004, pp. 135–144.

[4] J. Q.-P. Lin and H. W.-H. Din, "Using animation and interactive virtual technology to create interpretive materials for museum learning and promotion," in *SIGGRAPH Asia '08: ACM SIGGRAPH ASIA 2008 educators programme*. New York, NY, USA: ACM, 2008, pp. 1–10.

[5] R. Wakkary, M. Hatala, K. Muise, K. Tanenbaum, G. Corness, B. Mohabbati, and J. Budd, "Kurio: a museum guide for families," in *TEI '09: Proceedings of the 3rd International Conference on Tangible and Embedded Interaction*. New York, NY, USA: ACM, 2009, pp. 215–222.

[6] J. Schroyen, K. Gabriëls, K. Luyten, D. Teunkens, K. Robert, K. Coninx, E. Flerackers, and E. Manshoven, "Training social learning skills by collaborative mobile gaming in museums," in *ACE '08: Proceedings of the 2008 International Conference on Advances in Computer Entertainment Technology*. New York, NY, USA: ACM, 2008, pp. 46–49.

[7] E. Klopfer, J. Perry, K. Squire, M.-F. Jan, and C. Steinkuehler, "Mystery at the museum: a collaborative game for museum education," in *CSCL '05: Proceedings of th 2005 conference on Computer support for collaborative learning*. International Society of the Learning Sciences, 2005, pp. 316–320.

[8] V. Mateevitsi, M. Sfakianos, G. Lepouras, and C. Vassilakis, "A game-engine based virtual museum authoring and presentation system," in *DIMEA '08: Proceedings of the 3rd international conference on Digital Interactive Media in Entertainment and Arts*. New York, NY, USA: ACM, 2008, pp. 451–457.

[9] F. Liarokapis, N. Mourkoussis, M. White, J. Darcy, M. Sifniotis, P. Petridis, A. Basu, and P. F. Lister, "Web3d and augmented reality to support engineering education," *World Transactions on Engineering and Technology Education*, vol. 3, no. 1, pp. 11–14, 2004.

[10] M. White, F. Liarokapis, N. Mourkoussis, A. Basu, J. Darcy, P. Petridis, and P. F. Lister, "A lightweight xml driven architecture for the presentation of virtual cultural exhibitions (arcolite)," in *Proceedings of IADIS International Conference of Applied Computing*. Lisbon, Portugal: IADIS Press, 2004.

[11] M. Arends, J. Froschauer, D. Goldfarb, D. Merkl, and M. Weingartner, "Interaktion mit musealen inhalten in web 3d," in *Proceedings of the EVA Conference: Electronic Information, the Visual Arts and Beyond*. Berlin, Germany: EVA Conferences International, 2010.

[12] Y. A. Rankin, M. McNeal, M. W. Shute, and B. Gooch, "User centered game design: evaluating massive multiplayer online role playing games for second language acquisition," in *Sandbox '08: Proceedings of the 2008 ACM SIGGRAPH symposium on Video games*. New York, NY, USA: ACM, 2008, pp. 43–49.

[13] W. L. Johnson, N. Wang, and S. Wu, "Experience with serious games for learning foreign languages and cultures," in *Proceedings of the SimTecT Conference*. Brisbane, Australia: Simulation Industry of Australia, 2007.

[14] F. L. Greitzer, O. A. Kuchar, and K. Huston, "Cognitive science implications for enhancing training effectiveness in a serious gaming context," *Journal on Educational Resources in Computing*, vol. 7, no. 3, p. 2, 2007.

[15] F. Bellotti, R. Berta, A. D. Gloria, and L. Primavera, "Enhancing the educational value of video games," *Computers in Entertainment*, vol. 7, no. 2, pp. 1–18, 2009.