

# Design and Evaluation of a Serious Game for Immersive Cultural Training

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**Abstract**—3D Virtual Worlds have the potential to expand the knowledge of a foreign culture by presenting the information in a visual context. In this paper we describe the design and evaluation of ICURA, a Serious Game that provides an opportunity to learn more about Japanese culture and etiquette. ICURA incorporates different game design and learning principles to effectively communicate knowledge. The main goal is to combine aspects of learning and fun in an immersive 3D Environment to make the communication of knowledge an entertaining experience. We evaluated the game through a user study with 20 participants. The comparison of pre- and post-test results highlights the positive learning effect of ICURA.

## I. INTRODUCTION

There is no doubt that video games are part of our culture as much as books, movies and other forms of media. Games have historically been the cutting edge of technology [1] and constantly lead to new developments in the fields of computer graphics, game design and innovative storytelling. However, when it comes to games that are not primarily targeted at entertainment, people tend to perceive those games as boring [2]. Another misconception is that play is the opposite of work and thus can never be serious at all. In fact, games have always been a powerful mediator for learning [3]. The main reason for the public misconception may be the wrong integration of learning content into a computer game. Instead of creating boring educational add-ons, information should be well integrated into the game logic and aesthetics [4]. While educational games are still a niche market, the term *Serious Gaming* is getting more and more established in the general public and provides new ways of communicating knowledge within a game-like environment.

The term was first mentioned 1970 in the book *Serious Games* by Clark Abt [5], long before the introduction of computer into entertainment. He claims that card and board games are not intended to be played primarily for amusement, but also for education. The term was taken up again in 2005 by Mike Zyda, who describes Serious Games as “a mental contest, played with a computer in accordance with specific rules, that uses entertainment to further government or corporate training, education, health, public policy, and strategic communication objectives” [6]. Zyda was the first one who suggested a classification of Serious Games into

different categories. deFreitas and Jarvis consider the term as a synonym with “game-based-learning”, because both are used to refer to a digital game with a specific educational or training purpose [7]. Serious Games go beyond entertainment and attempt to educate players about less traditional learning topics, such as health care or political issues. The goal for the design of Serious Games is the successful integration of learning objectives with the elements of entertainment, play and fun [8]. 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. In this context Zyda created the term “collateral learning” - the learning that happens by mechanisms other than formal teaching [6].

Over the last years many topics were covered within Serious Games, ranging from simple learning games to highly elaborate training simulations for military purpose. In this paper we focus on the opportunities that Serious Games provide in the field of cultural awareness, cultural heritage and tourism. The term *culture* is usually associated with a life-world as well as a set of behavioral rules, forms of thinking and norms that emerge from human group interaction [9]. Cross cultural interaction is an important matter that requires the detailed understanding of the target culture. Behaving in an inappropriate way within a foreign culture can not only lead to embarrassing moments, but can also cause unintentional disrespectfulness. Serious Games represent a “safe” way to make mistakes and to learn culture in an environment that mimics reality as realistically as possible [10].

Most of the recent Serious Games that are targeted on teaching cultural awareness were developed for military purpose only. We developed a Serious Game that integrates effective game design principles to appeal to the average user. This paper presents the Serious Game ICURA, that is targeted at understanding contemporary culture and etiquette of a specific country, in this case Japan. The main goal is to combine aspects of learning and fun in an immersive 3D environment to make the communication of knowledge an entertaining experience. We evaluated the game through a user study with 20 participants.

The remainder of this paper is organized as follows. In the next Section we present the background and related work in the field of Serious Gaming. Then we outline the design of ICURA and deal with learning in Virtual Worlds in general. Section four describes the methodology of the evaluation and presents the results. Finally we conclude with directions for future work.

## II. BACKGROUND AND RELATED WORK

Based upon Zyda's definition of Serious Games, Michael proposes the following thematic classification [11]: Military Games, Government Games, Educational Games, Corporate Games, Healthcare Games, Political and Religious Games. This Section is organized according to this classification and gives an overview of recent projects from every subdomain, with special focus on the field of cultural awareness and tourism. The findings are summarized in Table 1.

### A. Educational Games

Educational Games look for ways to use Serious Games as an effective teaching medium. In the literature many examples for Educational Games can be found. *SeaGame* is a Massive Multiplayer Online Game (MMOG) for high-school students that was designed to promote best practices in sea-related behaviors, such as sailing or doing beach surveillance [2]. The main goal of *SeaGame* is to embed the educational content in a meaningful, homogeneous and compelling whole, where the player's enjoyment takes center stage. *Wu's Castle* [1] is a 2-dimensional role-playing game where students interactively construct C++ code to solve in-game problems. The results of the evaluation show that *Wu's Castle* is more effective than a traditional programming assignment for learning to solve problems on loops and arrays. The pervasive game *Power Agent* [12] is aimed at both teenagers and their parents and teaches how to reduce energy consumption at home. In contrast to the projects mentioned above, *Power Agent* is a mobile-phone based game that transforms the home environment and its devices into a learning arena for hands-on experiences with electricity usage. Many Serious Games can be found online to reach a wide audience. *Anti-Phishing Phil* [13] is an online game that teaches users good habits to help them avoid phishing attacks. A study showed that users who played the game were better able to identify fraudulent web sites compared to those, who read tutorials about phishing. Concerning cultural heritage and tourism there are two projects we want to mention here: *Travel in Europe* [4] and *Second China* [9], [14]. *Travel in Europe* (TiE) aims at implementing an innovative means to promote and divulge cultural heritage. In an online environment the user interacts within virtual representations of European cities and accomplishes missions in a treasure-hunt manner. The environment includes trial games, small and simple 2D games that deal with local artistic heritage and focus the player's attention on a particular building or artwork. The *Second China* island in the Virtual World of Second Life ([www.secondlife.com](http://www.secondlife.com)) is a 3D space in which cultural content is experienced virtually by the user. From a central

web-based portal, the user enters the learning environment and chooses between a 2D traditional web-based route, that provides some basic information about the Chinese culture, and a 3D immersive experimental route that explains important aspects in more detail. In different virtual learning scenarios *Second China* communicates respect and understanding of the Chinese culture.

### B. Corporate Games

Corporate Games deal with industrial applications for training, simulation, further education and skill enhancement in general. *CyberCIEGE* is a security training within a game-based environment that covers the significant aspects of network management and defense. In *CyberCIEGE* [15], users spend virtual money to operate and defend their networks. In 2009 the game *World of Subways Vol. 1 The Path* was presented with the Serious Games Award for Best Corporate Game ([www.seriousgamesaward.de](http://www.seriousgamesaward.de)). The player slips into the role of a train conductor and learns the complex procedure of operating a subway train within a realistic training environment.

### C. Political and Religious Games

Political and Religious Games often intend to spread a message instead of teaching the player. There are few publications about this subject area, but a collection of games can be found on [www.socialimpactgames.com](http://www.socialimpactgames.com). A successful example is the browser game *Dafur is Dying*. It was released in 2006 and demonstrates what it is like for more than 2.5 million people who have been displaced by the crisis in Sudan.

### D. Healthcare Games

Many Serious Games are being used in healthcare for treatment, recovery and rehabilitation. Marsh et al. and Wong et al. describe the experiences of the 2020 Classroom, an ongoing project to develop a 3D Learning Environment through a game called *Metalloman* to teach bioscience concepts to undergraduate students [16], [17]. Students "travel" and "perform" vital functions to complete mission objectives and interact with the human body in a playful way. A similar example is the game *Immune Attack* [18] that combines a realistic 3D depiction of biological structures and functions with educational technologies for teaching immunology to high school students. *SMILE* (Science and Math in an Immersive Learning Environment) is an immersive learning game that employs a fantasy 3D Virtual Environment to engage deaf and hearing children in math and science-based educational tasks [19]. It can be seen as an educational game and as a healthcare game. *SMILE* is the first bilingual immersive learning environment for deaf and hearing children.

### E. Government Games

A Government Game simulates politics of a nation, such as the creation of domestic political policies or political campaigns. *FloodSim* [20] is a Serious Game created to raise awareness of flooding, flood policy and flood related

TABLE I  
CLASSIFICATION AND EXAMPLES OF SERIOUS GAMES

<b>Education</b>	[1] [2] [4] [8] [9] [12] [13] [14]
<b>Corporate</b>	[15] World of Subways
<b>Politics &amp; Religion</b>	socialimpactgames.com
<b>Healthcare</b>	[16] [17] [18] [19]
<b>Government</b>	[20]
<b>Military</b>	[6] [10] [21] [22]

government expenditure in the UK. In this online game the player takes on the role of a flood policy strategist employed to implement a selection of strategies for addressing the risk of flooding based on a pre-defined budget.

#### F. Military Games

The military is the primary source of funding for Serious Games [11]. The first version of *America's Army* [6] was released in 2002 and started a revolution in thinking about the potential role of video games for non-entertainment purposes. The game was successfully used as soldier training and recruiting tool. In this context Zyda created the term “first person education”, a play on the phrase “first-person shooter” [6]. Two very elaborate examples of military games are *Tactical Iraqi* and *Virtual Iraq*. *Tactical Iraqi* was designed to accelerate a learner’s acquisition of spoken Arabic to assist soldiers in unpredictable tactical situations. *Virtual Iraq* is a virtual reality simulation intended to reduce the effects of Post-Traumatic Stress Disorder [21], [22]. *Tactical Iraqi* is pedagogical, *Virtual Iraq* is therapeutic. To come full circle Zielke et al. deal with a project that is tightly connected to the fields of cultural heritage and tourism, however, with a military background [10]. The 3D Asymmetric Domain Analysis and Training (3D ADAT) model is a platform for the development and visualization of dynamic sociocultural models. It provides a possibility to learn culture in a safe and realistic 3D environment. Based upon this framework, a Serious Game was developed that lets players increase their cultural expertise in simulated Afghan rural and urban environment.

### III. DESIGN OF ICURA

3D Virtual Worlds have the potential to expand the knowledge of a foreign culture by presenting the information in a visual context. Recent projects, as presented in the previous Section, form a good basis for the implementation of ICURA, although most of them were developed for military purpose only. We developed a Serious Game that integrates effective game design principles to appeal to the average gamer. ICURA is an immersive 3D adventure game that teaches contemporary Japanese culture and etiquette in a safe environment. It can be used as a tool to gather information about Japanese language, behavioral rules and culture in a playful way, either for pre-trip planning or for raising one’s interest in another culture. In order to complete the game, the player has to investigate the 3D Environment, collect items, combine them and talk to persons. Our motivation was to create an entertaining

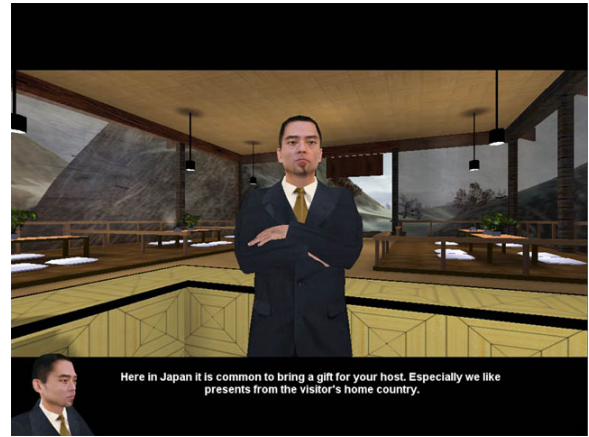


Fig. 1. The dialogue system of ICURA

adventure game, in which the learner plays an active role in the learning process.

#### A. Description of ICURA

1) *The plot of the game*: The player slips into the role of an Austrian tourist in Japan, who wants to learn more about Japanese culture, habits and some language basics. The plot of the game suggests that the player is a member of the Couchsurfing Network ([www.couchsurfing.org](http://www.couchsurfing.org)) and has arranged a meeting with another member in the fictive town of Kuya to stay at his place for some time. Unfortunately, both forgot to communicate the exact address or meeting point. All the player has is a print-out of the host’s Couchsurfing profile and a copy of previous emails. In this emails, Shoji (our host) describes typical rules of behavior for tourists in Japan. Therefore, the main goal of the game is to find Shoji. Various subgoals are added during the progress of the game.

2) *Graphics, UI and controls*: ICURA was implemented using the Torque Game Engine Advanced (TGEA, [www.torquepowered.com](http://www.torquepowered.com)). This enabled us to use state-of-the-art graphics, including elaborate 3D models of buildings and convincing weather effects. In addition, we added discreet music and sound effects that do not distract the player from the learning content. The avatar is controlled from a first-person view by using the WASD keys. The mouse cursor is used to interact with GUI elements and 3D objects. To interact with the 3D environment, the mouse cursor is placed over an object. A change of the cursor’s shape indicates the possibility for an interaction. By left clicking an object, the player investigates an object, a right click triggers an interaction, such as taking an object or talking to a non-player character (NPC). We integrated a dialogue system into the game that lets the player interactively choose what to say and which answers to give. Fig. 1 shows a dialogue with a NPC.

Concerning the user interface design, ICURA follows the example of classic 2D adventure games and incorporates a simple GUI that includes an inventory and several buttons. The inventory, displayed at the bottom of Fig. 2, stores all the objects the player is carrying, for instance the host’s



Fig. 2. The Graphics and the User Interface of ICURA

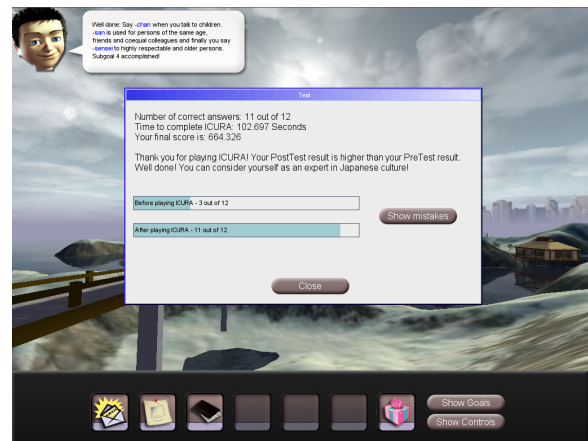


Fig. 3. Results of the pre- and posttest

Couchsurfing profile. As soon as the player takes an object in the 3D world, it appears as a 2D replica in the inventory. In addition, the inventory allows the user to investigate the stored items and to combine them with each other. The two buttons in the lower right corner display a summary of the controls of the game and the goals and subgoals the player has to accomplish. The upper left corner shows a small text box, the so called *Information Agent*. It documents the progress of the game and provides the player with useful information about Japanese culture and etiquette. Every important action the player takes is accompanied by a new message that is crucial for the learning process. Fig.2 shows all the GUI elements.

3) *Playing ICURA*: Once the user has started ICURA, she finds herself in a game-like 3D environment. She is prompted to complete a test that consists of 12 questions concerning language basics, Japanese culture and etiquette. This test is a measure to determine the preliminary knowledge of the player and subsequently serves as a basis for analyzing the learning effect of the game. Three different screens introduce the player to the user interface and the controls, as well as the purpose and the plot of the game. In order to complete the game, the player has to investigate the 3D Environment, collect items, combine them and talk to persons. As soon as the player reaches the end of the game and has found the host Shoji, she is faced with the test again. The game calculates the results of the tests and gives a short summarization and a final score that is composed of the number of correct answers in the post-test and the duration to complete the game. Fig.3 shows the end screen including two bars that visualize the results of both tests. The results are then uploaded to a server and displayed on an online scoreboard. Sheng et al. point out the importance of including an opportunity for the players to stop and think about what they are learning [13]. This is called the “reflection principle” and is employed by displaying the wrong answers from the post-test at the end of the game.

4) *ICURA and Itchy Feet*: ICURA is an extension to the e-Tourism environment *Itchy Feet*. Itchy Feet is a game-like e-Business application that fosters a lively society of travelers who exchange travel experiences, recommend tourism

destinations or just listen to catch some interesting gossip. Moreover, business transactions such as booking a trip or getting assistance from travel advisors or community members are constituent parts of this environment [23], [24]. Within the 3D world of Itchy Feet, every visitor is impersonated as an avatar and is able to enter different buildings. The Forum Building acts as meeting point for avatars, the Travel Agency and the Auction Building provide the functionality for booking flights and hotels and to buy tourism related products in real-time auctions. As an additional feature, we placed a Japanese temple into the 3D World of Itchy Feet to spark the visitor’s interest in the integrated game ICURA. Fig.4 shows an avatar in Itchy Feet and a signpost that leads to the Japanese temple. As soon as the avatar enters the temple, she can switch to ICURA to play the game. When the game is finished or broken up, the avatar is teleported back to the initial position in Itchy Feet. The package, including the Itchy Feet environment and the ICURA application, can be downloaded from our project’s homepage [www.itchy-feet.org](http://www.itchy-feet.org).

### B. Design Principles in Practice

ICURA incorporates different game design and learning principles to effectively communicate knowledge about Japanese culture and etiquette. Before explaining these principles in detail, let us have a look at learning in Serious Games in general. To raise the effectiveness of a Serious Game, deFreitas and Jarvis highlight four main aspects: the context, where a game will be used, the learner specification, representation and the pedagogical model or approach used [7]. Based on this approach, we defined five subdomains to be important for the design of ICURA:

1) *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. Johnson et al. state that a player forms memories, makes associations and uses the context later to aid in recall [21]. Therefore the creation of a particular context is crucial for the learning success. To foster the construction of





Fig. 4. Integration of ICURA into the 3D e-Tourism Environment *Itchy Feet*

knowledge, learners should also have opportunities for exploration and manipulation within the learning environment [25]. ICURA provides a huge game area that is freely accessible. The player has to explore this world and interact with the objects and other persons to fulfill the given tasks. The overall plot is authentic and provides a learning context that can be carried over to real life experiences. A learning game should always relate the material to the learner's experiences and organize the material into small chunks, building up from simple to complex. During the implementation of the game, we turned our attention to designing realistic and meaningful tasks. To follow the principles of constructivism, the puzzles and its solutions are an inherent part of the game plot. To quote an example, in one scene the player has to gain access to a Japanese temple to fulfill a subgoal. In order to successfully complete this task, the player has to put on slippers, which are provided at the temple's entrance. Otherwise a temple guard refuses the entrance. Hence, the player has to deal with the learning content actively to fulfill the task and can apply this information to a situation in real-life. By looking at objects and triggering interactions, informations are transferred to the user in an inconspicuous way. So, learning occurs as an incidental consequence of the game activity, also called *stealth learning* [21]. 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 [15].

2) *The player's motivation*: It is a challenge to entice people to play for hours. Greitzer et al. propose five guidelines to keep the player's motivation [15]. Leveling-up ("getting better" at something), adaptability of the game's difficulty, clear goals, interaction with other players, and a shared experience. We tried to incorporate as many guidelines as possible in ICURA.

As described above, we integrated a button that lets the player display the goals and subgoals of the game. The specific goals are: find your Couchsurfing host, find a present for him, wrap up your present, gain access to the temple, and find out where your host lives. As soon as a goal is accomplished, it gets marked with a green check mark. Therefore the goals and

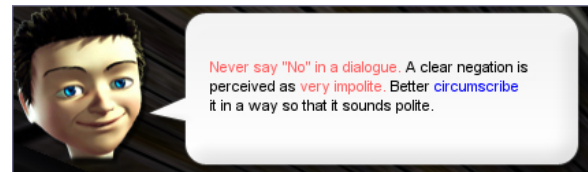


Fig. 5. The Information Agent teaching Japanese etiquette

the current status are visible to the player at any time of the game. ICURA is a single-player game, so in the first instance there is no interaction with other players. Due to the fact that ICURA is embedded in the 3D e-Tourism Environment *Itchy Feet*, the interaction happens as soon as the game is finished. The users can discuss the gaming experience and can exchange their views about the learning content. Two of the guidelines proposed by Greitzer et al. are tasks for future work [15]: the recent version does not allow to adapt the difficulty and leveling-up is not supported. The online highscore, as described above, can be seen of some kind of leveling-up functionality, although it is not directly integrated into the game. However, a highscore can raise the player's motivation to play the game again.

3) *Usability*: Pinelle et al. define usability as "the degree to which a player is able to learn, control, and understand a game" [26]. Failures in a game's user interface design can have a negative effect on the overall quality and success of a game and thus also influence the communication of learning content. Based on the analysis of video game reviews, they developed ten usability heuristics to help avoid common usability problems. ICURA follows these heuristics and provides consistent response to the user's actions. In addition to displaying learning content, the Information Agent in the upper left corner (Fig. 5) comments every action, informs the player about her current status and provides instructions and help. As for the puzzle mentioned above, the Information Agent proposes to take a look into Shoji's email for a hint before entering the temple. The email tells the player to put on the slippers before entering the temple.

4) *The Agent Principle*: The idea of using a virtual tutor was already used in other projects. In *Tactical Iraqi* it is depicted as a talking head that evaluates the learner's pronunciation and syntax [22]. In *Tactical Pashto* the player gets assistance from a non-player character that takes the form of an Afghan go-between [21]. In this context, ICURA was strongly influenced by Sheng, Magnien et al. and the idea of a "story-based agent" [13]. Agents are characters that help in guiding learners through the learning process. These characters can be cartoon-like or real-life characters. The usage of an agent as part of the story enhances learning. In ICURA, the Information Agent assumes the role of the "story-based agent" by guiding the player through the course of the game and simultaneously transporting learning content in small and comprehensible junks. Fig. 5 shows the Information Agent advising the player to never say "No" in a dialogue with a Japanese man or woman.

5) *The Element of Fun*: Yue and Zin list 15 features of game design and how they were implemented in the history educational game *HMIEG* [27]. They pay particular attention to the element of fun. The most successful feature for a video game, as well as for a Serious Game, is the player's enjoyment [2]. In a survey of Serious Game developers, educators and researchers, over 80 percent of respondents rated the "element of fun" as important or very important [11]. Existing Serious Games that deal with teaching cultural awareness, mostly in military context, often lack of funny elements. However, they are so important for the player's motivation and thus for the success of the game. For the design of ICURA fun was a central point. The game includes funny comments and jokes to make learning an entertaining experience. The importance of fun was also confirmed in the evaluation of ICURA that is discussed in the following Section.

#### IV. EVALUATION

The evaluation of ICURA was conducted in March 2010 and a total of 20 participants were invited to play the game. The overall goals of the evaluation include the following questions:

- How much information does the game communicate?
- What do people associate with the term Serious Game?
- Is the game fun to play and is the design of the 3D environment considered as convincing?
- Does ICURA spark interest in the Japanese culture?

A common approach to analyze the effectiveness of Serious Games is the comparison of pre- and post-test results to highlight the learning effect [1], [2], [12], [13], [19], [16]. In addition, questionnaires are used to collect demographic data and to detect strengths and weaknesses in game design and usability. A more extensive approach splits 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 [14], [28]. We decided to use the first approach because it is better suited for a smaller test population.

The evaluation for ICURA was carried out in five steps. In the pre-questionnaire, demographic data and information about the participant's computer usage were collected. The pre-test was completed to assess the participant's knowledge of the Japanese culture. Then ICURA was played and the post-test was taken. The last step was a final questionnaire to determine the overall satisfaction with the game. On average, it took 15 minutes to finish ICURA.

##### A. Results of Pre-Questionnaire

A total of 20 users participated in the evaluations of which four were female and 16 were male. On average they were 29 years old (Mean (M) = 29,35; Standard Deviation (SD) = 4,49). The youngest test person was 21 years old and the oldest was 43. Most of them were heavy computer users with an average computer usage of 41 hours per week (M = 40,7; SD = 17,42). 15 participants ranked their computer skills as either "good" or "very good" on a five point scale (M = 4,15; SD = 0,93, assuming that 1 is beginner and 5 is expert). So the test population shows higher-than-average computer skills.

Despite their intense computer usage The time they spend playing video games is comparatively low, with a mean of 3,15 hours a week (SD = 1,53). Nine participants enjoy to play games "much" or "very much", but nearly all of them mentioned, they don't have time to play games. Regarding the term *Serious Game*, nine people have never heard it before, while another eleven persons associated it with learning and education. One called it an *oxymoron*, because "a game can never be serious". All in all the confidence in computer games as mediators for knowledge is very high (M = 4,35; SD = 0,67), but they think learning games in general are moderately interesting (M = 3,35; SD = 0,88). 18 people show a "high" or "very high" interest in foreign cultures (M = 4,40; SD = 0,68), three of which have been to Japan once before, but in general the interest in the Japanese culture is moderate (M = 3,05; SD = 1,00).

##### B. Results of Post-Questionnaire

Directly after playing ICURA and taking the post-test, every participant was asked to complete a final questionnaire. The overall fun-factor of the game was rated high, with a mean of 4.20 (SD = 0,70). So our efforts to integrate elements of fun into the game seemed to pay off. No one said that playing the game makes no fun at all. The participants enjoyed the state-of-the-art graphics, the winterly landscape, the overall atmosphere, the humor and the learning content in general. Especially the integrated dialogue system was highlighted for its intuitive handling. One participant said that it reminds him of classic adventure games from the early 90s, such as *Monkey Island*, and he felt like being in Japan. The main point of criticism concerned the controls of the game. When pressing the left or right arrow keys, they expected the avatar to perform a sideways motion (called *strafing*), instead of turning around the axis. Although the game lets the player toggle the mouse cursor to activate a mouse-look view, scarcely anybody made use of it. This demonstrates that we took too less effort to explain the controls. One way to counteract this problem is to design a tutorial level to introduce the player into the game. As a rule of thumb and to avoid unpleasant surprises, it is best to stick to prevalent control principles, as they are used in current 3D first- or third-person action games. The difficulty of ICURA was ranked as adequate (M = 3,10; SD = 0,64, where 1 is "too easy" and 5 means "too difficult"). All in all 19 people think that the 3D world of ICURA is authentic and gives a feeling of being in Japan (M = 4,74; SD = 0,45).

One important issue was the evaluation of the Information Agent. We took great effort to direct the player's attention to the text box. As soon as it displays new information, the speech bubble blinks three times and an alert sound is played. 18 participants noticed when the Information Agent changed its state. In general, a user interface should be highly efficient, good looking and non-intrusive [27]. The Information Agent was not perceived as too intrusive (M = 1,26; SD = 0,56, where 1 means "not intrusive at all" and 5 means "very intrusive"). 16 people thought, the information from the Agent is "important" or "very important", because it is applicable to

real-life situations. No one thought it is of no importance. 14 participants would play the game again in order to answer all 12 questions in the test correctly and thus reach a higher final score. Those, who would not play it again think that they would not acquire new knowledge. 15 participants said that they would be interested in games like ICURA in private life ( $M = 3,94$ ;  $SD = 0,57$ ) and the game also sparked interest in the Japanese culture ( $M = 3,55$ ;  $SD = 0,94$ ).

The results of the pre- and post-test demonstrate how much information the game communicates. Both tests consist of 12 questions, 10 single-choice (one out of five is correct) and two multiple-choice questions (more than one can be correct). Four questions deal with language basics, four with behavioral rules and etiquette and the rest cover topics of culture and society. The questions are answered before and after the game was played. As Fig.6 shows, every participant was able to improve his or her results. On average, 5.05 questions were correct in the pre-test ( $SD = 1,99$ ). This value grew up to exactly 10 in the post-test ( $SD = 1,26$ ). Two people, who have not been to Japan before, were able to answer all questions correctly. A static or negative learning outcome would have potentially pointed to problems with the design of the questions or the tasks to provide a learning outcome [16]. So, the evaluation shows that ICURA successfully communicates informations about Japanese culture and etiquette. But there are significant differences in how the information is presented to the player within the game.

Following the constructivist learning theory, a big part of the learning content is designed as an integrated part of the puzzles in the game. The player has to deal with the learning content actively to fulfill a task. Other informations were just displayed by the Information Agent, without compelling the user to deal with it actively. The analysis of both tests shows that information which follows constructivist principles is communicated much more effectively. To give an example, before playing the game only four people knew how to salute an older and respectful person in Japan (by using the prefix - *sensei*). Afterwards everyone was able to answer this question correctly because the user had to know this fact to successfully get on with the game. Fig.7 shows this effect, in which the

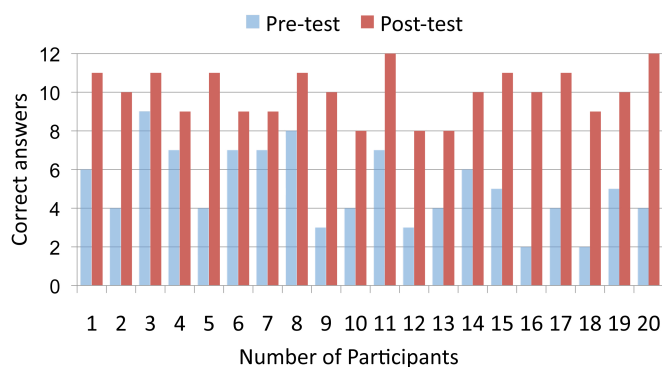


Fig. 6. Results of the pre- and post-test with 20 participants

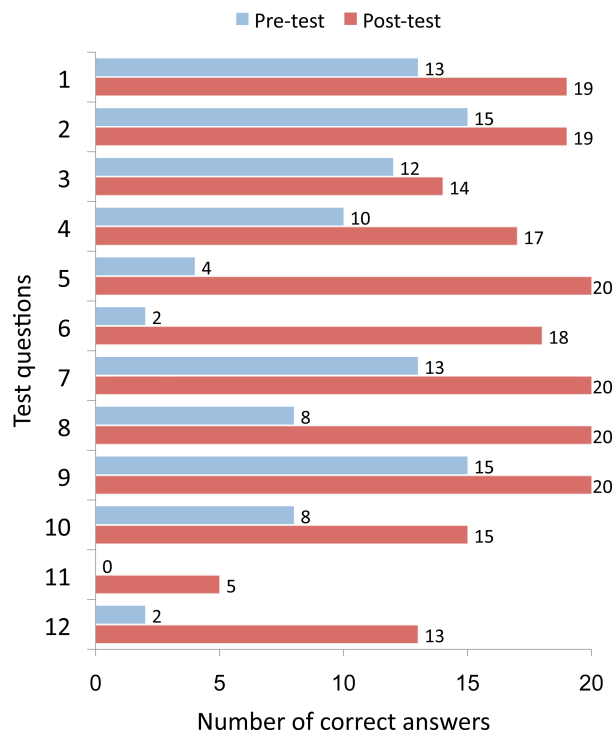


Fig. 7. Twelve test-questions and the number of correct answers given before and after playing ICURA

questions five to nine and their associated puzzles in the game follow the constructivist theory. On the other side, the language basics, like how to say “Hello” and “Thank You” in Japanese, were only communicated via the Information Agent and thus resulted in a lesser learning effect (see question 1 to 4).

So, to sum up the results of the evaluation, the term *Serious Game* is still new to many people. Those, who had heard about it, associate it with learning and educational games. ICURA was rated as very funny to play, the 3D environment was perceived as convincing and it did spark interest in the Japanese culture. Concerning the communication of knowledge, all participants could increase their knowledge about the Japanese culture and achieved a higher score in the post-test than they did in the pre-test. It is recommendable to wrap the story of the game around the learning content and to integrate every information into a puzzle to allow the player to deal with it directly. ICURA also lacks of voice output so far. As Moreno says, students learn better when words are spoken rather than printed [29]. Therefore we plan to integrate voice output in the next version of ICURA.

## V. CONCLUSION AND FUTURE WORK

ICURA is a 3D Adventure Serious Game that provides an opportunity to learn more about Japanese culture and etiquette. The main goal is to combine aspects of learning and fun in an immersive 3D environment to make the communication of knowledge an entertaining experience. The evaluation showed a significant learning potential. The experiences that we gained

during the development of ICURA will be transferred to another application area. Future plans include the creation of a Serious Gaming application for a project called *The Virtual 3D Social Experience Museum*. In this project we will investigate the effect of Serious Games in the field of cultural heritage and art history.

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