Assessment of an educational online virtual game environment: the case of SimSafety

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Abstract. Although the purpose of online virtual games is users’ satisfaction, they may be used as an educational tool as well. This paper presents a quality evaluation procedure along with its results, of an online virtual game environment with educational purposes, named SimSafety. The SimSafety virtual environment supports role-playing game scenarios in real-time and dynamic groups of online users. During the interaction with SimSafety environment, players (which are children and parents) are exposed, through a controlled and safe environment, to virtual internet threats in order to get familiar with them and learn how to overcome them. The evaluation procedure conducted in the Software Quality Laboratory of the Hellenic Open University. A brief presentation of games’ usability evaluation framework is presented while the relation between games and learning is discussed.

Keywords. Online virtual learning environment, game usability, quality evaluation

Introduction

Online virtual games, apart from the entertainment they offer, may also be used as educational tools. In this case of using games as a means for education, the issue of usability in a game environment is very significant in order to enhance users’ challenges. In this study, game usability is defined as the degree to which a player is able to learn, control, understand, be intrigued and enjoy the game. Many of the usability issues which arise in games are similar to those which arise in other software applications areas. Nevertheless, the need to focus on games usability and how usability principles are incorporated into games is emerged.

This paper presents the evaluation of an online virtual game environment used for educational purposes. The aforementioned virtual environment is “SimSafety-Flight Simulator” (http://www.simsafety.eu) which enables users to follow role-playing game scenarios in real-time, supporting dynamic groups of online users and exposing players to virtual safety traps. In SimSafety’s environment, players get familiar with the internet threats and eventually learn how to overcome them, or even better not to get involved in the first place. Furthermore, SimSafety environment is not just a conventional game, since it promotes socialization, educational actions and protection of internet exposure of a sensitive target group such as children. The target group of
this particular game is children in the age of 9-13 and its major purpose is to expose them, to internet risks with a safe way. The evaluation of SimSafety took place in the Software Quality Laboratory of the Hellenic Open University (HOU). Software Quality Laboratory operates within the frames of Software Quality Research Group (SQRG) (http://quality.eap.gr) which focuses on Software Quality Assessment and Software Evaluation, placing special emphasis on educational software quality. Software Quality Laboratory is a controlled laboratory environment, suitably equipped for the performance of usability tests of various software systems.

The rest of this paper is organized as follows; in section 1, usability evaluation issues for virtual games environments and their relation with learning are briefly presented. Issues relative to learning theories for games and learning are presented as well. Section 2 is a brief description of the SimSafety environment, its aims and objectives. Section 3 enlightens the evaluation procedure and goals as well as the profile of the players participated to the SimSafety’s evaluation. Section 4 presents the evaluation results and discusses a number of changes to the SimSafety environment that should be considered in its next version. Finally, section 5 summarizes the conclusion and presents the future goals.

1. Usability and Learning in Relation to Games

Initially games were developed for entertainment, nevertheless, most of them have a scenario and a problem to solve in order to achieve their goals and come to an end. Games’ usability is an important factor in order the game to be used with pleasure and satisfaction from the candidate player.

1.1. Usability of Games

Usability issues in games’ compared with other software applications’ interfaces, have to deal with different parameters and examine a wide range of subjects. An example of a different usability consideration for games is user errors. In many other applications, user errors are not desirable, but in games are more than expected. Therefore, due to the games’ designs, which have the intention to challenge users to find the way to achieve their goals, errors are expected [1].

A more generic (i.e. not always applicable in games) definition of usability is “the aspects of effectiveness, efficiency and satisfaction”. Effectiveness relates to the accuracy and the achievement of the user’s predefined goals, efficiency describes the resources used to achieve the goals and satisfaction is referred to user’s emotions [2].

So far, there is not any definite method to measure usability of a game. Nevertheless, games’ usability is depended on the easy way in which a player is able to start, understand the available functions and the goals of the game and finally play the game. Efficiency is affiliated with the resources which are used by the player in order to achieve the goals of the game. While, effectiveness is related with accuracy and the user’s achievement goals in order to reach the end of the game, or achieve a goal. Also, satisfaction is associated with the players’ mood.

Considering that the initial goal of a game is user’s enjoyable satisfaction, which consists of aspects of fun, immersive environment and experience of a user, is a major parameter in order to measure usability of a game. Games like other applications have an interface which is important to provide an effective and efficient interaction with the
user. Another essential aspect of usability of a game is playability, which has a major role in games’ design, but in different point of view compared with effectiveness and efficiency of its interface [1,3,4].

All aforementioned usability aspects for a game can be classified in three categories: game interface, game mechanics and game play. Game interface is referred to the devices, such as keyboard, mouse, controller, which a player use to interact with the system. Game mechanics include the ways the player is authorized to act through the game environment, such as walk, jump, fly etc. Game play is the total actions of the player in order to achieve the goals of the game [5]. The usability of aforementioned categorization is relevant with the type of the game (eg. adventure games, role-playing etc.) and the platform machine (eg. pc, console etc.) which are used [3].

Consequently, a more specific definition for usability in games is the point of view in which the player is able to learn, control and understand the game. This definition relies on previous studies, which were focused on usability issues and on playability heuristic rules.

1.2. Games and Learning

Games, in their infancy, received severe criticism for their negative influence to users, such as addiction, unsociable affect or violence behavior. However, recent researches have shown that games have mainly positive points of view. Some of the positive characteristics of games are their educational aspect [6], enhance of collaboration and socialization [7], enforce of logical thinking and decision making [8]. Moreover, games are used to academic community in many levels and they proved to be very useful specifically for the enhancement of the students’ motivation. Additionally, games demonstrate practical skills, stimulate perception and problem-solving skills, strategy planning, tools organization and obtaining intelligent answers.

Many games have a scenario and a problem to solve in order to achieve their goals and come to an end. In this way, logical and critical thinking are enforced during the game. The game “Lord of the rings”, enforces book reading, while “Civilization IV” enhance observation, logical thinking, geography, problem-solving and decision making. Furthermore, “Total war: Rome” is an example of strategic planning game and “Sims” and “Second life” are games of social simulation [9].

Students’ motivation and interest for learning is enhanced when “fun” embedded to the educational process [3]. Many researches support the idea, of teachers using video games in the educational procedure [10]. Communication and interaction among teachers and students can increase in and out of the classroom if they use video games during teaching. Video games are considered to be a strong educational tool which provides teaching information and learning outcomes. Moreover, provide to teachers a new way to share their knowledge and extend the traditional teaching methods. By using a video game through the process of an educational activity, teachers create all the appropriate conditions for the students’ future challenges and students can improve their skills [11].

Many educational theories and learning efficiency are affiliate to games’ environments. The theory of experiential learning (i.e. if you do it you learn it) is a basic game’s parameter which support the navigation of the users in the game’s environment according to a game scenario but also allow them to take their own decisions which affect the outcome of the game. The player may repeat the same action many times in order to achieve the success of an activity. Theory of inquiry-based
**learning** (i.e. what will happen if I do that?) is related to games in which players allow to navigate without any restriction. In these environments the users try new ways in order to overcome obstacles that emerge. Moreover, the theory of *self-efficacy* (i.e. if you believe, you will manage to succeed; you will try much harder) is relevant to games in which the player’s motivation enhance by the items collection when specific goals were achieved. Another theory is *learning through a specific target* (i.e. you learn better if you work on a well set target) which concerns specified game’s objective. Furthermore, theory of *cooperation based learning*, studies in classrooms have testify that working in a group instead of individual learning process improves significantly the learning process outcomes [12].

### 2. Aims and Objectives of SimSafety

SimSafety, the acronym of Flight Simulator for Internet Safety, is an online virtual reality game environment for children. SimSafety provides to players, in this case children, a safety environment while expose them to internet risks. Furthermore, supports role-playing game scenarios in real-time, dynamic groups of online users and expose players to safety traps in order to learn how to overcome them. Additionally, SimSafety has a 3D environment that provides a wide range of activities in order to achieved predefined goals. Through playing in SimSafety environment, children enhance their socialization skills, they learn about internet safety and other things [13].

The game environment exposes its users to potential risks but “safely”. Furthermore, is innovative if is compared to other games due to the fact that enhance interaction between the players and promote learning through experience of playing. The environment includes game scenarios, addressing dynamic online user groups and exposing them to coherent actions and events. Also, in order to deal with complexity and difficulty issues, SimSafety includes challenging game rules (e.g. scoring, game awards) that will ensure re-playability and scalability of game levels. Moreover, eliminates the “digital gap” between parents and children or teachers and pupils, and enhance the collaboration between them. The game environment is also supports the communication and collaboration between targeted groups from different countries [14].

### 3. Evaluation Procedure

The aim of this study was to assess the quality of the SimSafety Online Virtual Game environment and to provide feedback, using the results of the assessment, regarding the improvement of the game’s environment. The mentioned assessment was based on the ISO9126 standard [15], which describes “Quality” using six factors: *functionality, reliability, usability, efficiency, maintainability and portability*, which are associated to a number of criteria in a hierarchical manner, and finally to a set of metrics.

Due to the use of the OpenSimulator platform, maintainability and portability factors were assured. Therefore, the emphasis was placed on the remaining four quality factors (especially usability), which affect directly the users. The OpenSimulator is a 3D Application Server, capable of hosting massive multiplayer on-line 3D environments. This platform has many similarities to the “Second Life” environment,
since it is a project inspired by Second Life. Despite being at an early stage of development, the platform proves to be quite stable and robust, even when serving many concurrent users [16], therefore maintainability and portability issues were resolved due to the participation of the open-source community.

3.1. Evaluation Methodology

The methodology used for the evaluation of SimSafety environment, included assessment methods such as Actions Logging, Experts Observation and Interview. It should be mentioned at this point that, there were some limitations regarding the choice of the methods employed, since the users participated in the assessment were children of ages among 9 - 13 years. Therefore evaluation methods more suitable to adults, such as the Thinking Aloud Protocol, or Co-discovery could not be used.

Actions Logging (or User Logging) is an evaluation method that includes recording of all user’s activities, during their interaction with the interface under assessment, by the use of specialized equipment and software. In this case, the equipment used was 2 cameras, 2 microphones, hardware VNC and specialized logging software. Experts Observation added the evaluators’ comments to the data gathered by various sources. In this case the experts’ recorded comments were combined with the video from the camera recordings. The collected data were digitally archived, synchronized and analyzed using Observer XT software. Finally, the data collected from the Actions Logging and the observation was compared to the findings from the interviews.

Figure 1. View from the recordings inside the observation room.

Figure 1 presents the view of the evaluators (real-time recordings of the evaluation procedure), inside the observation room. The screen on the left shows the video from the roof camera which is combined with the audio recordings of the evaluator’s comments. The screen on the right shows the video captured from the PC in which the child is playing the game, combined with the audio captured inside the test room.

During the evaluation procedure, a number of peculiarities came up. A significant one was the transfer of users in and out of laboratory’s test room. Usually, changing the
users into the test room, during an evaluation procedure (according to the needs of the evaluation), is quite easy when adults are involved. In the case of SimSafety evaluation however, some of the children did not want to stop the game. On the contrary, adults sometimes feel peculiar inside the test room, due to the fact that they were monitored and all their actions are recorded. In this case children forgot all about the observation and the evaluation procedure, after a while, and focused almost entirely on the game.

The overall evaluation process, including the breaks, the initial orientation, the discussion and switching in and out of the test room lasted approximately 5 hours. Out of this time just over 3½ hours was the actual evaluation recordings. Finally, the overall time to analyze the archived data was approximately 18 hours.

3.2. Setting of the Evaluation

The evaluation of SimSafety environment took place in a suitable controlled setting where the performance of users in preplanned tasks was able to be measured. This controlled setting was the Software Quality Laboratory of HOU. An overview of the laboratory is presented in figure 2.

![Figure 2. The Software Quality Laboratory of HOU.](image)

The Software Quality Laboratory comprises of two rooms, the testing room (on the right in figure 2) and the observation and control room (on the left in figure 2). The observation room is separated by the testing room by a one-way mirror so that the members of the quality evaluation team can watch the children play SimSafety, but not vice-versa. The maximum number of persons inside the testing room is two children (accompanied by their parents) and –in some cases– a member of the assessment team, depending on the case study. All other members of the assessment team were sited inside the observation room viewing the evaluation procedure.

The laboratory equipment installed and used during the assessment consisted of one roof-mounted video camera that records the player’s behavior, such as hand movements, facial expression and general body language throughout the experiment, a microphone that was placed close to the players, in order to record their utterances and
another microphone that was installed in the observation room to record evaluators’ comments.

Video from the camera as well as the real time image of the participant’s monitor are both directed to video monitors into the observation room where they are recorded for further evaluation. Since the members of the assessment team are not in the same room with the players this eliminates almost entirely any possible biasing effects due to inadvertent non-verbal communications or mannerisms. The test room is structured in such a way that gives the player the feel of a normal office room and not a laboratory. Finally the camera (roof-mounted) and the microphone are placed in such a way that are not easily observable, despite the fact that the player is informed of their existence before the beginning of the experiment.

For the experiments conducted with the participation of children and parents, specialized recording software, such as the Usability Logger [17] developed by SQRG, was used in order to record all players’ actions. This software combine recordings from player’s camera and microphone, as well as recordings of all users’ actions in the screen (screen captures, mouse movements, keystrokes, and idle time). The use of such software was essential since some games within the SimSafety environment required the participation of 5 children; therefore some children played the game outside of the laboratory, but within HOU premises, in a room nearby and under the supervision of one of the evaluators.

3.3. Participants of the Evaluation

As mentioned earlier, the participants of SimSafety’s environment evaluation were children accompanied from their parents. More specifically, six children and five parents (two of the children were brothers) participated in the evaluation experiment. For the setup of SimSafety environment in the PCs available and the technical support required during and after the evaluation, three technicians (members of RACTI, the partner that developed the environment) were present. Furthermore, four members of the SQRG of HOU participated as the evaluators. Out of these four evaluators, two were responsible for the observation and the recording of the procedure as well as the gathering of the data and were sited inside the observation room, one was inside the room where the rest of the children played the game and the other evaluator was available outside the test room to aid in case some advice regarding the evaluation was required.

3.4. Evaluation Scenario

During the evaluation procedure, the scenario used was separated into 7 different tasks. The tasks that the participants had to complete during the game were:

1. Learn how to navigate in the virtual world.
   Hints:
   • Take a look around, read signs, experiment.
   • Learn how to navigate inside the Online Environment.
   • Follow the signs to go to the SimSafety Park.
   • Try flying around.

2. Visit the world and the house of knowledge. Find out what you should be aware of when you navigate the Internet.
Hints:
- Try to find the House of Knowledge.
- Visit the different Sections of the House of Knowledge to see what is there.
- Wait for a few minutes until you read the signs in the House of Knowledge.
- Information retrieved from the House of Knowledge may be useful in different sections of the Game.

3. Meet new people, make new friends minding the rules you have found out in the house of knowledge.
Hints:
- Keep in mind what you learned in the House of Knowledge each time you make new friends in the game.
- Make Friends in the Game by right clicking on an avatar and asking from it to be your friend.

4. Have you been bullied yet? Follow the reporting procedure.
Hints:
- How do you recognize that you have been bullied? Check for Instant Message Notification at the bottom corner on your left.
- You may get bullying messages, spam messages, advertisement that you do not wish to receive. In that case, you have to react and increase your score.
- Report bullying in the Bullying Reporting Department. Find the “Bullying Reporting Department”, open the door, enter the building and fill in a bully report.

5. Change your clothes. Select something nice to wear. Play an interactive game.
Hints:
- It is time for you to have some fun. Visit the “Mall” area (it is next to the “Bullying Reporting Department”) and select something nice to wear.
- There are instructions in there that you can follow in order to change your clothes.

6. There are 4 Quiz points in SimSafety (locate them in the Info Centre, the report centre and the park). Try answering some of the questions (score at least 4 points).

7. Try to return to the welcome region by teleporting (you can search for the welcome region in the map).

4. The Evaluation Results

Analyzing the recorded data from the evaluation of the initial version of SimSafety, a number of issues came up. The majority of these issues were related to the quality factor usability. More specifically, out of the major issues detected, most of them were usability related, whereas the rest were functionality, reliability and efficiency related.

In Table 1, there is a summary of the most significant problems that were detected during the evaluation. In the first column of the Table, the symbols used are $F$ for functionality, $E$ for efficiency, $R$ for reliability and $U$ for usability.
### Table 1. Significant reported issues

<table>
<thead>
<tr>
<th>Category</th>
<th>Detection method</th>
<th>Short Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>F</td>
<td>Observation</td>
<td>The goal of the game is not always clear to the children.</td>
</tr>
<tr>
<td>F</td>
<td>Observation and interviews</td>
<td>Some videogames perceived as quite ‘adult’ from the children.</td>
</tr>
<tr>
<td>E</td>
<td>Data logging</td>
<td>Delays in the avatar during walking through the SimSafety areas.</td>
</tr>
<tr>
<td>R</td>
<td>Observation and data logging</td>
<td>System crashed.</td>
</tr>
<tr>
<td>U</td>
<td>Data logging</td>
<td>Children had more fun exploring the environment, rather than playing the games.</td>
</tr>
<tr>
<td>U</td>
<td>Observation and interviews</td>
<td>After exploring the area and playing all the games there is nothing else to do.</td>
</tr>
<tr>
<td>U</td>
<td>Data logging</td>
<td>The lack of a visible scoring system reduces competition and fun.</td>
</tr>
<tr>
<td>U</td>
<td>Interviews</td>
<td>Children asked for more items to use in the SimSafety area.</td>
</tr>
<tr>
<td>U</td>
<td>Data logging and interviews</td>
<td>The stating requirements of some videogames are not clear to the children.</td>
</tr>
</tbody>
</table>

Apart from the issues presented in Table 1, some minor problems were also detected that either were not significant and were immediately solved on the following version of SimSafety, or they were depended on the limitations of the 3D environment used. A typical problem of the latter category was the lack of avatars that look like children, since it was not supported in this version.

As far as the usability issues concerned, it was observed that children joining the environment had more fun exploring it, rather than playing the actual game. More specifically, data gathered, showed that they prefer exploring, walking or flying around, teleporting but not playing the game immediately. It was also observed and mentioned in the interviews that after exploring the area and performing the obvious activities of the environment there was nothing else to do. Moreover, the lack of more items that can be used by the players as well as the lack of a visible scoring system reduces competition and fun of the game. Finally, the stating requirements of some videogames are not clear to the children.

The solution to the aforementioned problems was the introduction of items related to internet safety (such as a piece of paper with a login username and password written on it) that children could use freely while exploring the environment, as well the use of bots (virtual people that interact with the children). By introducing the aforementioned items, in the environment of the game, the interactivity was increased adding more fun to the game and increasing the engagement of the player with it. Additionally, the use
of a ‘Report Centre’ where a game player can declare a lost and found object or report that he has been bullied aided towards learning while exploring and interacting.

Furthermore, the scoring problem was also solved, adding points into any ‘proper’ action related to Internet Safety and, as discussed previously, more items were added into the environment. Of course not all the items asked by the children (such as bikes, cars, etc.) but only the ones related to the goal of the game, still with some exceptions in order to increase the essential fun element of the game. Finally, regarding the ‘visibility of game status’ and the starting requirements of each game this was resolved by adding instructions and mechanisms to inform the children about the number of players registered in each game and the number of players that are required to start playing.

Regarding the functionality related problems, the goal of the game was not always clear to the children (some videogames perceived as quite ‘adult’ from the children). The solution to this issue was the addition of game play instructions. More specifically, detailed instructions were incorporated in certain areas of the game environment. In addition, an introductory place (the starting place for all first-time visitors) was created, where some basic instruction, regarding the game play, are presented. Despite the addition of detailed instructions, some parts (especially role-playing parts inside the environment) still cannot be played effectively by children. These role-playing parts were kept intentionally, since they found to be suitable for the participation of adults either by impersonating the threats of the internet or making provocative questions and initiating interesting discussions. These games were also found to be very useful when playing within the class, by many students as well as the teacher, or at least one adult.

Finally, the problems related to efficiency and reliability were related totally to the version of the platform used in the evaluation and solved entirely in the following versions.

5. Conclusion and Future Goals

The evaluation presented in this paper was the first, preformed in a suitable setting and adding to identify and solve problems in the alpha version. Further evaluation procedures and mostly the pilot runs in schools proved that all the reported problems were addressed and the results regarding children satisfaction were encouraging and promising in relation to game sustainability. Our future goals are to apply other methods of evaluation in virtual games comparing the effectiveness of the results, find the drawbacks and proposed a way to overcome them.

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References