

Usability and Education of Games through Combined Assessment Methods

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ABSTRACT

In this paper we use evaluation methods that are mainly used in software so as to assess the usability of a video game. More specifically we examine the strategy game "Civilization IV" as well as the tutorial of the game. The study is using during the process of the experiment original evaluation methods as well as combined and the final results are of great interest. It is worth mentioning that we have used a strategy game which is not merely educational and evaluated to what extend it may contribute to the learning process.

Categories and Subject Descriptors

H.5.2 [information interfaces and presentation]: User Interfaces-*evaluation/methodology*

General Terms

Measurement, Experimentation, Human Factors

Keywords

Usability, evaluation, assessment methods, games, videogames, computer games, education, learning process.

1. INTRODUCTION

In this study we describe experimental and inquiry methods for usability evaluation in all three levels –interface, mechanism, game play- of a videogame. In the past usability expert evaluations and testing in games were mostly presented through case studies. Therefore, it is quite difficult and inapt to present facts and conclusions based on them and in the end jeopardize to state mere assumptions. Consequently it is indispensable nowadays to conduct more in-depth studies on this topic and the present research is conducted in this direction. Another issue being raised in this study is the comparison of usability methods and the traditional quality assurance methods used in game development. This study and common knowledge suggest, that these two concepts serve different needs and have different aims, but there is little experimental information available proving whether this is the case or not. Through our research we provide more specific results experimentally proved regarding videogames in order to suggest a standardised range of usability evaluation methods exclusively for videogames. Usability is not necessarily an educational factor in a videogame and this fact is constantly under discussion in several works[13]. The fact that we suggest methods that measure the usability of a videogame assists

in studying to what extend the usability of a game can aid the learning process.

2. USABILITY IN GAMES

Studies on videogames have numerous extensions not all of which are relevant to the present research that focuses on measuring the usability of videogames. There is not a specific model that has been "adopted" by the scientific community for the measurement of games' usability. In an effort to define usability in relation to a game we refer to ISO standard of usability (9241-11)[5], in which the three basic usability metrics are described, effectiveness, efficiency and satisfaction.

The effectiveness is linked with accuracy and total achievement of the goal set by the user, efficiency relates to the resources spent for the attainment of the objectives and satisfaction affiliates with the users' mood. Frokjaer [4] believes that these three factors have to be considered as separate, independent usability factors. The videogames like all other software types have an interface that should provide effective and efficient means of interaction between the user and the videogame; but of course when studying the playability of a videogame, which is an indispensable part of usability, it is obvious that the three usability metrics do not have the same influence on the videogame.

Clanton[1] suggests a way of combining various usability forms into three areas that are relevant to the structure of the videogame; these are the game's interface, mechanism and game play. The game's interface is the device through which the user interacts with the game; the mechanism is the combination of animation and programming, whilst game play refers to the procedure that the user goes through so as to reach the game's objective. All three different areas are functional, must be satisfied and should be analyzed and evaluated during the development of the videogame.

3. EDUCATION AND VIDEOGAMES

The science of education apart from developing various theories has also attempted to isolate methods through which the learning procedure results can be improved. A number of these methods apply to video games [6].

More precisely *the theory of Experiential learning* "If you do it you learn it" is one of the key elements of a video game providing that the users have to navigate themselves in the videogame's world, follow a game scenario but also make crucial decisions which affect the outcome of the videogame. In many cases they are made to repeat the same action several times in order to

succeed. *The theory of Inquiry-based learning* "What will happen if I do that?" is relevant to video games as they give the user the chance of unlimited navigation round the game's world. The user often tests new ways of handling the obstacles that emerge and has to try new techniques or invent tricks to get past them. *The theory of Self-efficacy* "If you believe, you will manage to succeed; you will try much harder." All video games have points, levels, items that the user has to collect and, therefore, is motivated to continue playing and trying constantly for a better result. *The theory of Learning* through a specific target "You learn better if you work on a well set target." All the games have a specified objective. If that objective is well defined, then it is one the positive aspects of the game which would be due to the designer/developer of the videogame. *The theory of Cooperation based learning*. Studies in classrooms have proved that team work improves significantly the learning process results. There has been an improvement of 50% in comparison to individual learning process [6]. It is worth mentioning that a research in 1998 proved that during a video game the user's brain produces dopamine [7]. The dopaminergic transmission can affect the learning process and concentration; enhance behaviour and is critical for sensorimotor functions in the striatum [11], [12].

To conduct the experiment procedure we have used a videogame that has not been developed for education and by using inquiry methods we evaluate the game's contribution to the learning process based on users' views and to what extent the usability of the game affects the learning process.

The time we spend on the game is also a very important factor that enhances the learning process. It is evident that we are able to learn a subject much better if we spend more time studying it. Statistic analysis proves that an average American gamer spends an average of 6.8 hours per week on videogames. Respectively in the 2004 American Freshman: National Norms Survey by UCLA's Higher Research Institute shows that pupils in secondary education spend five to eight hours per week to do their homework. If pupils had access on their daily homework through educational games then they would double the time on their homework [9]. There is no doubt that the learning process can be enhanced by the use of videogames and the results of the applied experimental evaluation methods validate this concept.

4. THE ASSESSMENTS METHODS ADJUSTED TO GAMES

The usability evaluation methods that were applied to software have been originally also used for the assessment of the usability of videogames without any particular adjustments such as [10] Nielsen's heuristics. The necessity for more suitable methods of video game evaluation had then become obvious. Videogames are an industry that has millions of demanding customers while researches that reflect the affect of videogames' usability on entertainment and fun are increasing continuously. The lack of experimental procedures that evaluate exclusively videogames in combination with the deficiency of valid conclusions were the reasons that inspired us to use experimental usability evaluation techniques in the field of videogames

4.1 Heuristics for Game Usability

The most popular assessment method is the use of heuristics. The current bibliography of heuristics for usability evaluation comes

into three levels: the first level is interface and consists of controls and display. The second level is mechanics meaning that the user interacts with the game world and the third level is game play which reflects the problems and challenges faced by the user [3]. The usability evaluation methods that are used mainly on software are the heuristics due to the small amount of resources required. The creation of a certain scenario is a compulsory condition so as to apply the usability evaluation methods in videogames. The heuristics are more appropriate for the assessment of software in comparison to videogames despite the fact that there have been numerous attempts to generate heuristics adjusted to videogames. Therefore we use combined experimental evaluation methods along with the contribution of inquiry methods; we find it necessary, however, to refer to heuristics in an attempt to substantiate our choice to use alternative methods for the assessment of usability.

In usability evaluation there is a history of using heuristic principals to find usability problems. Though Nielsen's heuristics [10] have proved to be effective when applied to game design [8], usability heuristics that are targeted to games comprise a developing research field. Some heuristics have been designed specifically for electronic games. Federoff [3] designed one set of 40 heuristic guidelines for games. Desurvire and her colleagues [2] made some developments and put out another set of 43 heuristics for games. These heuristics are a great start, but both of these sets of heuristics are relatively vague and difficult to implement during the design process. For instance, Federoff includes heuristics like "create a great storyline," and "a good game should be easy to learn but hard to master". The diversity of the present research lies on the fact that the heuristics used are not adjusted for videogames; instead experimental methods are being used thus exploring new horizons of videogames' usability evaluation.

4.2 Inquiry and Experimental Methods

For the reported usability evaluation two categories of methods are used, Experimental and Inquiry. In inquiry methods the evaluators are informed of the users' preferences, needs and individuality hence giving the users the ability to express their opinion. Inquiry methods take place outside the quality assessment laboratories with the participation of users and are aimed to record the users' reactions and views.

The Inquiry methods we have used are questionnaires before and after the conduct of the experiment, in addition to a personal interview of the users who were asked open-ended and closed questions. Federoff [3] based on the existing literature states that there are ten usability heuristics that refer to interface, two that refer to mechanism and nineteen that refer to game play. This might lead to the conclusion that the most important usability factor is the game play and it comes in accordance with Clanton's conclusions [1] where he mentions that "videogame designers and publishers adamantly believe that the key factor of a successful game is game play." In our research we examine this fact by the use of questionnaires.

The Experimental methods involve the observation of individual users performing specific tasks with the game under evaluation. In these methods the users perform representative tasks, under the discrete attendance of usability experts (the personnel supporting the Experiment). In the reported evaluation the Experimental

methods we had used were: a) *Thinking Aloud Protocol* in which the users express verbally their thoughts, feelings and opinions while interacting with the system, b) *User Logging In* that records user’s activities by the use of special equipment like cameras, microphones and specialized software, and finally c) *Co-Discovery Method* in which the users attempt to perform tasks together while being observed. The difference of this method over the thinking aloud protocol is two-fold: most people have someone else available for help and the interaction between the two participants can bring out more insights than a single participant vocalizing his or her thoughts. Moreover this method has better effect on the learning process and specially in cooperative learning.

5. DESCRIPTION OF USED EXPERIMENTAL METHODS

A combination of inquiry and experimental methods without adjustments were initially used in order to measure the video game’s usability.

All the participating users of the experiment fill in questionnaires before and after the gaming process, whilst a personal interview that focuses on the game’s usability is being conducted. Through the interview the users express their views as to what percentage they consider that a non-educational game can contribute in the learning process; more specifically the idea of the user can acquire a piece of information like the time or place of a crucial or even a trivial event. In addition they articulate their thoughts on the association between the game’s usability and its learning process. The total population of the experimental procedure consisted of ninety five (95) users and on only fifteen (15) of the users of randomly selected profiles –age/profession– the experimental methods have also been used.

The experiment took place in the Software Quality Assessment laboratory of Hellenic Open University. This laboratory is suitably equipped for the performance of usability tests of various systems. A schematic of the laboratory is shown in figure 1.

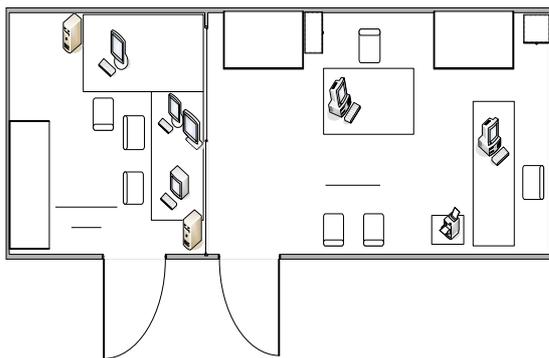


Figure1. Software quality assessment laboratory of HOU

The purpose of the evaluation of the game “Civilization IV” is to control the game’s usability and the game itself. The aspects that have been registered for farther analysis of the game’s usability were:

- *The number of basic movements the player has managed.*
- *The time needed to complete the scenario.*

- *The effect -if any- when the player has already used/visited the game’s tutorial.*
- *The final score of each player.*
- *The effect on the final score when there is a single player and when there is a group of two simultaneous players on the same PC.*
- *Evaluation of the game’s contribution to the players’ social behaviour; such as one’s learning process.*
- *The contribution of the game’s usability on the players’ learning process.*
- *Study the actual association of the pleasure/fun of the game (undoubtedly the game offers pleasure/fun) with its usability and education.*

In this section we describe the experiment objectives, which should be as precise, accurate, clear and measurable (or observable) as possible. The objectives derived from specific questions and issues related to the experiment purpose.

Table 1. Experimental objectives of Civilization IV

Tutorial	Assists the player with familiarisation of the game’s environment and the achievement of the game’s goals
Game	How long did it take for the player to accomplish basic moves/movements? Did the player learn in the end history or geography? Is every game option’s function clear to the player? The game’s map navigates the player correctly/successfully?
General	Does the player think that the specific game is easy to use; it assists in the learning process?

Inquiry methods (in this case questionnaires) provided us initially with subsidiary characteristics of the users such as their computer familiarity, the time they usually spend on videogames and the Internet. Subsequently the monitoring of the users started in the quality assessment laboratory of HOU. The conduct of the experiment has also evinced difficulties in the application of the new techniques of usability evaluation for software on videogames; the most immense being the users’ difficulty to interface with the game and to express their thoughts out loud at the same time. The evaluation was taking place in all three levels of the videogame. The first result was negative and that was reflected as much on the users’ low scores as on their approach to participating in the experimental procedure. Taking this first result into consideration and following a further study of the existing techniques we came to the decision of combining the Thinking Aloud Protocol and the Co-Discovery Method. The users were interfacing with the game either co-operative in groups of two or in nearby computers that resulted in an easier access to the

game as well as in a better understanding of the game play, since the users had the possibility to converse and in that context to express out loud their responses and views, information that we have used for the usability assessment of the videogame.

6. RESULT ANALYSIS – FUTURE WORK

The result analysis of the interviews and questionnaires answered by the users have shown that 80% of the users believe that the game's usability –primarily in the field of interface– affects their disposition towards their further involvement or time spending on the game and the fun of it. The user's responses to questionnaires and personal interviews showed that a game that is not designed to be educational may affect the learning process significantly as 85% of the users acquired primary historical - chronological information that was needed during the game play.

The result analysis of the inquiry methods proved that the factors that have an effect on usability could also influence the learning process and this is why it is worthy to standardize/adjust them so as to correspond to the requirements of a videogame. The scientific community has analyzed the heuristic evaluation method to a great extent in software as well as in videogames.

The combined experimental methods that were used generate better results since they make it is easier for the users to express their thoughts and reactions; in this way we are able to collect additional information which will lead us to more valid conclusions for the connection of usability, fun and education of a videogame.

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