Non-functional requirements that influence gaming experience: A survey on gamers satisfaction factors

Maria - Eleni Paschali[1], Apostolos Ampatzoglou[2], Alexander Chatzigeorgiou[3], Ioannis Stamelos[1]

[1] Department of Informatics, Aristotle University, Thessaloniki, Greece

[2] Department of Computer Science, University of Groningen, Groningen, The Netherlands

[3] Department of Applied Informatics, University of Macedonia, Thessaloniki, Greece

maria.eleni.paschali@gmail.com, a.ampatzoglou@rug.nl, achat@uom.gr, stamelos@csd.auth.gr

Abstract: Requirements engineering is an extremely crucial phase in the software development lifecycle, because mishaps in this stage are usually expensive to fix in later development phases. In the domain of computer games, requirements engineering is a heavily studied research field (39.3% of published papers are dealing with requirements [1]), since it is considered substantially different from traditional software requirements engineering (see [1] and [14]). The main point of differentiation is that almost all computer games share a common key-driver as requirement, i.e. user satisfaction. In this paper, we investigate the most important user satisfaction factors from computer games, though a survey on regular gamers. The results of the study suggest that, user satisfaction factors are not uniform across different types of games (game genres), but are heavily dependent on them. Therefore, this study underlines the most important non-functional requirements that developers and researchers should focus on, while dealing with game engineering.

Categories and Subject Descriptors

K.8 [Personal Computing]: Games, **D.2.9 [Management]**: Software Quality Assurance (SQA). The ACM Computing Classification Scheme: http://www.acm.org/class/1998/

General Terms

Measurement, Experimentation, Human Factors.

Keywords

computer games, user satisfaction factors, survey

1. INTRODUCTION

According to a well-known IT advisory and consulting company (Gartner), the revenue from computer and console games raised to $93 billion in 2013 from $79 billion in 2012 [11]. In addition to that, playing games has outperformed many other entertainment forms like listening to music and watching movies [7].

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In contrast to the industrial growth of game development, the scientific research on the subject is slowly moving from an infant to a more mature stage through papers published in major journals and conferences [1]. According to Ampatzoglou and Stamelos [1] and Kasurinen et al. [14], a game development phase that is in need of further scientific investigation is the analysis phase. In almost every software development lifecycle, the analysis stage is connected to requirements engineering. To this end, Callele et al. [6], state that requirements engineering (that is requirements elicitation and specification) is a common reason for game development project failures and therefore constitutes an interesting research field. The main expectation of every game is to be entertaining [14] and [20], even in special cases of games, e.g. serious or educational games. Specifically, entertainment is an important factor of serious games since it contributes towards the motivation and engagement qualities of games, so as to make their learning or serious elements more attractive [13]. Although, this claim is beyond any doubt, it is rather vague and needs to be decomposed to concrete statements. According to Callele et al. [5], the functional requirements are the minimum aspects that must be fulfilled before the game is released. In addition to that, in [4] the authors suggest that games' main requirements are emotional requirements, in the sense that the user is expected to feel several emotions during gameplay similar to those while watching a movie [20]. Such emotions can be arisen by game characteristics such as scenario, graphics, etc. Moreover, although in game engineering the distinction of *functional* and *non-functional* requirements is not a trivial (and investigated) tasks, we believe that the aforementioned enjoyment characteristics, i.e., scenario or graphics, can be enhanced by considering non-functional requirements, such as "*the narrative flow of the scenario should be smooth*", or "*the dialogs during gameplay should be realistic and interesting*", etc.

Therefore the aim of this paper is to present the most important user satisfaction factors, which will enhance game requirements with non-functional ones that lead to a user satisfaction increment and consequently, enjoyment. In Section 2 of the paper, we provide an overview of related work on user satisfaction factors. In Section 3, the survey design is presented, whereas the results are presented and discussed in Sections 4 and 5. Finally, in Sections 6, 7, and 8 we present threats to validity, future work and conclude this study.

2. RELATED WORK

In this section we present related work on user satisfaction factors for computer games. We note that in this section we have deliberately excluded papers that discuss game evaluation

heuristics (e.g. [8] and [19]) and *game satisfaction metrics* (e.g. [2]), since they are considered as indirect related work.

Firstly, in [12] it is suggested that computer game satisfaction factors are game genre related. The satisfaction factors that were under consideration (Scenario, Graphics, Sound, Game Speed, Game Control, Character and Community) have been ranked according to their importance in several game genres (Role Playing Games - RPG, First Person Shooter - FPS, Sport Video Games and Computer-Mediated Board Games). The most important factors have proven to be Graphics, Game Control and Character, while Community and Sound have appeared to be less important. The average importance of each factor among games genres is depicted in Table I. A possible limitation of this study is that during the interviews the respondents were not asked to evaluate the importance of each factor, but evaluated their satisfaction from specific factors for specific games (indicated by the survey design). However, the design of this survey does not guarantee neither that the raters where satisfied from the specific game, nor that the raters had significant experience in playing the specific game. Nevertheless, this is a large-scale survey, with important finding, which are directly comparable to ours. Thus, an in detail comparison of the two studies results will be presented in Section 5.1. However, while discussing the results of this paper, we have to take into account that this study has been published almost a decade ago, when the state of practice in game industry was substantially different.

Table I. User Satisfaction Factors [12]

id	factor	importance
1	Character	20,0 %
2	Graphics	17,6 %
3	Game Control	16,7 %
4	Game Speed	13,7 %
5	Scenario	11,1 %
6	Sound	10,8 %
7	Community	10,1 %

Additionally, Noveck et al. [21] focus on interactivity as the major component that offers satisfaction to gamers. They explore the interaction of virtual and real worlds, and how reality reacts with video games. The "online friends" are just as close to each other as their friends in "real life" with the exception they probably have never met. Every social interaction is same as if it were happening in real life. However, in a virtual world there seems to be fewer possibilities for mistakes. This makes virtual reality and online games the perfect place for people to establish their unique identity without having to worry about mistakes. Usability analysis from the interactivity perspective, concludes that this customization of personality endears players to these games due to the satisfaction they derive from being in control of their identity.

Finally, in [23] the authors conducted a survey to identify whether the quality of graphics is an important factor for gamers, in order to decide playing a game or not. The results suggested that a little more than the half of participants support either that graphics never influence their decision on playing a game, or they were undetermined on the subject (Table II). On the opposite side we could not ignore the amount of people within this group that be influenced by graphics (about 46%) and leads to the conclusion that graphics is a crucial decider for playing a game. Furthermore, the participants suggested that graphics appeal to the effectiveness of a game to draw in people and make them want to play the game. If cautiously designed and implemented graphics should entice a perspective player long enough that the game can advertise what it has to offer.

Table II. Influence of graphics [21]

Influence of Graphics on Gamers Play Preference	Percentage of respondents
Never influences	26%
Undetermined	28%
Sometimes influences	26%
Always influences	20%

3. SURVEY DESIGN

According to Pfleeger and Kitchenham [20], surveys are the most fitting empirical research method for collecting information to describe, compare or explain knowledge, attitudes and behavior. In the case of investigating gamers satisfaction factors, the games that are taken under consideration should be used for an adequate amount of time, so that regular gamers can describe their posteriori overall experiences during gameplay. This survey is organized based on the activities defined by Pfleeger and Kitchenham [22]:

(a) set research objective,
(b) plan and schedule the survey,
(c) ensure that appropriate resources are available,
(d) design the survey,
(e) prepare the data collection instrument,
(f) validate the instrument,
(g) select participants,
(h) administer and score the instrument,
(i) analyze data, and
(j) report the results.

In order for not making excessive use of sub-sectioning, we present activities (a–d and g) in Section 3.1 (namely *Survey Design*), activities (e, f and h) in Section 3.2 (namely *Survey Instrument Design*), activity (i) in Section 3.3 (namely *Data Analysis Strategy*) and activity (j) in Section 4.1 (namely *Statistical Analysis*).

3.1 Survey Design

Survey design section aims at presenting research objectives and research questions, survey planning, resource management and selection of participants. The design process began with reviewing the objectives, examining the target population identified by the objectives and deciding on the processes that should be used for obtaining the information needed to address those objectives. In this stage we needed to consider factors such as: (a) determining the appropriate sample size, and (b) ensuring the largest possible response rate [15].

Research Objective: The goal of this survey formulated as a GQM statement [3] is: "*analyze non-functional requirements categories for the purpose of evaluation with respect to their importance as a satisfaction factor from the point of view of the users in the context of game applications*".

Research Questions: Based on the aforementioned goal we were able to state two research questions that would guide survey design and reporting of the results:

RQ1: What are the most important user satisfaction factors for each game genre?

RQ2: Are there differences among the importance of satisfaction factors across game genres?

Design: The aim of this survey is:(a) to point out user satisfaction factors for each game genre that can eventually lead to additional requirements, and (b) to identify possible differences between game genres. Based on its nature and special characteristics, this survey has been organized as a *not supervised, cross sectional, case controlled* study [13]. The study is not supervised, because researcher do not interfere while participants fill in the survey instrument, whereas it is cross-sectional and controlled because participants have been asked about their past experiences in a given point in time [15]. Finally, concerning the experimental design of this study, this survey is a *concurrent controlled study in which participants are not randomly assigned to groups*, in the sense that the participants are naturally divided into groups, based on their preference on a specific game genre [15].

Plan and Schedule: According to Kitchenham and Pfleeger, there are six common ways to get information: literature searches, talking with people, focus groups, personal interviews, telephone surveys, and mail surveys [16]. In this survey, we decided to perform data collection through an online questionnaire, so as to increase the number of possible participants. An additional reason for that is the fact that the expected design of the survey is not complex, thus, supervision will not be necessary.

In order to motivate the target population to participate in our research, we sent invitation emails in two phases (an initial one, and a reminder). The reminder has been sent two weeks after the original email, and we stopped waiting for answers, one month after sending the reminder.

Resource Management: Online surveys are clearly the most cost effective and fastest method of distributing a survey. In addition, the fact that conducting an internet survey is a relatively "cheap" process, left us with substantial time budget for designing the survey, analyzing and reporting the results.

Participants Selection: As participants in this survey we needed to identify a broad set of regular gamers. For selecting candidate participants we used social media technologies and more specifically, we sent invitations to more than 500 contacts of the authors. From the collected responses we exclude those, in which respondents do not have sufficient experience in game playing (less than 5 years), and those who seem to be outliers based on the survey instrument evaluation process (see Section 3.2). Based on the aims of this research, we expected to collect a minimum of 100 responses, in total. A minimum amount of responses per game genre was not set[1]. Therefore, we acknowledge a possible limitation in producing creditable results for all of them. However, in some popular game genre cases, this number would be adequate for statistical analysis, and would provide an unbiased, and representative sample for this work. In order to guarantee the collection of the desired amount of responses we estimated a response rate of 20%, which according to Kitchenham and Pfleeger [15] is an acceptable response rate. Although the goal of setting the estimated response rate to 20% might seem optimistic, we were confident that the popularity of gaming among youth would enables us to achieve it in our web survey.

[1] However, we note that a minimum threshold of 10 responses has been set, as a prerequisite to creditably discuss results on a specific game genre.

3.2 Survey Instrument Design

According to Kitchenham and Pfleeger [14] survey instruments are usually questionnaires that are developed in three steps (preparation, evaluation, and documentation).

Prepare the Data Collection Instrument: For this study we needed to construct a new survey instrument. This decision is common in software engineering research, since instruments are not available and are seldom properly validated [16]. In this path we explored related work in order to identify possible weakness, to learn from past experiences and eventually to improve our survey[16].The most important part of preparing a questionnaire is the selection, statement and wording of questions. In our study, this process was governed by the guidelines provided in [14]:

- keep the amount of questions low,
- questions should be purposeful and concrete,
- answer categories should be mutually exclusive, and
- the number, the order and the wording of questions should avoid biasing the respondent.

To this end, we constructed a questionnaire with 25 questions: five multiple choice questions, one open-ended question, and nineteen questions in a 5-point Likert scale. The Likert scale was based on the importance of the satisfaction factor, i.e. *Not Important, Relatively Not Important, Neutral, Important,* and *Very Important.*

As a general structure, we logically grouped our questions [10], so as to make out questionnaire easier to complete. Therefore, the questionnaire begins with some demographic information (sex, age, preferred game genre, and game play intensity), next the subject is asked to pick a game that he / she has played in the previous 6 months and excited him / her. The selection of this game is the basis for all other questions. In the third part of the questionnaire, the subject is asked to rate, in the aforementioned Likert scale, the importance of each considered user satisfaction factor (scenario, controls, graphics, sound game speed, game community, and character solidness: taken from [12]) for enjoying the previously selected game. We note that despite the fact that the *Role-Playing Games* category consists of several sub-genres (e.g., Live-Action RPGs, Single-Player RPGs or Massive Multiplayer Online RPGs), we preferred to group all these sub-categories in their generic one, so not to confuse inexperienced participants. The last part of the questionnaire has several detailed questions on enjoyment factors that will be used for evaluation reasons (see below).

Evaluation: Before data collection, the survey instrument should be evaluated [17]. First, through pretesting with a small number of participants (pilot survey) we checked the understandability of the extracted questions, the validity and the reliability of the survey instrument, and the fitness of the data analysis strategy [17]. Especially for ensuring the validity of the process (by testing the consistency of respondents' answers), we have organized the survey instrument into components, that were all related to the same user satisfaction factor, and spread them in different spots of the used questionnaire (the complete questionnaire is available in the Appendix).

For example, concerning the scenario component, we have set questions 7.1, 10, 15, and 21. This way, the consistency of the answers can be tested a posteriori, by making correlation analysis

and Principal Component Analysis (PCA) [9] after gathering all responses. We expect that the answers in these questions would be correlated, and that after PCA, all these questions would be automatically placed in the same component.

Documentation: For documentation reasons, we have developed a questionnaire specification (survey protocol) describing: (a) the objectives of the study, (b) the description of the rationale for each question, and (c) the description of the evaluation process. During questionnaire administration we updated the documentation with more information[16].

3.3 Data Analysis Strategy

Our dataset consists of 25 columns (questions) and 112 rows (responses). The data analysis [18] has three main goals: (a) evaluate the correctness of the developed questionnaire, (b) identify the most important user satisfaction factor for each game genre, and (c) investigate if there are differences between the significance of each factor among the studied game genres. In order to achieve the previous goals, the following methods of analysis have been performed:

Principal Component Analysis: This analysis will reveal if the predefined parts of the questionnaire are clearly separated by the subject responses. In order for the questionnaire to be validated, the analysis should identify seven components (one for each satisfaction factor) [9].

Descriptive Statistics: Analysis with frequency tables will reveal the most important user satisfaction factors for each game genre. For visualization, histograms will be created. Finally, based on the histograms, skewness can be calculated. In order to have an indication on the importance of a factor, it is expected to present a high negative skewness value (see Figure 1) [9].

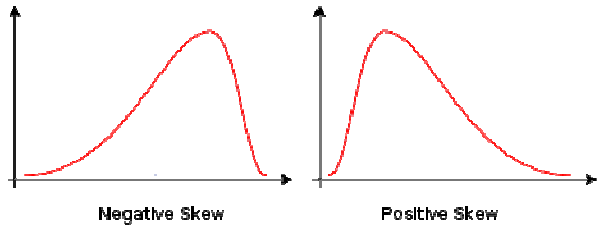

Figure 1. Examples of positive and negative skewness

We note that we use histograms as means of visualization, instead of boxplots, because our variables are ordinal, and therefore treating them as numeric values would not be appropriate. For similar reasons, we have selected not to perform paired sample t-tests, for comparing means or use 95% confidence intervals.

4. RESULTS

In this section we report the results of this survey. On the completion of data collection we were retrieved 131 responses (a response rate of 26.2%), from these, based on the evaluation criteria set in Section 3.2, we removed 19, and the final set of valid responses was 112 data items. In this section, we present the raw results of the statistical analysis, whereas findings are interpreted and discussed in Section 5.

The principal component analysis (PCA), as expected has pointed out 7 major components for the questionnaire. Each component corresponded to one satisfaction factor, and the questions that have been intentionally been placed as "control questions" for the specific satisfaction factors have been attached to it (see Section 3.2). The components that seemed to lack in terms of clarity where *Scenario* and *Controls*, for which some "control questions" have been misclassified. A possible explanation for that is the existence of a medium strength correlation between these satisfaction factors. All correlations between satisfaction factors are presented in Table III. As desired most satisfaction factors are weakly correlated (<0.4), with very limited exceptions. Additionally, no pair of satisfaction factors presents a strong correlation (>0.7).

Table III. Correlation Between Satisfaction Factors

Scale	Controls	Graphics	Sound	Game Speed	Game Community	Character Solidness
Scenario	0.54	0.31	0.24	0.06	0.38	0.07
Controls		0.41	0.32	0.13	0.40	0.01
Graphics			0.37	0.23	0.26	0.09
Sound				0.23	0.39	0.01
Game Speed					0.30	0.03
Game Community						0.04

In order to identify the most prevalent user satisfaction factors for each game genre we present one frequency table for each game genre (see Table IV). In each column we present the satisfaction factors, whereas in each row the score of the Likert scale that we used in the questionnaire. Finally, the number inside each cell represent the corresponding frequency of the pair. In the final line of each embedded table (one for each game genre), we present the skewness of the corresponding distributions. The *most important* user satisfaction factors have been marked with dark grey in the background of the cell, whereas *less important* satisfaction factors have been marked with a light grey background.

Table IV. Satisfaction Factors Per Game Genre

Scale	Scenario	Controls	Graphics	Sound	Game Speed	Game Community	Character Solidness
Sport Video Games							
Not Important	0	0	0	1	3	1	1
Relatively Not Important	0	0	0	0	3	3	1
Neutral	6	5	3	9	3	4	2
Important	8	7	10	3	3	4	7
Very Important	1	3	2	1	3	3	4
Skewness	0,31	0,22	0,00	-0,47	0,00	-0,21	-1,19
First Person Shooters							
Not Important	0	0	0	0	2	0	0
Relatively Not Important	0	0	0	0	1	1	2
Neutral	3	3	4	2	4	6	7
Important	6	4	6	5	2	3	3
Very Important	3	5	2	3	3	2	1
Skewness	0,00	-0,35	0,26	-0,52	-0,29	0,44	0,52

Scale	Scenario	Controls	Graphics	Sound	Game Speed	Game Community	Character Solidness
Adventure Games							
Not Important	0	0	0	0	4	0	1
Relatively Not Important	2	2	1	1	3	0	5
Neutral	4	8	11	8	4	6	5
Important	5	8	6	8	6	10	6
Very Important	10	3	3	4	4	5	4
Skewness	-0,78	0,00	0,05	0,06	-0,27	0,07	-0,14
Computer-Mediated Board Games							
Not Important	0	0	0	1	0	1	0
Relatively Not Important	1	1	2	0	0	0	1
Neutral	2	2	0	1	2	2	2
Important	2	2	3	2	1	0	2
Very Important	0	0	0	1	2	2	0
Skewness	-0,51	-0,51	-0,60	-1,11	0,00	-0,51	-0,85
Role Playing Games							
Not Important	1	1	0	0	2	2	1
Relatively Not Important	1	0	0	1	1	0	0
Neutral	6	10	8	10	7	6	11
Important	12	8	15	12	14	10	11
Very Important	8	8	4	5	4	10	5
Skewness	-0,99	-0,59	0,16	0,02	-1,07	-1,21	-0,57
Strategy Games							
Not Important	0	0	0	0	1	0	1
Relatively Not Unimportant	0	1	0	2	3	0	1
Neutral	10	8	7	8	10	9	6
Important	8	10	14	11	3	11	12
Very Important	7	6	3	4	8	5	5
Skewness	0,23	-0,11	0,14	-0,17	-0,15	0,27	-0,96

The identification of the most important satisfaction factor is equally influenced by both the value of skewness and the frequency of "Important" and "Very Important" values. For example, in the domain of *Adventure Games*, although the second most negatively skewed variable is *Game Speed*, the fourth most negatively skewed variable, i.e., *Game Community*, appears to have been evaluated as "Not Important" and as "Relatively Not Important" by none of respondent, whereas at the same time as "Important" and as "Very Important" from 70% of the respondents. Therefore, its significance as a user satisfaction factor cannot be neglected.

The results suggest that in each game genre, different factors are influencing users' enjoyment. For example, the *Solidness* of the *Character* is extremely important in *Sport Video Games*, *Strategy*, and *Role Playing Games*, but not as important for the rest game genres. Similarly, *Scenario* is important for *Adventure* and *Role Playing Games*. The most important satisfaction factor has proven to be the *Game Community* for *Role Playing Games (RPGs)*, whereas the least important has proven to be the *Solidness of the Character* for *First Person Shooters*. The histograms on the importance of these satisfaction factors are presented in Figures 2 and 3, accordingly.

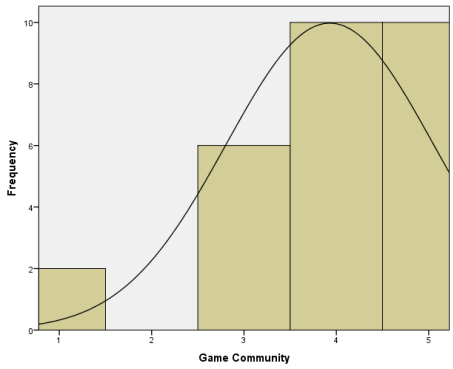

Figure 2. Influence of Game Community on RPG

Figure 3. Influence of Character Solidness on FPS

Consequently, concerning RQ_1 (i.e., what are the most important user satisfaction factors for each game genre?), we could state that *Character Solidness is the most important factor on gamers enjoyment across the genres which collect the appropriate amount of responses, followed by Scenario and Sound.* Concerning, RQ_2 (i.e., are there differences among the importance of satisfaction factors across game genres?) we argue that *such factors are not uniform across all game genres, but each game type has its specialties that need to be further investigated.*

5. DISCUSSION

In this section we discuss the raw results presented in Section 4. The results are firstly interpreted and compared to existing literature (see Section 5.1), and later on implications for researchers and practitioners are being presented (Section 5.2).

5.1 Interpretation of Results

The results of this survey suggest that in each game genre, different factors are important for engaging users' satisfaction. By trying to extract some overall results, we could state that *Character Solidness*, *Scenario* and *Sound* are highlighted as the most important factors for gamers' satisfaction, followed by *Game Speed*, *Game Community*, *Controls* and *Graphics*. These results are substantially differentiated from existing literature [12]. More specifically, *Sound* and *Scenario* appear nowadays to be more important factors for engaging user satisfaction, than in the

original survey [12], whereas *Graphics* and *Game Controls* appear not to be considered equally important as they used to be in 2006.

However, a change in the ranking of user satisfaction factors can be expected in the sense that such factors are highly related to the most popular game genre, and the state of practice in the industry. For example, during the last years, the quality of the *Graphics* in games has increased so much that, users cannot very easily perceive a difference in the Graphics of an "outstanding" and a "moderate" quality game. Therefore, this might have led them into not being extremely attracted by impressive Graphics, since it is now considered as state of practice that can no more be part of trade-offs during game design decisions.

In addition, the results on the specific games genres are quite expected. In *Sport* games, the users are heavily influenced by *Character Solidness* and *Sound*, and both these observations are considered expected. For example, in a soccer game (e.g. PES), one of the most important features is considered the creation of the profile of the soccer players: how close they are to reality in terms of skills and movements, etc. Similarly, since most of soccer game players are soccer fans in their real life, they are expected to be excited with the stadium chants and the atmosphere during game play. Also, the differences in the sound effects, when competing a top level team compared to when competing a low-level teams with minimum attendance brings a completely new level of realism to the game. Similarly to Sport games, in *First Person Shooter* Games (FPS) the users seem to be excited by the *Sound* of the game. For a game genre, in which quick movements, pace and the alertness of the player is crucial sound can be an important factor to keep the gamer "alive" during game play.

In *Adventure* and *Role Playing* Games (RPG), scenario is considered a very important parameter for engaging players' interest. Strong but solvable quests, multiple endings for different scenes, substantial effect of decisions in the plot of the game, are just some of the must have requirements in these game genres that are related to the story of the game. In contrast to *Adventure Games*, which are simplified versions of *RPGs*, scenario is not the only parameter affecting player's experience in Role Playing Games. More specifically, RPG players are also interested in *Controls* (since they tend to be rather complex in this kind of games), *Game Speed* (mostly because nowadays these games have been transformed to MMORPGs – Massively Multiplayer Online Role-Playing Games – in which performance is crucial), *Game Community* (mostly due to the fact that players compete against other human players, forming communities that immerse in the gaming experience), and *Character Solidness* (as indicated by the name of the game genre, each player is in command of a persona/role: the detail in which this role is described and the way that the character influences the behavior and game experience is expected to be considered important for regular gamers).

5.2 Implications for Researchers and Practitioners

The results described in this paper can be considered very important for both game researchers and practitioners. On the one hand researchers can build on the results of this study, as follows:

- *they can focus their research on modern and important aspects of game engineering*, that have a strong effect on the success of games (related to the satisfaction that users get from playing the game)
- *they can try to quantify the way that all these satisfaction factors are perceived by the gamers*, and propose metrics and/or heuristics suitable for each game genre. Such metrics, will provide indications on the potential interest of users in the game, and can be monitored during game development.

On the other hand, practitioners can benefit by the results of this study in the sense that:

- *they can prioritize activities during game design*. In the game engineering community it is generally accepted that the game product time to market is extremely shrunk [1]. Thus, the identification of the most important non-functional requirements of each game genre can be used from development teams so as to emphasize on them. For example, since *Character Solidness* is an important user satisfaction factor for *Strategy Games*, in such a game that uses real characters as actors, the development teams should pay special attention on the description of the character (e.g., appearance, voice, inherent characteristics) and its resemblance to the real character that it represents.
- *they can get indications on what kind of trade-offs between quality characteristics and time to market can be crucial for game success*. More specifically, when facing a trade-off decision, the game engineer can retrieve the importance of the satisfaction factor in the specific game genre and use it in his / her decision making process.

5. THREATS TO VALIDITY

In this study we classified threats to validity in four classes: threats to construct validity, threats to internal validity, threats to external validity and threats to reliability. In this section the validity threats are presented, accompanied with the approaches that we followed to mitigate them.

Threats to construct validity: These threats concern the design of the study and especially the identification of the correct measures for the concepts being studied. The measures that have been used in this study are straightforward (a simple count). However, a possible threat of this type can be identified based on if the subjects have correctly understood the formed questions. In order to mitigate this threat, we performed a pilot survey on a limited number of participants, and calibrated the questions so as to be easy to understand.

Threats to internal validity: These threats concern the identification of cause-and-effect relationships and the evidence of causality. In this study the investigated relationship is if the ranking of user satisfaction factors is based upon the game genre. A possible threat here, is that the rater might not be completely focused while responding questions, and although asked to focus on one game (of a given game genre), he / she might consider different game genres based on the type of question. To mitigate this threat, we performed the following actions: (a) we clearly advised the subjects to consider only one game during filling in the questionnaire, and (b) we evaluated the consistency of answers by inserting in the questionnaire check questions (see "evaluation" Section 3.2), subjects that did not provide consistent responds have been excluded for this survey. Finally, despite the fact that modern games might not completely match one game genre, we mapped each one of the respondents answers to exactly one game genre. However, although we acknowledge this decision as a

possible threat to validity, we believe that since the respondent is also indicating the game genre that he/she is interested in, he considers the game that he/she has picked as mostly similar to the specific genre.

Threats to external validity: As threats to external validity, we consider those factors that limit the possibility to generalize the findings beyond the sample of the study. Obviously, a different set of respondents could lead to different results. This kind of threat is always valid in an empirical study, however in this case we consider the amount of participants adequate for partially mitigating this threat. However, results on *Computer-Mediated Board Games*, heavily suffer from this threat due to the limited number of participants who selected to fill-in the questionnaire based on a *Computer-Mediated Board Game*.

Threats to reliability: This aspect of validity is concerned with the extent by which the data and the analysis are dependent on the particular researchers. Reliability is demonstrating that the operations of a study, such as the data collection procedures and analysis, can be repeated, with the same results. We used a survey protocol (see Section 3), documenting the procedures that have been followed. With these operational steps we believe that an external auditor could in principle repeat the procedures and arrive at the same findings and conclusions.

6. FUTURE WORK

As future work we plan to replicate this study with more participants in all game genres, and validate the fact that game user satisfaction factors are evolving based on industrial state of practice and the popularity of specific game genres. In addition we plan to investigate the possibility of defining source code or design metrics that can assess the enjoyment of regular gamers, in order for them to be used in pre-production phases and guide game development process.

7. CONCLUSIONS

This paper aimed at investigating the factors that are most influential on the enjoyment that a computer game offers to its players. In order to achieve this goal we conducted a not supervised, cross sectional, case controlled survey on more than 110 regular gamers. The results of the study suggested that such factors are not uniform in all computer games, but are heavily dependent on the genre of the game (e.g. the expectations of a gamer from a *Sport Video Game* are different compared to those from a *Strategy Game*). Also, the results suggested that these factors are changing during time, and they cannot be taken for granted. Therefore, continues research on the subject is necessary. The findings of the study have been interpreted and discussed from a researchers and a practitioners point of view.

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APPENDIX – Full Questionnaire

1.Which is your gender?
Male… Female…

2.How old are you?
<15… 15-24…. 24-40…. >40…

3.What type of games do you prefer?
Sport Games… First Person Shooters… Adventure Games…
Board Games… Role Playing Games… Strategy Games…

4.How often to you play video games?
Never… Once a month… Once a week… Less than an hour a day… 1-3 hours a day… 3 or more hours a day…

5.What kind of gamer do you consider yourself?
Inexperienced… Beginner… Moderate… Almost Expert Expert…

6. Choose your favourite game

7. For the game of question 6, please place a score (1-5) on the quality of some aspects of the game (Scenario, Graphics, Game Speed, Sound, Community, Controls, Character).

8. How important do you think the context of a game (solving riddles, killing enemies, reach a target) is?
Very Important ... Important ... Neutral ...
Relatively Not Important... Not Important ...

9. How important is the quality of *graphics of the main character*?
Very Important ... Important ... Neutral ...
Relatively Not Important... Not Important ...

10. How important is the change of levels of difficulty during gameplay?
Very Important ... Important ... Neutral ...
Relatively Not Important... Not Important ...

11. How important is the existence of music in a game?
Very Important ... Important ... Neutral ...
Relatively Not Important... Not Important ...

12. How important is the quick response of the game?
Very Important ... Important ... Neutral ...
Relatively Not Important... Not Important ...

13.How important do you think the quality of *graphics of the rest of the scenes is(landscape, outdoor scenes, indoor scenes)*?
Very Important ... Important ... Neutral ...
Relatively Not Important... Not Important ...

14 . How important do you think the loss of frames is?
Very Important ... Important ... Neutral ...
Relatively Not Important... Not Important ...

15. How important do you think the plot of a game is?
Very Important ... Important ... Neutral ...
Relatively Not Important... Not Important ...

16. How important do you think the change of music according to the plot is?
Very Important ... Important ... Neutral ...
Relatively Not Important... Not Important ...

17 . How important do you think the improvement of graphics quality as the level of difficulty rises is?
Very Important ... Important ... Neutral ...
Relatively Not Important... Not Important ...

18. How important do you think the quick response of the main character is?
Very Important ... Important ... Neutral ...
Relatively Not Important... Not Important ...

19 . How important do you think the ability to play the game online against human competitors is?
Very Important ... Important ... Neutral ...
Relatively Not Important... Not Important ...

20. How important do you think the simplicity of the game control (combination of keyboard, mouse or joystick) is?
Very Important ... Important ... Neutral ...
Relatively Not Important... Not Important ...

21.How important do you think the creation of your own character with unique characteristics(name, emblem)is?
Very Important ... Important ... Neutral ...
Relatively Not Important... Not Important ...

22. How important do you think the altering of the plot of the game according to the main character selection is?
Very Important ... Important ... Neutral ...
Relatively Not Important... Not Important ...

23 . How important do you think the ability of online chat during the game play is?
Very Important ... Important ... Neutral ...
Relatively Not Important... Not Important ...

24. How important the change of controls according to the plot of the game is?
Very Important ... Important ... Neutral ...
Relatively Not Important... Not Important ...

25. How important the existence of spatial sound which is consorted with graphics is?
Very Important ... Important ... Neutral ...
Relatively Not Important... Not Important ...