Towards a Framework of Player Experience Research

Lennart Nacke
University of Saskatchewan
Saskatoon, Canada
len@cs.usask.ca

Anders Drachen
Aalborg University
Ballerup, Denmark
drachen@hum.aau.dk

ABSTRACT
Player Experience (PX), user experience in the specific context of digital games, is currently a nebulous term with no commonly accepted definition or coherent backing theory. In this paper, a brief overview of the current state-of-the-art of PX knowledge is presented, with a specific emphasis on comparing PX research with the massive amount of knowledge currently being generated about user experience in other areas of HCI, notably productivity applications. Furthermore, to outline the current gaps in the knowledge of PX and integrate current research into a unified theoretical framework, creating a shared point of reference for the decidedly multi-disciplinary PX research.

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Digital games, player experience, user experience.

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K.8.0 [General]: Games – Personal Computing; J.4 [Computer Applications]: Sociology, Psychology – Social and Behavioral Sciences; H.5.2 [Information Interfaces and Presentation]: User Interfaces – Theory and Methods.

INTRODUCTION
Player experience (PX) research is currently evolving to be a fundamental concept in an expanding field of work with a strong empirical research focus [1,11,14,15]. Thus, empirical game science applies interdisciplinary research methods from HCI, CS, Neuroscience, Media Studies, Psychophysiology and Psychology just to name a few. Early game-focused research came largely out of the CS field, especially in the areas of Computer Graphics and Artificial Intelligence. In recent years, however, there has been an increasing interest in the emotional and affective aspects of the user experience that games provide, because good experiences correlate with happy customers and thus sales in the industry context [9]. Much effort has recently been put into widening usability concepts to investigate softer factors of UX in terms of underlying affective principles and action plans for improving design, similar actions are now being taken to formalize playtesting methodology during game development [14,15]. However, no cohesive discussion of the relationship of different gameplay experience methods has been presented. On the academic side, PX is of interest in order to understand how and why people choose to interact with digital entertainment products [12]. In this paper, a brief review of the current knowledge on PX is presented, against the background of the wider field of user experience research and –development. Initially, the key models of general user experience are presented, followed by a discussion about the differences between games and productivity applications. This leads into a discussion about the current work towards identifying player experience and how to measure it. Finally, the available theory is merged into a basic three-layer framework of PX, aimed to serve as an anchor point for future theoretical work on PX.

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2. THEORETICAL MODELS OF USER EXPERIENCE
While a comprehensive review of all user experience (UX) models is out of scope of this paper, a few of the key theories are introduced here: Hassenzahl [4] produced a model, which views UX from the dual perspectives of designer and user, distinguishing further between intended and apparent character of a product. He emphasized that there designers cannot guarantee that products are used or perceived as intended, e.g. because the emotional response of a user to a product is influenced by the situational context. He notes that the process of forming an opinion about a specific product includes variables such as features, individual customs, expectations, influence of past product experiences and the situational setting. In Hassenzahl´s [4] model, user experience is shaped via the iconic value of a product and the prior memories it triggers. A product can have pragmatic (e.g., utilitarian value) and hedonic (e.g., knowledge/skill stimulation, communication of identity, memory evocation) attributes. These ideas are applicable in the context of games as well, as they provide challenges, stimulation and novelty to create personal value, but it is worth noting that digital games are generally played for their hedonic value, and that the pragmatic impact of play if at all present, is hidden underneath the hedonic experience. Focusing on the hedonic qualities of UX, Jordan [6] developed a model of user needs based on Maslow's motivational model of human needs. In this model, pleasure follows from usability, which follows from functionality. Jordan [6] defined four types of pleasure: 1) psycho-pleasure (cognitive and emotional reactions); 2) physio-pleasure (evoked tactile and olfactory stimuli); 3) socio-

pleasure (evoked by relationships, society, personal status, or indicative of social identity), and: 4) ideo-pleasure (aesthetics and ideological value). While games are pleasure-centric products, they also need to be evaluated from sociological and technological perspectives. Garrett proposed a UX design model for the web with UX elements on different layers of abstraction during the web development process [3]. His notion of moving from an abstract strategy to a concrete aesthetic surface in product development can be adapted to game development, but needs to be refined in its details, which will be discussed below. Overall, UX research has also recognized fun as an important factor for people to interact with products. More generally, three important threads for UX research have been outlined: addressing human needs beyond the instrumental, affective and emotional aspects of interaction, and the nature of the experience. Similar to product experience in general, PX is very complex, since player personas and profiling, game brand awareness, individual expectations based on past experiences and marketing campaigns are all factors contributing to it. Another definition of UX describes it as forming from interaction with user and product in the particular context of use, including social and cultural factors. More precisely, the interaction of all these factors is seen as contributing to UX. Kankainen [7] discusses user-centered methodologies for concept-level product design defines UX as a result of motivated action in a certain context. Motivation, action, and content all form the vertices of a triangle that subsumes present experience. Thus, temporality is introduced to this model, indicating that previous experiences are likely to shape present experiences, and those are again going to shape future experiences. The model is discussed in a user-centered product concept design process. It focuses on creating the product content by evaluating motivational needs (i.e., reason for the behavior of a person) and action needs (i.e., process and behavior of persons executing an action). For the design of digital games, this model can be useful; however, motivational needs of individuals are hard to assess with any kind of methodology, while action needs of a person can be evaluated during gameplay if behavior and emotional responses of players are recorded.

Few researchers have tried to specifically model PX or in a similar vein, playability. Fernandez [2] proposes a rather complex model of digital player experience, which has similar traits to the aforementioned temporality. The model is built around temporal influences before (i.e., antecedents), during (i.e., processing) and after (i.e., consequences) the PX [2]. The model regards fun as the major outcome of player experience constructed from emotional and cognitive player responses and then proposes that game evaluation follows from this. If such a model has to be used in game production, this is a shortcoming. A mapping of usability to playability to evaluate UX in the context of digital entertainment presented by Sánchez et al. [16] introduced so-calld ”facets of playability”. The approach attempts to integrate practical methodology in the development process. However, while being derived from concepts of usability, the model has severe limitations, notably: 1) It is not described what process was used to derive the game playability concepts; 2) Each of the fuzzy concepts of playability is defined by using other fuzzy conceptual descriptions. This is also true for the facets of playability derived from the initial descriptions. Malone studied what makes things fun to learn and presented a model of intrinsically motivating instruction, which has been influential to the design of digital games as well [10], hypothesizing that challenge comes from having goals with uncertain outcomes. The model is useful for creating design guidelines, but not so much for explaining PX.

In summary, a number of different UX models and approaches are around but none of them is comprehensive and focused on methods of studying gameplay. This leads naturally into the discussion about the key differences between games and productivity-oriented applications (and products).

3. HOW ARE GAMES DIFFERENT?

As mentioned in the introduction, games vary from productivity applications in that the core product itself, the game, is the focus of recreational and not functional interaction. In contrast to information appliances, game software does not operate solely according to general usability principles, for example task efficiency or ease of use. While productivity software is primarily created with functionality in mind, digital games are designed for creating pleasurable experiences, which can stimulate cognitive and emotional processing [14]. The product design literature suggests an overlap between usage and experience of products [6,13]. Hedonic value influences the perception of a product’s function. Since games are usually only “used” to generate positive emotions or enjoyment, the boundaries between experience and functionality are completely blurred. Essentially, in games the user experience comes first, usability second. Indeed, tasks related to the actual controls and gameplay of a computer game may be designed to be difficult and hard to learn, depending on the intention of the design. This is one of the major distinguishing factors between productivity software and digital games. While game design is not about usability per se, a computer game does benefit from adhering to the tenets of usability and usability appears to be a good foundation for enjoyable PX [15]. However, in computer games PX is not dependent on usability – some of the most popular games in history have included glaring usability errors (e.g. Heroes of Might & Magic VII). Only in more recent years have game interfaces become the subject of usability testing. This non-dependency of PX on usability is likely not unique to computer games, however, the basic focus of games vs. productivity tools emphasize this issue. When comparing games and productivity software, the difference in focus on respectively goals vs. experience

reflects the basic difference that productivity software is outcome-oriented ("do-goal"-oriented in the terminology of Hassenzahl [4], while games are process-oriented. This leads to a set of specific challenges in the design and assessment of PX in games.

1) PX optimization: Every piece of game software and interface has to be optimized with PX in focus, not just usability/functionality or a combination of these and PX. This supersedes even established principles of interaction design.

2) Complexity: Contemporary computer games are becoming increasingly complex pieces of software, even within the indie/hobbyist community, where modern development tools permit hobbyists to produce games of a much higher quality relative to the major commercial titles, than was possible a decade ago (e.g. Darwinia). Major commercial franchises such as Quake, Unreal Tournament, Tomb Raider or World of Warcraft provide a large range of interaction possibilities, complex controls, a variety of challenges, and different choices for setting up the game, and even tools for the users to create their own playfields (a process referred to as "modding"). Games are thus reminiscent of ultra-complex applications. Game design accommodates the problem of complexity by ensuring that user learn how to play the game as they play it. Learning curves in games can be steep or shallow, but must match the skills of the target audience in order to avoid frustration. The design methods adopted by games to teach users complex systems carries a potential to be adapted to the development of productivity applications.

3) Time: The temporal dimension is central, both in terms of design and assessment. Computer games can be designed with a specific intended playtime in mind, or promote a variety of interaction periods. The temporal dimension of games is closely linked with psychological concepts such as flow and immersion/presence. Measurements of PX are heavily affected by the temporal dimension of play, e.g. in relation to subjective recall of events, or measurement methods interrupting the interaction flow between player and game [8]. There are as yet no universally accepted guidelines for how to test PX in relation to the temporal dimension of gameplay.

In terms of design, a central concept is player retention, i.e. the ability of the game to keep the user playing the game. It is a common problem that players do not finish playing a game, i.e. not obtaining full value for their investment and potentially compromising user satisfaction. E.g. in a study of over 25000 players of Tomb Raider: Underworld, Drachen et al. [1] found that only about 5% of the players had completed the game. Retention design uses behavioral biology and –psychology to prompt the user into playing the game for extended periods of time and/or to return to playing the game. Importantly, while retention and PX are closely aligned, a game with a high degree of retention does not necessarily carry a positive PX.

2. TOWARDS GRASPING PLAYER EXPERIENCE

Current PX research is aimed at investigating emotional, social, and cognitive components of the experience emerging from the interaction between players and a gaming system. However, current PX research is focused on the part of the user experience that occurs while the player is interacting with the game software [14]. PX research is in this regard focused along similar lines of reasoning as general UX research. In contrast, UX literature includes also the experience that occurs when the user interacts with the company that produces the product under investigation, as well as the services of the company [4]. Indeed, Law et al. [9] recommended that the term UX is scoped to "products, systems, services and objects that a person interacts with through a user interface". These perspectives appear relevant to PX, as company branding and customer support exist in the games industry similar to other industries. Similarly, UX research has included considerations about the state of the user and the experiences of the user when interaction is initiated. Irrespective of whether PX occurs while interacting with the game or the company, once this interaction has ended, the user will initiate a process of remembering, which adds individual bias to the perceived PX, and which potentially impacts on proceeding interaction. In essence, there is a before, during and after interacting with a game [2].

Branding is a core component of marketing in the computer games industry where the reputation of the company is one of the key factors in maintaining a fan base of hard-core gamers who act as opinion-leaders to the wider community of game players, i.e. customers. According to Law et al. [8], branding can impact on UX in subtle ways, for example, if a user purchases a game from a company that the user does not like, there is the potential for a negative impact or a feeling of guilt when playing the game (even if the user likes the game). Conversely, buying a game from a company that historically has produced games that the customer likes, but then realizing that the game in question is different than what was expected, can lead to a feeling of disappointment with the company.

With respect to company customer support interaction, this occurs within the game industry in a capacity similar to the general software industry, e.g. helping people to get through a game. For multi-player games, customer support typically also covers hosting support and typically community building and –support. For games that are primarily aimed towards multi-player online play (MMOGs, first-person shooters, etc.), the hosting- and community services have a direct influence on user perception of a game, while strictly speaking not taking place during the actual playing of the game. For example, if a matching service places players with different skill levels in the same games, the PX is potentially affected due to the lack of challenge for some players, and overwhelming challenge to others. Given that challenge is a core component of flow, an argument can be made for the impact of customer services on PX. Similar

arguments can be posed for lag periods which causes players to experience a delay between their control input and the game reacting to it, and server drops, where a player is dropped from a game server, requiring renewed login.

Defining the component of PX that occurs during runtime when the user interacts with the digital game, is complicated because of the range of psychological variables that it has been attributed to contain, for example dynamic concepts such as flow,, learning, immersion, fun, pleasure, enjoyment, and others. There is limited understanding about which components that are the most important and empirical evidence to back up respective claims is currently largely lacking. Exceptions include e.g. Mandryk et al. [11]. However, neither of these include evaluation of all potential variables, how the variables interact or in which situations/contexts that they arise. Within the academic research environments, the work being carried out towards being able to measure and test PX is focused along two directions: Those who employ psycho-physiological measures [e.g. 11] generally combined with self-evaluation/attitudinal data; and those who work primarily with qualitative and semi-quantitative methods. Instrumentation data – in game development referred to as game metrics – are becoming increasingly important as a tool for measuring the behavior of players during interaction periods in detail [1]. Combining instrumentation data with PX measures provides a means for obtaining detailed information about which game components or sequences that provide quality PX, and where there are problems in the design [e.g. 1,8].

In summary, the list of potential psychological components of PX, and corresponding psycho-physiological indicators of these components, is growing, and there currently exists no model for how these components interact and operate in detail; nor to which contexts of use are they native and how these contexts affect them. Another problem is that key terms such as entertainment, affect, enjoyment, fun etc. do not have a shared definition in the literature, and are often used interchangeably. This has led to a proliferation of PX models and theories, which generally lack empirical backing (an exception is the GEQ-survey system of Ijsselsteijn et al. [5], which has been cross-correlated with psycho-physiological measures). The outstanding challenges do not prevent the application of methods for testing specific components of or contributing variables influencing, PX. Additional challenges are posed by the recent developments of natural user interfaces, where parts or the whole body is used during interaction, e.g. Microsoft Kinect. It is an open question how current PX measurement methods handle these new interfaces and what the implications are for PX evaluation.

While the shared understanding of what constitutes PX during the periods of user-game interaction has yet to be achieved, there is a general agreement that it is a central component of user-oriented game design & development; and that it is not a simple construct but rather comprised of psychological experience components some of which can be measured using psycho-physiological methods [12]. Furthermore, that PX is affected by the properties of the user [1,2,14,15], the situational context; the temporal dimension and of course the game design (the system design) itself. The PX model presented here accounts for these considerations of PX. Despite the shortcomings in PX theory, empirical evaluation of PX is clearly useful, evidenced in the uptake of user-experience centric testing methods in the industry such as the TRUE system established by Microsoft Game User Research [8], who successfully employed RITE-testing, combined with instrumentation data and surveys to extensively evaluate the design of Halo 2 (and later Halo 3), which was later contributed to be an important factor in making this one of the best-selling games ever to be published [8].

Current methodologies employed in the game and creative industries may not work with the full extent of PX, however, this does not prevent the development of methods for assessing specific parts of PX – notably fun, flow and engagement, irrespective of the nebulousness of these concepts. In the past the evaluation of games has been a largely informal process, however, the game industry is rapidly adopting more formal techniques to evaluate their products [1,7,14,15]. However, classic usability testing is not sufficient for user-testing games, since its standard metrics (e.g., effectiveness in task completion or efficiency in error rate) are not directly mappable to digital games. Productivity software is primarily created with functionality in mind. However, digital games are created with an enjoyable experience in mind. While traditional usability metrics are still relevant, they are subsidiary means that can supplement physiological and metrical assessment of digital games. Good evaluation methodologies for digital games must allow us to make inferences of the game's success in terms of impact on the player and for describing how successful the interaction with the game reflects the designer's intent. Current evaluation approaches have focused on evaluating playability with more or less complete models of PX. From the discussion of this work, we derive the following major requirements for a framework of PX in games: (1) The framework must provide broad and inclusive layers that focus on player and game evaluation; (2) each of the layers should include at least one emerging methodology for game evaluation; (3) the model should be applicable to stages of the development process of digital games, ideally allowing for each layer to be tested iteratively but at the same time.

4. A PLAYER EXPERIENCE FRAMEWORK

In the above, we have seen that time [e.g. 2] and abstraction [e.g. 12] are used as taxonomical dimensions when talking about player experience (PX). In this section a framework is presented that attempts to combine the existing empirical

and theoretical PX research into a single framework that encompasses the different levels or views of PX. The framework is not intended as a practically applicable tool, but as a frame of reference for future PX research.

Three Layers of Abstraction in PX: It has been argued previously that PX in a practical context can be seen in three different layers of abstraction [12]. These three layers progress from very concretely graspable and technical game system experience (1) to the experience that influences and is influenced by the perceptive and operational actions of the player (2), culminating in the abstract experience levels that is shaped by interactions with other players, games, technologies, etc. (i.e., the context) in a certain segment of time (3) (Figure 1). Each of these layers or frames of reference forms a taxonomical framing device to describe an actor, which itself is a set of processes, influencing PX. On the bottom layer, the technological game system is an actor that exerts influence on player experience by its functionality, rules, mechanics, and other means. On the other hand the player is an actor able to provide content and essentially data that will shape the behavior and content of the game system itself. We do not need to know the internal processes that each actor consist of, but we need to consider the input and output of these processes that shape the interaction between those actors from which the experience occurs. An example for creating game system experience are possibilities to modify games, such as editing levels, changing textures or gameplay settings. Games like Spore or Little Big Planet provide an increasing number of so-called user-generated content to create a rich and aesthetic game system experience that can be adjusted to individual preferences by creating and sharing content between users.

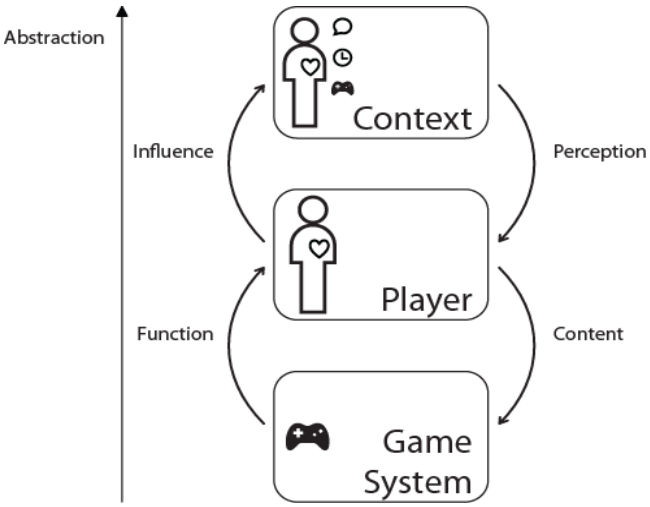

Figure 1: Different Layers of abstraction PX.

The next interaction taking place is between the player and context actors, which can be other players, other games, memories and affection toward a certain game or genre. Again, the context actor is basically a black box of processes executed in the context of playing, which interact with the player in some way. By playing a game, a player directly influences this context on an individual level, such as creating knowledge on how to progress through the game world or on a social level, such as discussing the game content with friends. This context then again shapes how the player perceives the game individually. An example for this could be a bad review making the game less enjoyable or memories of a prior game in a series making the newest episode more enjoyable.

Temporal Progression of PX: Following the notion that the temporal context is important [e.g. 2] for understanding the experience during playing a game, it is necessary top synthesize the actors from the three levels of abstraction with the temporal dimension of PX. Interactions between more concrete and more abstract actors happen during a certain segment of time. As this interaction of system, player, and context progresses, the nature of each actor may change and thus create a new and different experience. A couple of important notes on this process includes: 1) A game system is not likely to change smoothly over time, but is usually altered in technological steps. For example, systems like gaming consoles do not change gradually, but incrementally after a given fixed time period, when new technology has been invented and the market is deemed ready to invest into a new console system. In contrast, for systems such as a personal computer this process is more gradual, because of their open architecture and flexibility. However, a game system may also refer to the software that builds the core of digital game, for example a game engine. However, while a game system may be altered individually over time (thus only altering the game system actor), new PX only emerges once this system starts interacting with the player actor for a certain time segment. 2) Players as human beings are more gradual in their change over time, since human perception are made up of psychological and physiological processes that quickly adapt to change and form our reactions and behavior accordingly [11,13,14]. Thus, even with the game system remaining consistent over a period of time, the experience may change as the player may be influenced by context or by individual intrinsic changes of time. The change becomes only apparent in the interaction with the game system as the altered experience emerges when the player starts using the controller to interact with the game. 3) The context surrounding the player will change over time based on the sociological, economic, or political changes that influence the life of players. Temporal context changes can happen rapidly and thus influence the player's perception of and interaction with a game. E.g., for children the restrictions made by their parents as to what time they are allowed to play will change over time as the children grow up. This indicates how complex PX is, since all three PX actors will change their interactions over time and individually, shaping the interactions between them and thus shaping the gameplay experience. It can therefore be argued that PX can only be

assessed for a certain point in time and is likely to change as time goes by, as is also indicated by research in user experience [4,9]. It may be possible to assess each actor of PX in order to improve it and shape how the levels interact in the future. It is certainly possible to build upon previous experiences but it is difficult to determine future experiences and we therefore have to treat them as a black box of consequences that follow from the actions that we exerted at the current point of time (Figure 2).

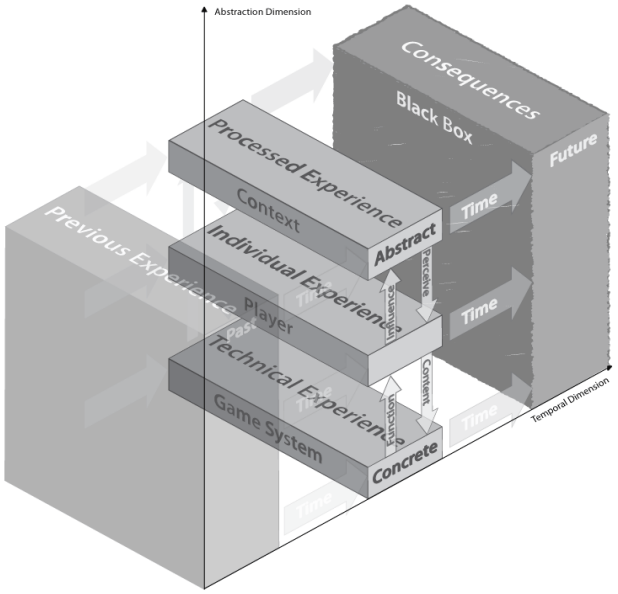

Figure 1: The PX framework in overview.

6. DISCUSSION AND FUTURE WORK

In this brief paper, the current state-of-the-art of PX research has been outlined, some comparisons made with the general research on user experience, and a synthesis of current knowledge presented in terms of a framework of PX, aimed at serving as a reference point for future work – e.g. identifying where a particular theoretical or practical work is situated in relation to the framework. The framework presented here is meant as groundwork for future studies into PX and can hopefully be refined as knowledge is build empirically and theoretically. In the current state-of-the-art it is not possible to comprehensively model how PX is created and experienced in detail – the sheer number of variables that potentially impact on it is too big to lead to any kind of functional model - if there is one conclusion that we can draw from the more than 250 publications focusing on theoretical and empirical aspects of PX, it is that the process by which PX are created, is complex and associated with a number of variables that contribute to greater or minor extent. This challenge should not prevent future research from developing various methodologies to measure PX. To proceed with the development of methodologies in the assessment of PX, it is here recommended to investigate related fields, such as neurology or mathematics to find new quantifiable and accurate methods to model parts of system, player or context experience. Moreover, while not discussed here due to space issues, there are vast amount of experiential concepts that seem to be related to gameplay and each warrant a study on their own (e.g., presence or flow).

REFERENCES

1. Drachen, A., Canossa, A. and Yannakakis, G. N. Player Modeling using Self-Organization in Tomb Raider: Underworld. In *Proc. CIG 2009*, IEEE (2009), 1-8.
2. Fernandez, A. Fun Experience with Digital Games: A Model Proposition. In *Extending Experiences: Structure, Analysis and Design of Computer Game Player Experience*. Lapland University Press, (2008), 181-190.
3. Garrett, J. J. *The Elements of User Experience: User-Centered Design for the Web*. New Riders, CA, 2003.
4. Hassenzahl, M. and Tractinsky, N. User experience - a research agenda. *Behaviour & IT*, 25, 2 (2006), 91-97.
5. IJsselsteijn, W., de Kort, Y., Poels, K., Jurgelionis, A., & Bellotti, F. (2007). *Characterising and Measuring User Experiences in Digital Games*. In Proc. ACE 2007.
6. Jordan, P. W. Pleasure with Products: Human Factors for Body, Mind and Soul. In *Human Factors in Product Design: Current Practise and Future Trends*. Taylor & Francis (1999), 206-217.
7. Kankainen, A. UCPCD: User-centered product concept design. *Proc. Conf. on Designing for UX* (2003).
8. Kim, J. H., Gunn, D. V., Schuh, E., Phillips, B., Pagulayan, R. J. and Wixon, D. Tracking real-time user experience (TRUE): a comprehensive instrumentation solution for complex systems. In *Proc. SIGCHI 2008*, ACM (2008), 443-452.
9. Law, E., Vermeeren, A. P. O. S., Hassenzahl, M. and Blythe, M. Towards a UX manifesto. In *Proc. British HCI Group Annual Conference*, British Computer Society (2007), 205-206.
10. Malone, T. W. Toward a Theory of Intrinsically Motivating Instruction. *Cognitive Science*, 5, 4 (1981), 333-369.
11. Mandryk, R. L.. Physiological Measures for Game Evaluation. In *Game Usability: Advice from the Experts for Advancing the Player Experience*, Elsevier Science (2008), 207-235.
12. Nacke, L. From Playability to a Game Usability Model. In *Proc. Future Play*, ACM (2009), 11-12.
13. Norman, D. A. *The Design of Everyday things*. New York, NY: Doubleday, 1990.
14. Pagulayan, R., Keeker, K., Wixon, D., Romero, R. L. and Fuller, T. User-centered design in games. In *The Human-Computer Interaction Handbook*. L. Erlbaum Associates Inc. (2003), 883-906.
15. Pagulayan, R., & Steury, K. Beyond usability in games. *Interactions, 11*, 5 (2004), 70-71.
16. Sánchez, J. L. G., Zea, N. P. and Gutiérrez, F. L. From Usability to Playability: Introduction to Player-Centred Video Game Development Process. In *Proc. HCD 2009*. Springer (2009), 65-74.