

# Heuristic evaluation in game and gamification development

Mikko Rajanen

Interact Research Unit, University of Oulu, Finland  
mikko.rajanen@oulu.fi

Dorina Rajanen

Interact Research Unit, University of Oulu, Finland  
dorina.rajanen@oulu.fi

**Abstract:** Game development business has become very competitive, therefore it is very important to develop games that stand out from the vast amount of other competing game titles. Usability of the game is crucial to ensure game acceptance, which in turn will contribute to more sales and profit for the game company. Game usability can also contribute to better player engagement and better accomplishment of individual and organizational objectives in the case of gamification. One successful method to ensure good usability is heuristic evaluation, which has been proven useful also in game development. However, the existing heuristics are criticized for being too general to suit specific games. This study investigates the views and practices of the game companies regarding game usability heuristics and the extent to which they utilize heuristic evaluation as a game usability method. A series of surveys was conducted in the North American and North European companies and the results show that all game professionals view usability as being very important in games, however the extent of utilization of heuristic evaluation in game development is overrated. Implications for the development practice and research in games and gamification are discussed.

## 1. Introduction

Game development business has become very competitive (McDonald, 2017; Filho et al., 2014), therefore it is very important to develop games that stand out from the vast amount of other competing game titles (Pagulayan et al., 2003). Usability of the game is crucial to ensure game acceptance and subsequently positive players' reviews (Pagulayan et al., 2003; Febretti & Garzotto, 2009; Sánchez et al., 2009). Usability is important in gamification development as well, as it optimizes player engagement and accomplishment of individual and organizational objectives (Rajanen & Rajanen, 2017). Usability is defined as being "the extent to which a product, system, or service can be used by specified users to achieve specified goals with effectiveness, efficiency, and satisfaction in a specified context of use" (ISO, 2010).

One successful method to ensure good usability is heuristic or expert evaluation (Nielsen, 1993), which has been also introduced in the game context (Federoff, 2002) and proven useful in game development (e.g., Laitinen, 2006). However, the existing game heuristics are typically criticized for being too general to suit the specificity of different games genres. Thus, the literature has become abundant of various lists of game heuristics from which it is difficult to choose (Desurvire, Caplan & Toth, 2004). Moreover, the available game heuristics need further development to improve their comprehensibility and clarity (Korhonen, Paavilainen & Saarenpää, 2009; Rajanen

& Nissinen, 2015; Amaro et al., 2016). Furthermore, the conceptualization of game usability represents also an issue in employing heuristic evaluation as the understanding and definition of game usability affects the way heuristic evaluation is conducted, its scope, and the categories in the heuristic list. Some game usability heuristic lists include only issues of interface, controls, and methods of interaction (Pinelle, Wong & Stach, 2008), while others add also aspects of gameplay and mechanics (Federoff, 2002).

This study investigates through a survey approach the views and practices of the game companies regarding game usability heuristics and the extent to which they utilize heuristic evaluation as a game usability method. The aim is to understand the practice of game heuristic evaluation given the current debate in the literature on what constitutes game usability and effective game usability heuristics. The purpose is also to understand how game heuristics adoption could contribute to the design and development of effective gamification systems that reach their goals to motivate users to utilize them and to change their behavior towards the desired target.

The paper is structured as follows. Section 2 presents a brief state-of-the-art of game heuristics research. Section 3 presents the state-of-the-art of game heuristics practice in North America and Northern Europe. Section 4 discusses the findings, existing research on heuristic evaluation in relation with gamification, implications to research and practice, and concludes the paper.

## **2. Game heuristics in the gamification context**

Heuristic evaluation (HE) is a widely used software usability evaluation method in industry because it is considered a discount usability method not requiring a lot of infrastructure, time, and money (Nielsen, 1993; Schaffer, 2008; Desurvire & El-Nasr, 2013). It involves a group of experts evaluating a software product guided by a list of so-called heuristics that provide rules of best-practice design, first individually and then as a group. A single person can also perform HE, although using more than one evaluators is recommended in order to find more problems (Livingston, Mandryk & Stanley, 2010).

Heuristics can be used in game development as early as in the concept design phase and prototype phase, where they can help to inspire a creative player experience (Desurvire & El-Nasr, 2013) as well as to identify usability problems before becoming too expensive and difficult to fix (Desurvire, Caplan & Toth, 2004; Pinelle, Wong & Stach, 2008). Although most of the generic heuristic lists can be used in analyzing the user interface of a game (see Laitinen, 2006), these heuristics still fail to address the fundamental game play issues (Federoff, 2002).

Federoff (2002) created a set of 40 game usability heuristics that are categorized into game interface, game mechanics, and gameplay heuristics. This is the first set of heuristics targeted to games and many of the subsequent game heuristics build on it (see e.g., Desurvire, Caplan & Toth, 2004). Desurvire et al.'s heuristic list has four categories (gameplay, story, mechanics, and usability heuristics) and has been found to be very helpful in early phases of game design for evaluating general issues. Further developments of game heuristics targeted specific genres (Desurvire & Wiberg, 2009), mobile games (Korhonen & Koivisto, 2006), multi-player games (Korhonen & Koivisto, 2007; Song & Lee, 2007), and social media platforms (Papaloukas, Patriarcheas & Xenos, 2009).

Several authors focused on developing general heuristics for games instead of targeting those to specific genres or types of games (see e.g., Schaffer, 2007; Pinelle, Wong & Stach, 2008; Koeffel et al., 2010). Pinelle et al. (2008) created a set of usability heuristics focusing mainly on identifying

usability problems; they thought that earlier heuristics focused too much on engagement and fun, while failing to consider usability in the traditional sense. Koeffel et al. (2010) formed a list of heuristics for evaluating usability across multiple game genres based on existing literature; they have also decided to omit the concept of flow from their heuristics due to criticism presented in the literature. Their game usability heuristics are built around a modular framework consisting of three categories: device specific heuristics, gameplay and game story heuristics, and virtual interface heuristics.

Some of the existing game heuristics are of particular relevance in the gamification context, where the educational or instructional aspect, the engagement, and the fact that the users are not necessarily experienced players or gamers are issues of primary concern. Gamification represents the use of game design elements in non-gaming systems to improve user experience and user engagement (Deterding, Sicart, Nacke, O'Hara, & Dixon, 2011). Gamification is viewed as having a business or organizational orientation (Werbach & Hunter, 2012), namely gamification is considered beneficial to an organization or goal (such as education) by creating and maintaining intrinsic motivation of users to achieve desired target behaviors through the play of a well-designed game.

The design of gamification involves introducing game-design elements into the software development of the target system, and it is challenging. Thus, game heuristics can facilitate the development of the gamification system and ensure that the target objectives of the system are fulfilled. A relevant research in this respect, in particular applicable to the educational aspect of gamification, is that by Omar & Jaafar (2010) who developed the first set of playability heuristics targeted to educational games. This set of 34 heuristics focuses on five aspects: user interface, playability, content, pedagogical, and multimedia. Sweetser, Johnson, and Wyeth (2012) created a heuristic list of 165 heuristics for evaluating real-time strategy games based on the gameflow model by Sweetser & Wyeth (2005) to achieve detailed gameflow criteria for one game genre. These heuristics have eight categories: control, immersion, concentration, player skills, challenge, clear goals, and social interaction (Sweetser et al., 2012); these could be applicable to gamification design to ensure flow and engagement. Desurvire & Wiberg (2015) introduced a set of heuristics focusing on the experience of the new players, particularly casual gamers. They addressed the game usability and game usability heuristic evaluation through the concept of game approachability, which they define as making games initially more friendly, fun, immersive, and accessible for those players who have the desire to play, yet do not always follow-through to actually playing the game.

In addition to the three sets of heuristics above that are relevant to gamification, Tondello, Kappen, Mekler, Ganaba, and Nacke (2016) developed a heuristic list specifically targeted to gamification design. This list distinguishes between three types of heuristics based on the type of motivation the system is targeting: intrinsic, extrinsic, and context-dependent motivations.

### **3. Heuristics evaluation practice**

To understand how practitioners perceive game usability and practice heuristic evaluation, a series of surveys among North American (Canada and USA) and North European (Denmark, Finland, Ireland, Latvia, Lithuania, Sweden, UK) companies was conducted. Data were collected as part of a larger, long-term research effort to understand the views of practitioners on usability and their utilization of usability methods in the game development. The present study focuses on data collected during 2012-2016 starting in Finland (2012), then extending to other Northern European countries (2014) and further to North America (2016). The survey reached in total 331 companies

in North Europe (NE) and 802 companies in North America (NA), whose contact information was mainly available on [gamedevmap.com](http://gamedevmap.com).

The first survey, which was conducted in Finland in 2012, contained mainly open answers and the obtained data were coded and used to form categories (Hsieh & Shannon, 2005) that were utilized in the subsequent surveys as multiple-choice answers or multiple answers in close-ended questions. The questionnaire consisted of 39 questions: 29 close-ended questions and 10 open questions. The questions were in English. In this paper, only questions regarding the concept of game usability and heuristic evaluation are analyzed (see Figure 1). In addition, relevant background information about the participants is reported.

<p>How important is usability in games in your opinion? (1 Not important at all ... 5 Very important)</p> <p>Do you conduct usability activities in your company? (Yes / No)</p> <p>Do you use heuristic evaluation to evaluate usability? (Yes / No)</p> <p>If answered No:</p> <p>    Why don't you use heuristic evaluation? (multiple-answer question)</p> <p>If answered Yes:</p> <p>    Who does the heuristic evaluation? (Company employees, Outside experts, Other)</p> <p>    Whose task is to perform heuristic evaluation inside the company? (open answer about the job role)</p> <p>    How many people are conducting the evaluation? (open answer)</p> <p>    What heuristic list is used for the evaluation? (multiple-answer question indicating various lists such as Nielsen's list, Federoff's list, Own list, other)</p> <p>    Why are you using heuristic evaluation? (multiple-answer question)</p> <p>    What do you think about the existing heuristic lists? (five statements rated on the scale 1 Strongly disagree 5 Strongly agree)</p> <p>What aspects do you think the concept of usability consists of? (multiple-answer question)</p> <p><i>Note:</i> The reasons for using (or not using) game HE were collected in the survey by multiple-answer questions. The possibility to give additional reasons in open answers was also provided to respondents. However, no open answers have been supplied by respondents. In Finland, only open answers have been given which were further coded into the multiple-answer questions for the subsequent surveys.</p>
--

**Figure 1. Selected questions about game usability and heuristic evaluation**

A total of 59 valid responses were received from NA and 45 valid responses from NE, the response rate being 7.4% and 16.8%, respectively. The respondents were professionals with different roles in game development; the unit of analysis of the survey data was company. Company size varied from very small (1 to 5 employees) to large (over 100 employees). The dataset includes the data from Finland, which were coded in a structured way and to match the subsequent surveys.

### **3.1 The concept of game usability**

Usability was regarded as very important in games by both NA companies (average score 4.68 on a 5-point Likert scale) and NE companies (4.69). When asked to rate the importance of different aspects of game usability such as interface, controls, user experience, flow, game mechanics, the top three aspects associated with game usability were user interface, controls, and user experience. Table 1 shows the ratings by region. No significant differences were found among the ratings in NA and NE by employing the Mann-Whitney test. Game mechanics, fun and gameplay as well as flow and game challenge are not viewed amongst the most important aspects of game usability by many of the respondents.

**Table 1. Aspects of game usability**

Aspect of usability	NE companies (N = 45)		NA companies (N = 59)		Total (N = 104)	
	n	%	n	%	n	%
User interface	42	93 %	49	83 %	91	88 %
Controls	41	91 %	51	86 %	92	88 %
User experience	38	84 %	53	90 %	91	88 %
Flow	32	71 %	39	66 %	71	68 %
Challenge	26	58 %	40	68 %	66	63 %
Gameplay	25	56 %	39	66 %	64	62 %
Fun	22	49 %	36	61 %	58	56 %
Mechanics	20	44 %	38	64 %	58	56 %

### 3.2 Heuristic evaluation

Table 2 shows the extent of employing heuristic evaluation in the sample of companies conducting usability activities ( $n = 34$  and  $50$  in NE and NA, respectively). The proportion of NA companies performing HE (28%) is greater than in NE (18%). Nevertheless, the overall utilization of this approach seems overrated, in reality reaching only 24% of the sampled companies that perform usability activities.

**Table 2. Heuristic evaluation in game development**

Game companies	Perform usability activities		Perform game HE	
	n	%	n	%
NE companies	34	76	6	18
NA companies	50	85	14	28
Total	84	81	20	24

Companies not conducting HE have given different reasons for not employing game HE (Table 3). Among them is lack of awareness, perceived time costs or other costs (too time consuming, no time to test new methods, expensive), lack of human resources to perform HE, lack of knowledge or expertise, not perceiving HE as worthwhile, and perceived unsuitability of the heuristic lists (e.g., too general, not comprehensive, unsuited for own games).

**Table 3. Reasons given for not using heuristic evaluation in game development**

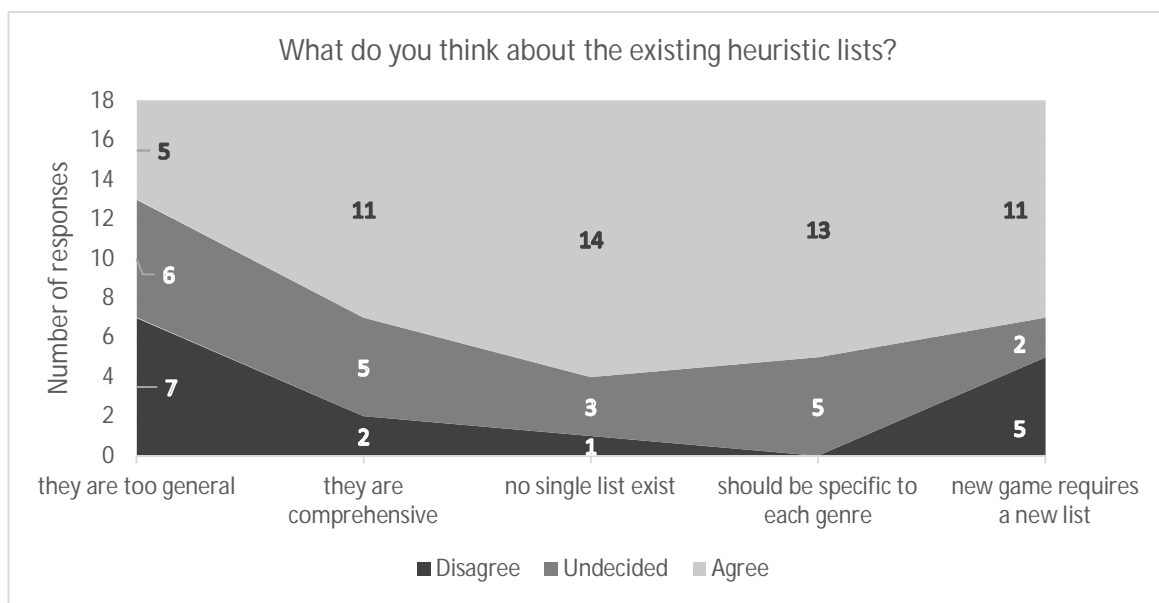
Reason	NE companies N = 34 (n)	NA companies N = 50 (n)	Total N = 84 (n)
Did not know about HE	11	20	31
Did not know how to use HE	3	10	13
Thought that HE is too time consuming	4	5	9
Did not think it is worthwhile	2	5	7
No suitable existing heuristic lists	1	4	5
Not enough people to conduct HE	3	2	5
Seen as too expensive	1	1	2
HE did not produce good results when used	0	1	1
Other	1	3	4

Among the reasons of employing HE, respondents noted that HE is cheap, effective, easy to use, fast to perform, and reduces the number and/or severity of usability problems. Table 4 shows the reasons given for using heuristic evaluation as part of usability evaluation.

**Table 4. Reasons given for using heuristic evaluation in game development**

Reason	NE companies <i>N</i> = 6 ( <i>n</i> )	NA companies <i>N</i> = 14 ( <i>n</i> )	Total <i>N</i> = 20 ( <i>n</i> )
HE is an effective way to find problems	3	11	14
Proactive use of HE reduces the number of problems found in later stages of development	4	9	13
HE is easy to use	3	6	9
HE is not too time consuming	4	4	8
HE is a cheap method	3	3	6
Other	1	2	3

When asked to characterize the existing heuristics lists, many respondents using HE characterized them in a positive light (Figure 2). Moreover, the majority of the respondents indicated that there exists many lists and that the heuristics should be specific to each game genre or each new game.



**Figure 2. How respondents characterized the existing heuristic lists, N = 18 (data from Finland not available)**

The way the game HE was employed varied with respect to company size, to whether the evaluation is done by own employees or by external experts, and to the kind of team involved in HE. The general profile of a team performing HE is one that functions within a large company, with own employees as usability experts, and typically consisting of a single member. In NA, teams of three members and external usability experts were also common. Different roles were involved in HE such as player champion, lead designer, user researcher, programmer, quality assurance specialist. Companies used as game heuristics mainly their own lists, as well as Nielsen's list of heuristics adapted or used together with own list.

## 4. Concluding discussion

This study described the state-of-the-art of heuristic evaluation in game development companies. The aim was to understand the practice of game heuristic evaluation given the current debate in the literature on what constitutes game usability and effective game usability heuristics. The purpose was also to understand how game heuristics adoption could contribute to the design and development of effective gamification systems that reach their goals to motivate users to utilize them and to change their behavior towards the desired target. Though the sample size of surveyed companies is relatively small, the findings provide interesting and valuable insight on how companies understand game usability and apply game heuristics in game development with implications to gamification development.

### 4.1 *Findings and implications for game heuristics research and practice*

Game usability was seen mostly associated with user interface, controls, and user experience, which are general aspects of usability not specific to games. The more specific aspects such as flow, challenge and gameplay were also seen related to usability, but they did not reach consensus as to their importance among the developers. Moreover, fun and game mechanics were the least associated with game usability. However, a slight trend could be observed in the North American companies which recognize these attributes as part of game usability to a larger extent.

Regarding game heuristic evaluation, the data show to some degree that game heuristics evaluation is overrated in literature as compared to reality, a significantly large amount of sampled companies not being involved in heuristic evaluation despite its stated benefits in the literature (Nielsen, 1993; Schaffer, 2008; Desurvire & El-Nasr, 2013). Various reasons were exposed as to not using heuristics in game evaluation such as the lack of knowledge and experts, lack of time, and lack of suitable heuristics. These findings call for future research on promoting the heuristic evaluation to game companies and providing game heuristics that are clearer, easier to understand and apply in practice, and providing examples similarly to the ones developed by Nielsen (Nielsen, 1993).

The majority of the companies which employed game heuristic evaluation developed and used own heuristic lists, and/or used an adapted Nielsen's list. Moreover, respondents involved in heuristic evaluation considered that specific lists should exist for specific genres and new games. These results indicate a natural practice and an expected attitude towards game heuristics, given that on the other hand, the majority of the practitioners found the existing heuristics unsuitable. However, ideally, heuristics are a means to provide some form of standardization among similar products, thus creating heuristics for each game or gamification system is neither economically sustainable nor conceptually justified. Perhaps researchers and practitioners together should agree on what constitute good game heuristics, to avoid unnecessary efforts to be spent on creating tailored heuristics that are difficult to use outside their domain. Thus, there is a need for a collaborative effort between researchers and practitioners to develop heuristics that are comprehensive and useful to practitioners, and to increase the awareness, adoption and diffusion of heuristic evaluation practice in the game companies. More case studies (similar to that by Laitinen, 2006) and surveys should be conducted to explore also the benefits of game and gamification heuristics in development contexts.

## 4.2 *Implications for gamification heuristics research and practice*

Some implications and further research questions that are pointed out by this research are regarding the gamification context. One aspect regards the gamification development context and the other the gamification heuristics. Huotari and Hamari (2012) suggest that gamification is a value co-creation process to “enhancing a service with affordances for gameful experiences” that takes place as a collaborative act between developer and player or user. However, there is a lack of studies on how gamification is dealt with in a development context, therefore research should address this topic too in order to advance the gamification practice and to determine the value of gamification and gamification heuristics for game development companies. Our study provides an initial step in this direction. Examples of further research questions are as follows. Does the gamification design and development typically elaborate itself in a game development company or in ad hoc setting dictated by momentary needs (for example, in classroom, to improve some performance metrics and engagement, the teacher is adapting the teaching in a gamified manner)? To what extent game development companies are involved in gamification-system development? Are gamification developers familiar with heuristic evaluation? Do they use heuristic evaluation and if yes, do they employ specific gamification heuristics developed and used for this purpose?

Many respondents highlighted the need for specific heuristics for different genres and for new games, thus research on gamification heuristics is timely. Gamification is typically referred to as employing game elements such as leaderboards, levels, digital rewards (e.g., points or badges, real-world prizes), competitions and social or peer pressure (see e.g., Deterding et al., 2011; Lister et al., 2014) to elicit user engagement through intrinsic and extrinsic motivation (see Karatassis & Fuhr 2016). Relevant research questions are as follows. To what extent gamification heuristics should include guidelines about these game elements? How usability can be integrated into gamification heuristics to ensure optimal flow, engagement and reach of target behavior? An initial step in this direction is done by Tondello et al. (2016) who provide a list of 28 gameful design heuristics to identify design gaps in gamification systems based on motivation types. Our literature research has identified also that heuristics that focus on educational aspects of the game (Omar & Jaafar, 2010), gameflow and engagement (Sweetser et al., 2012), and new or casual players (Desurvire & Wiberg, 2015) can provide valuable guidelines to be adapted to the gamification context. Moreover, the survey data showed that practitioners viewed game usability as an important aspect in games. Then again, they rated the user interface, controls and user experience as the top three most important aspects of game usability. Thus, gamification heuristics should take into account these usability aspects.

Future research should investigate further these issues especially in the company context to assess the integration of heuristics evaluation in gamification development and developer’s attitude and awareness of game and gamification heuristics.

### **Acknowledgements**

We thank Janne Rautio, Joonas Nissinen and Juho Tapani for their contribution in collecting the data and performing an initial data analysis.

### **References**

Amaro, A. C., Veloso, A. I., & Oliveira, L. (2016). Social games and different generations: A heuristic evaluation of Candy Crush Saga. In *Technology and Innovation in Sports, Health and Wellbeing (TISHW)*, International Conference on (pp. 1-8). IEEE.



- Desurvire, H., & Wiberg, C. (2015). User Experience Design for Inexperienced Gamers: GAP—Game Approachability Principles. In *Game User Experience Evaluation* (pp. 169-186). Springer International Publishing.
- Desurvire, H., Caplan, M., Toth, J.A. (2004). Using heuristics to evaluate the playability of games. *CHI '04: Extended Abstracts on Human Factors in Computing Systems*, 1509-1512.
- Desurvire, H., El-Nasr, M.S. (2013). Methods for game user research: Studying player behavior to enhance game design. *Computer Graphics and Applications, IEEE*, vol. 33(4), 82-87.
- Desurvire, H., Wiberg, C. (2009). Game usability heuristics (PLAY) for evaluating and designing better games: The next iteration, *Lecture Notes in Computer Science*, vol. 5621, 557-566.
- Deterding, S., Sicart, M., Nacke, L., O'Hara, K., & Dixon, D. (2011). Gamification: using game-design elements in non-gaming contexts. In *CHI'11 Extended Abstracts on Human Factors in Computing Systems* (2425-2428). ACM.
- Febretti, A., & Garzotto, F. (2009). Usability, playability, and long-term engagement in computer games. In *CHI'09 Extended Abstracts on Human Factors in Computing Systems* (pp. 4063-4068). ACM.
- Federoff, M.A. (2002). *Heuristics and usability guidelines for the creation and evaluation of fun in video games*. Indiana University, Bloomington.
- Filho, V., Moreira, Á. V. M., & Ramalho, G. L. (2014). Deepening the understanding of mobile game. In *Computer Games and Digital Entertainment (SBGAMES)*, 2014 Brazilian Symposium on (pp. 183-192). IEEE.
- Huotari, K., & Hamari, J. (2012, October). Defining gamification: a service marketing perspective. In *Proceeding of the 16th international academic MindTrek conference* (pp. 17-22). ACM.
- Hsieh, H. F., & Shannon, S. E. (2005). Three approaches to qualitative content analysis. *Qualitative health research*, 15(9), 1277-1288
- ISO (2010). ISO 9241-210: *Ergonomics of human system interaction-Part 210: Human-centred design for interactive systems*. International Standardization Organization (ISO).
- Karatassis, I., & Fuhr, N. (2016). Gamification for WebSAIL. In *GamifIR@ SIGIR* (pp. 15-20).
- Koeffel, C., Hochleitner, W., Leitner, J., Haller, M., Geven, A., Tscheligi, M. (2010). Using heuristics to evaluate the overall user experience of video games and advanced interaction games. In R. Bernhaupt (Ed.), *Evaluating User Experience in Games* (pp. 233-256). Springer.
- Korhonen, H., Koivisto, E.M.I. (2006). Playability heuristics for mobile games. *MobileHCI '06: Proceedings of the 8th conference on Human-computer interaction with mobile devices and services*, 9-16.
- Korhonen, H., Koivisto, E.M.I. (2007). Playability heuristics for mobile multi-player games. *DIMEA '07: Proceedings of the 2nd international conference on Digital interactive media in entertainment and arts*, 28-35.
- Korhonen, H., Paavilainen, J., Saarenpää, H. (2009). Expert review method in game evaluations: comparison of two playability heuristic sets. *MindTrek '09: Proceedings of the 13th International MindTrek Conference: Everyday Life in the Ubiquitous Era*, 74-81
- Laitinen, S. (2006). Do usability expert evaluation and test provide novel and useful data for game development?. *Journal of Usability Studies*, 1(2), 64-75.
- Lister, C., West, J. H., Cannon, B., Sax, T., & Brodegard, D. (2014) Just a fad? Gamification in health and fitness apps. *JMIR Serious Games* 2 (2): e9. doi: 10.2196/games.3413.

- Livingston I.J., Mandryk, R.L., Stanley, K.G. (2010). Critic-proofing: How using critic reviews and game genres can refine heuristic evaluations. *Futureplay '10: Proc. of the International Academic Conference on the Future of Game Design and Technology*, 48-55.
- McDonald, E. (2017). *The global games market will reach \$108.9 billion in 2017 with mobile taking 42%*. Retrieved on 20.4.2018 from <https://newzoo.com/insights/articles/the-global-games-market-will-reach-108-9-billion-in-2017-with-mobile-taking-42/>
- Nielsen, J. (1993) *Usability engineering*. Academic Press, Boston.
- Omar, H. M., & Jaafar, A. (2010). Heuristics evaluation in computer games. In *International Conference on Information Retrieval and Knowledge Management: Exploring the Invisible World, CAMP'10*.
- Pagulayan, R.J., Keeker, K., Wixon, D., Romero, R.L., Fuller, T. (2003). User-centered design in games. In J.A. Jacko & a. Sears (Eds.). *The human-computer interaction handbook: fundamentals, evolving technologies and emerging applications*, 883-906.
- Papaloukas, S., Patriarcheas, K., Xenos, M. (2009). Usability assessment heuristics in new genre videogames. *PCI '09: 13th Panhellenic Conference on Information 2009*, 202-206.
- Pinelle, D., Wong, N., Stach, T. (2008). Heuristic evaluation for games: Usability principles for video games design. *CHI '08: Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*, 1453-1462.
- Rajanen, M. & Nissinen, J. (2015) A Survey of Game Usability Practices in Northern European Game Companies. *IRIS: Selected Papers of the Information Systems Research Seminar in Scandinavia*. Issue Nr 6 (2015). Paper 8. <http://aisel.aisnet.org/iris2015/8>.
- Rajanen, M., & Rajanen, D. (2017) Usability benefits in gamification. In *Proc. of the 1st GamiFin Conference* (pp. 87-95) Pori, Finland. [http://ceur-ws.org/Vol-1857/gamifin17\\_p12.pdf](http://ceur-ws.org/Vol-1857/gamifin17_p12.pdf).
- Sánchez, J.L.G., Zea, N.P., Gutiérrez, F.L. (2009). From usability to playability: Introduction to playercentred video game development process. *LNCS, vol. 5619*, 65-74.
- Schaffer, N. (2007). *Heuristics for usability in games - white paper*. Retrieved on 20.4.2018 from [http://gamesqa.files.wordpress.com/2008/03/heuristics\\_noahschafferwhitepaper.pdf](http://gamesqa.files.wordpress.com/2008/03/heuristics_noahschafferwhitepaper.pdf)
- Schaffer, N. (2008). Heuristic evaluation of games. In K. Isbister, & N. Schaffer (Eds.), *Game usability - Advice from the experts for advancing the player experience* (pp. 79-90). Burlington, MA, USA: Morgan Kaufmann.
- Song, S., Lee, J. (2007). Key factors of heuristic evaluation for game design: Towards massively multiplayer online role-playing game. *International Journal of Human Computer Studies*, 65 (2007), 709-723.
- Sweetser, P., & Wyeth, P. (2005). GameFlow: a model for evaluating player enjoyment in games. *Computers in Entertainment (CIE)*, 3(3), 3-3.
- Sweetser, P., Johnson, D. M., & Wyeth, P. (2012). Revisiting the GameFlow model with detailed heuristics. *Journal: Creative Technologies*, 2012(3).
- Tondello, G. F., Kappen, D. L., Mekler, E. D., Ganaba, M., & Nacke, L. E. (2016). Heuristic Evaluation for Gameful Design. In *Proc. of the 2016 Annual Symposium on Computer-Human Interaction in Play Companion Extended Abstracts* (pp. 315-323). ACM.
- Werbach, K., & Hunter, D. (2012). *For the win: How game thinking can revolutionize your business*. Wharton Digital Press.