

Usability Benefits in Gamification

Mikko Rajanen, Dorina Rajanen
Interact Research Unit
University of Oulu
Finland
mikko.rajanen@oulu.fi, dorina.rajanen@oulu.fi

Abstract: This paper contrasts the user-centred design with the gamification design framework and proposes a model of usability benefits adapted to gamification. The model is useful for selling the usability activities to management and strategists when developing gamified solutions, services, and software. In this paper, we focus on identifying the benefits since they can be used to legitimise the usability activities in a development project. The user-centred design process focuses on understanding the user, their needs and requirements, and the paper shows that the benefits of this approach transcends the user dimension and reaches towards the developing organization by providing competitive advantage and reduced developing costs.

Keywords: Gamification, Usability cost-benefit analysis, User-centred design

1. Introduction

Gamification is an umbrella term for the use of video-game elements in non-gaming systems to improve user experience and user engagement (Deterding et al., 2011). Gamification as a concept has existed for quite a long time (see e.g., Malone, 1980). In academic context, gamification has been raising as an important topic of research starting with the paper of Deterding and colleagues at CHI 2011. Gamification has been explored in many study contexts and has been assigned different goals such as: raising engagement in education (Muntean, 2011), helping usability work to find usability issues (Saha, Manna & Geetha, 2012), and improving risk management in an enterprise (Bajdor & Dragolea, 2011). The design of gamification involves introducing game-design elements into the software development (SD) context. Creating a highly engaging, full-blown gamified system is difficult, time consuming and costly (Kapp, 2012). However, gamification has not been discussed from the point of view of usability strategy and usability cost-benefit analysis; this paper fills this gap in the literature by focusing on the positive impact that usability has on developing and using gamified systems.

Strategic usability is adopted by organizations that aim to integrate usability engineering in the organizational processes, culture, and product development by utilizing usability data to make decisions about products (Rosenbaum, Rohn, & Humburg, 2000). Usability cost-benefit analysis represents one tool used by such organizations to understand the impact of usability activities and prioritize them (see e.g., Bias & Mayhew, 2005). Usability benefits and costs for organizations started to become officially recognized recently with the proposal of including an organizational perspective to usability in the forthcoming revision of the ISO 9241-11 standard (see Bevan, Carter, & Harker, 2015). This revision will acknowledge that usability can overcome potential risks and negative outcomes of inappropriate interaction with a product, system, or service (see Bevan et al., 2015). However, a survey of usability and user experience professionals in 2016 (Rajanen et al., 2017) revealed that organizational usability defined as “the match between the product and the organization adopting it” (Elliot & Kling, 1996) is not widely adopted by usability practitioners, but it starts to be recognized. Most of the research on usability cost-benefit analysis is found in relation to traditional software development context (see Rajanen, 2011; Aydin, 2014) as well as in specific domains such as web development context (see Bias & Mayhew, 2005) and OSS development context (Rajanen, 2011), but there is a lack of studies on usability benefits in the context of gamification. Nevertheless, a survey among North-European game companies showed that usability and user-centred design are considered important for most of the companies in designing and developing games that are fun and engaging (Rajanen & Nissinen, 2015). It is noteworthy that proportionally more of the small game companies responding to the survey, when compared to the large companies, reported lacking knowledge of the usability methodologies and benefits (Rajanen & Nissinen, 2015).

The aim of the paper is to clarify the benefits that usability brings to gamification. To this end, we analyse the gamification design framework through the lenses of user-centred design methodology. This study uses the conceptual-analytic approach (Järvinen 2001, p. 17) to integrate the two design frameworks (gamification and user-centeredness) and identify the role of usability methods, models, and measurements in providing gamified systems that fulfil the needs of businesses and end-users. As a result, the paper proposes a model of usability benefits adapted to gamification. The model is useful for selling the usability activities to management and strategists when developing gamified solutions, services, and software. The paper shows that the benefits of the user-centred approach in gamification transcends the user dimension and reaches towards the developing organization by providing competitive advantage and reduced developing costs.

The paper is structured as follows. Section 2 describes usability and the user-centred design approach. Section 3 introduces the usability cost-benefit analysis models and summarizes the usability benefits to development organizations as well as to customers and end-users. Section 4 analyses the gamification design through the lenses of user-centred design. Section 5 proposes a model of usability benefits in gamification, discusses implications and future work, and concludes the paper.

2. Usability and User-Centred Design

Usability is defined in the ISO standard of human-centred design 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 9241-210, 2010). Usability has been recognized in literature as a crucial factor for the success of interactive systems and products (Maguire, 2001). Among the benefits of usability for the users and vendors, the following have been identified: increased user productivity, reduced user errors, reduced user learning effort, reduced service and support, increased acceptance, and increased reputation (Maguire 2001).

Human-centred design or user-centred design is a development approach that ensures developing systems with optimal usability. Rogers et al. (2011) point out that user-centred design involves creating alternative design solutions and evaluating them. ISO 9241-210 (2010) is the international standard that provides practical guidelines for achieving maximum usability in the system development process. The standard clarifies the role of iteration in the whole design process (not just evaluation); emphasizes that human-centred methods can be used throughout the system life cycle; explains the design activities; and clarifies the principles of human-centred design (ISO 9241-210, 2010). According to ISO 9241-210, human-centred design focuses on the users, their needs and requirements, and applies human factors/ergonomics, and usability knowledge and techniques. The design activities specified in ISO 9241-210 are: 1) understand and specify organizational requirements; 2) understand and specify context of use; 3) produce design solutions; 4) evaluate design against requirements. These are iterative, meaning that they are refined and cycled until the results are satisfactory.

Usability has been an important competitive edge in maturing software markets for decades (Grudin, 1991; Nielsen, 1993; Rosson and Carrol, 2002). However, bringing usability into the software development life cycle has been a challenge for an equally long time (see Ohnemus, 1996; Rajanen & Iivari, 2007). One reason for this is that the benefits of better usability are not easily identified or calculated (see Karat, 1994; Rajanen & Iivari, 2007; Rajanen, 2011). Usability teams in software development organizations have always been competing for resources against other software development project groups, who have objective cost-benefit data readily available (Karat, 1994). For clarifying and communicating the cost-benefits to management and other stakeholders, a series of models called usability cost-benefit analysis models, aim to tackle the problem of estimating the costs and benefits of the usability work required to achieve better usability (see Donahue, 2001; Bevan, 2000; Ehrlich & Rohn, 1994; Karat, 1994; Mayhew & Mantei, 1994; Rajanen & Jokela, 2004; Rajanen, 2006).

Over the years, the concept of usability was extended to incorporate the concept of user experience (UX) which reflects the subjective feeling and assessment of the individual towards the product, system, or service in use. User experience focuses on the preferences, perceptions, emotions and physical and psychological responses of the users during the use of an interactive product, as well as before and after use (Bevan et al., 2015), and it is typically associated with the satisfaction dimension of usability (Bevan et al., 2015).

3. Usability Cost-Benefit Analysis

Cost-benefit analysis is a method for assessing the projects from the investment point of view (Karat, 1994). This method involves making investment decisions by comparing the estimated costs and benefits of the planned actions based on collected and analysed data regarding technological and financial aspects of the projects. As a result, the management concentrates the available resources in the most useful way on such planned activities that have low costs and potentially high benefits (Rajanen, 2011). The usability cost-benefit analysis is in practice conducted in the planning phase of a development project (Maguire, 2001). While there are many different cost-benefit analysis models for different contexts, there are still relatively few published models for analysing the costs and benefits of usability work in the company software development context (Rajanen, 2011).

Generally, the five most popular models of usability cost-benefit analysis differ by the focus and perspective they adopt. Mayhew et al. (1994) focuses on the benefits that are of most interest to the audience of the analysis. Ehrlich et al. (1994) focuses on the benefits of usability from the viewpoint of the vendor company, corporate customer, and end user. Karat (1994) analyses the usability benefits through cost-benefit calculation of human factors work. Donahue (2001) divides the focus between the costs for the development organization and the benefits for the customer organization. Bevan (2000) analyses the benefits of usability to the development organization during different phases: development, sales, use, and support. According to these models, the potential benefits of better usability can be divided in two categories: benefits in the development context and benefits in the use context (see Table 1).

Table 1. Summarization of the usability benefits outlined in literature.

Usability benefits in development context	Usability benefits in use context
Increased sales	Reduced training time and learning effort
Reduced development costs	Increased productivity
Reduced training and support costs	Reduced errors
Increased acceptance and reputation	Increased (customer and user) satisfaction

4. User-Centred Design in the Gamification Context

In this section, we contrast the user-centred design activities with the six-step gamification design framework by Werbach & Hunter (2012): 1) Define business objectives; 2) Delineate target behaviours; 3) Describe your players; 4) Device activity loops; 5) Don't forget the fun; and 6) Deploy the appropriate tools.

We selected the framework by Werbach & Hunters (2012) because it is a widely cited gamification design framework and the conceptualization of gamification by Werbach & Hunters (2012) is similar to other seminal gamification frameworks such as Deterding et al. (2011) (see Seaborn & Fels, 2015). Moreover, Werbach & Hunters' (2012) framework has a business orientation; it views gamification as beneficial to an organization or goal (such as education) by creating and maintaining intrinsic motivation of users to achieve desired target behaviours through the play of a well-designed game. Thus, this framework fits with our aim to identify business and end-user benefits of usability and user-centred design.

4.1 Define Business Objectives

Gamification Design: For gamification to work it is critical to have a good understanding of the goals of the intended gamified system. After that the system is created to specifically address those goals (Werbach & Hunter, 2012: 87). The business goals or objectives define the purposes for which the systems are designed (e.g., an educational tool for learning in a school setting, or a tool for simulating a business process in a company).

User-Centred Design: The user-centred design process starts with a planning and scoping phase (Maguire, 2001) where all project stakeholders are invited to define the scope of the system and plan how usability is addressed through the project. The next phase, defining the context of use, involves defining in detail all aspects of use of the system: users, tasks, environment, etc. These two phases produce the organizational and user requirements and the use contexts. A large variety of UCD

methods can be applied in order to increase understanding of needs and motivations of all stakeholders involved (e.g., focus groups, task analysis, feedback methodologies).

Benefits for gamification: In gamification, the developers are better provided with information and insights about the characteristics of their customers, end users, and their player types which help in identifying and defining the business objectives. Failure to identify, understand, and define the business objectives may lead to designing and developing a system that does not reach its full potential; also the development project may be stopped by the upper management if the identified business objectives do not justify the development costs.

4.2 Delineate Target Behaviours

Gamification Design: When designing and developing gamified systems, it is important to define what the designer wants the users to achieve and how to measure that behaviour. The target behaviour should be as specific as possible in order to measure and evaluate the behaviour. Werbach & Hunter (2012: 89-90) propose two metrics to measure the target behaviour: points and win states. They do not however specify the ways how to actually motivate users to perform the target behaviour, only how to track it.

User-Centred Design: During the user-centred design process, the target behaviours are iteratively defined when clarifying the context, and then are designed and evaluated. The design solution space is large and usability methods provide the means to select among competing solutions. A large variety of usability methods (from high-level emotion and cognitive self-reports to low-level psychophysiological measurements) can be employed to improve and evaluate design solutions (Kuniaysky, 2003; Kivikangas et al., 2011).

Benefits for gamification: In gamification, user-centred design and usability methods help designers to design and evaluate alternative target behaviours and choose the optimal ones for development and implementation. Failures to identify, define, evaluate, and select the target behaviours may lead to designing and developing a system that does not fit the requirements.

4.3 Describe Your Players

Gamification Design: Because the players are the users of the gamified system, it is important to describe the players' characteristics. Moreover, different player types have different personal preferences and styles of playing, thus knowing the typologies of the players and their characteristics ensures that the system has maximum appeal to them (Werbach & Hunter, 2012: 91-93).

User-Centred Design: User-centred design focuses strongly on understanding users and their characteristics by dedicating a phase in the design addressing the context of use. Usability methods addressing personality, psychology, and behavioural phenomena (Deterding et al., 2011) contribute to defining all relevant dimensions of users in the context of system use and creating personas as user representatives to use during design and development. One of the most well-known classification of players' characteristics is the Bartle classification of video game players (Bartle, 1996), which has also been further adapted into gamification context (Marczewski, 2013).

Benefits for gamification: In gamification, user-centred design can be used to create personas as representative players and to understand players' profiles and their implications to the game use. Failure to identify and understand the players may lead to designing and developing a system that does not appeal to the users; in the worst case, the users reject the system altogether because they feel it is incompatible with them.

4.4 Device Activity Loops

Gamification Design: Activity loops move the action in a gamified system forward and they structure the core gameplay aspects. The concept of activity loops is that an action provokes another action, which again provokes another action. There are two different categories of activity loops: engagement loops and progression loops. Engagement loops describe what the players do, why they do it, and what the system does in response. It is important to give immediate feedback to the user and with that motivate him/her to perform another action. The goal of the engagement loop design is that users

always know when they do something good and get immediate feedback to prove it. Still, it is not enough to get just feedback, because feedback alone will not tell the user whether he/she is advancing or not. Because of this, progression loops are needed. Progression loops can give perspective on the player's journey on a macro level. The player experience with the system should not be the same on the first use and later after a month of use. If the experience stays the same over time the user might get bored and not motivated to use the system again. Progression loops give the impression that the experience changes as users move through it. That is usually achieved with escalating levels of challenge and difficulty. The difficulty to win different kinds of challenges should increase to match the increased ability of the user. (Werbach & Hunter, 2012: 94-97).

User-Centred Design: Usability and UX methods at the evaluation phase (in particular, usability testing and psychophysiological measurements; Diah et al., 2010; Kivikangas et al., 2011) give the developers valuable feedback on how the actual users actually respond to system.

Benefits for gamification: In gamification, the usability and UX methods at this evaluative step help developers to assess and tailor the progression and engagement activity loops for the target players. Failure to identify problems in the design loops decrease or ruin the player experience and may result in user frustration, boredom, or confusion, lack of appropriate feedback from the system, and lack of motivation and flow.

4.5 Don't Forget the Fun

Gamification Design: Fun is in the core of games and gamification. The fundamental goal of gamification is to create systems that are more fun and more engaging by gamifying them. Because of this goal it is very important that using the system is ultimately fun and the player has a positive experience, otherwise it does not matter how well it should theoretically work. This is where testing and the overall user experience are important. When creating a gamified system it is easy to forget that it is all about fun. (Werbach & Hunter, 2012: 98-99).

User-Centred Design: Fun and enjoyment have been considered in human-computer interaction development since its inception (e.g., Malone, 1984). Though not always as front-runners, nowadays emotion and enjoyment become a common place when discussing user experience and usability. Usability methods, such as game heuristic evaluation lists, usability testing, focus groups, and psychophysiological measurements, are employed during the design and development process to find and fix all the usability, user interface, and gameplay issues that would unintentionally come between the player and the fun.

Benefits for gamification: The usability and UX methods in this step of gamification help finding and fixing fun-breaking issues. Failure to identify usability issues that break the flow and fun from the player will make the gamified system less fun than it could be, and will have a negative impact on the player attitude. Furthermore, the designers should also take into account the more subjective user experience aspect when designing gamification in addition to the more objective usability aspects.

4.6 Deploy the Appropriate Tools

Gamification Design: After the previous steps have been successfully accomplished, developers apply the most relevant and effective elements and structures into the system. Not any combination of the elements or structures ensures a system that has the target effects. According to Werbach & Hunter (2012: 99-101), successful games require a certain combination of right gamification elements and structures.

User-Centred Design: During the user-centred design process, several design solutions are proposed and evaluated (Rogers et al., 2011). Since the process is centred on the user, the technical aspects of the system are adapted to the user and his/her context and target behaviour from the start. Moreover, the evaluation of usability and UX throughout the process cycle ensures that the system conforms to the stated requirements.

Benefits for gamification: Applying the user-centred design principles and activities throughout the gamification design process ensures that developers select the best tools, design elements, and structures and combine them in a system that is appropriate and serves the business objectives and

player engagement and progression to the maximum effect. This results in reaching the business objectives of the system and keeping the players engaged and satisfied. Failure to evaluate, improve and verify the combination of gamification elements and structures may lead to system not reaching its full potential (business objectives, target behaviours, activity loops, and /or the fun of the game).

5. Discussion and Conclusions

We summarize in Table 2 the analysis of the gamification process through the user-centred design lenses by proposing a model of usability benefits in gamification.

Table 2. A model of how gamification benefits from usability.

Usability benefits in gamification development	Usability benefits in gamification use
<p>Increased sales</p> <ul style="list-style-type: none"> - Business objectives are well defined, understood, and embedded in the game 	<p>Increased productivity</p> <ul style="list-style-type: none"> - The game design is based on the business objectives and ensuring the usability, UX, flow and fun, as well as engagement and achieving the target behaviour.
<p>Reduced development costs</p> <ul style="list-style-type: none"> - The design and development is iterative and incremental making sure that the critical issues of target behaviours, players profiles, activity loops for player engagement and motivation, fun of the game, and deployment solutions are well tested before implementation, thus resulting in less need for later costly changes. 	<p>Reduced errors</p> <ul style="list-style-type: none"> - Game is designed according to usability requirements for ease of use, effectiveness, and efficiency, as well as UX requirements of subjective experience with respect to the target behaviour and business objectives.
<p>Reduced training and support costs</p> <ul style="list-style-type: none"> - The result game is tailored and adapted to the players and not vice versa, by understanding, knowing and modelling the target players. 	<p>Reduced training time and learning effort</p> <ul style="list-style-type: none"> - The activity loops for progression and engagement are designed by continuously involving the users.
<p>Increased acceptance and reputation</p> <ul style="list-style-type: none"> - The potential customers and end-users are adopting the game and provide positive feedback through different channels. 	<p>Increased (customer and user) satisfaction</p> <ul style="list-style-type: none"> - The potential customers and end-users are adopting the game and provide positive feedback through different channels.

This paper fills a gap in the literature of gamification by highlighting the strategic role of usability and user-centred design in the development of gamified systems. Maguire (2001) identified that usability cost-benefit analysis is an activity that in practice takes place at the start of a project, namely, in the planning phase, in order to determine stakeholders to dedicate resources and define the scope of the project from the user and customer point of view. In this paper, we focused on identifying the benefits since they can be used to legitimise the usability activities in the development project. The user-centred design process focuses on understanding the user, their needs and requirements, and the paper shows that the benefits of this approach transcend the user dimension and reaches towards the developing organization by providing competitive advantage and reduced developing costs.

This paper contributes to the theory by exploring, contrasting and modifying the usability benefits identified in productivity software development context to categorize and fit these usability benefits into the gamification software development context. The results from this research indicate that it is possible to fit the usability benefits into the gamification context to identify how gamification benefits from usability in gamification development context and in gamification use context. Furthermore, this paper highlights the importance of good usability and the use of usability methods and user-centred design process when developing gamified solutions, since problems in usability could have serious

impact in the critical issues in gamification design and development, and ultimately, if the business objectives are reached or not.

The results of this paper can be utilized by gamification practitioners (e.g., managers, usability specialists, and developers of gamification) to motivate and justify the usability activities, and the resources needed for them. Furthermore, usability benefit analysis researchers can use the gamification usability benefit framework as systematic criteria to further develop better usability cost-benefit analysis models in general as well as developing further specific usability cost-benefit models tailored to gamification development context. Also, the findings of this paper can be utilized by gamification researchers to further analyse and develop models on the relationship between gamification, usability, user experience, and service design.

With regard to future areas of research, one future area of study is to evaluate the proposed model of usability benefits in gamification in real-world contexts, in companies or education settings. This evaluation could be carried out as an exploratory case study in a gamification software organization, or as a survey among gamification companies, as well as among end-users or beneficiary organizations of gamified solutions. Furthermore, another future area of research is to expand the proposed gamification usability benefits model to explicitly take into account different aspects of usability such as effectiveness, efficiency, satisfaction, safety, user experience, as well as to integrate the model into the service design perspective, and map usability and UX methods onto the model.

References

- Aydin, B. (2014). *Development of a decision tool for cost justification of usability* (Doctoral dissertation, Texas Tech University).
- Bajdor, P., & Dragolea, L. (2011). The gamification as a tool to improve risk management in the enterprise. *Annales Universitatis Apulensis Series Oeconomica*, 13(2).
- Bartle, R. (1996). Hearts, clubs, diamonds, spades: Players who suit MUDs. *Journal of MUD research*, 1(1), 19.
- Bevan, N. (2000) *Cost Benefit Analysis version 1.1. Trial Usability Maturity Process*. Serco
- Bevan, N., Carter, J., & Harker, S. (2015). ISO 9241-11 revised: What have we learnt about usability since 1998?. In *International Conference on Human-Computer Interaction* (pp. 143-151). Springer International Publishing.
- Bias, R. G., & Mayhew, D. J. (Eds.). (2005). *Cost-justifying usability: An update for the Internet age*. Elsevier.
- 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.
- Diah, N. M., Ismail, M., Ahmad, S., & Dahari, M. K. M. (2010). Usability testing for educational computer game using observation method. In *Information Retrieval & Knowledge Management (CAMP)*, 2010 International Conference on (pp. 157-161). IEEE.
- Donahue, G. (2001) Usability and the Bottom Line. *IEEE Software*, Vol. 18(1), 31-37.
- Ehrlich, K., & Rohn, J. (1994) Cost Justification of Usability Engineering: A Vendor's Perspective. In: Bias, R., Mayhew, D. (eds.): *Cost-Justifying Usability*. Academic Press, 73-110.
- Elliott, N., & Kling, R. (1996) Organizational usability of digital libraries in the courts. In *Proc. of the Twenty-Ninth Hawaii International Conference on, System Sciences* (Vol. 5, pp. 62-71). IEEE.
- Grudin, J. (1991) Systematic Sources of Suboptimal Interface Design in Large Product Development Organizations. *Human-Computer Interaction*, Vol. 6(2), 147-196.

- ISO 9241-11 (1998). *Ergonomic requirements for office work with visual display terminals (VDTs) - Part 11: Guidance on usability*. Geneva, CH: International Standard Organization.
- ISO 9241-210 (2010). *Ergonomics of human system interaction-Part 210: Human-centred design for interactive systems*. International Standardization Organization (ISO).
- Järvinen, P. (2001) *On Research Methods*. Opinpajan Kirja, Tampere.
- Kapp, K. (2012) Games, gamification, and the quest for learner engagement. *T+ D*, 66(6), 64-68.
- Karat, C-M. (1994) A Business Case Approach to Usability Cost Justification. In Bias, R., Mayhew, D. (eds.): *Cost-Justifying Usability*. Academic Press, 45-70.
- Kivikangas, J. M., Chanel, G., Cowley, B., Ekman, I., Salminen, M., Järvelä, S., & Ravaja, N. (2011). A review of the use of psychophysiological methods in game research. *Journal of Gaming & Virtual Worlds*, 3(3).
- Kuniavsky, M. (2003). *Observing the user experience: a practitioner's guide to user research*. Morgan Kaufmann.
- Maguire, M. (2001). Methods to support human-centred design. *International journal of human-computer studies*, 55(4), 587-634.
- Malone, T. W. (1980). What makes things fun to learn? Heuristics for designing instructional computer games. In *Proc. of the 3rd ACM SIGSMALL symposium on Small systems* (162-169). ACM.
- Malone, T. W. (1984). Heuristics for Designing Enjoyable User Interfaces: Lessons from Computer Games. In *Human Factors in Computer Systems*. p. 1-12. Norwood, NJ: Ablex Intellect Books.
- Marczewski, A. (2013). *Gamification: a simple introduction*. Andrzej Marczewski.
- Mayhew, D. & Mantei, M. (1994) A Basic Framework for Cost-Justifying Usability Engineering. In Bias, R., Mayhew, D. (eds.): *Cost-Justifying Usability*. Academic Press, 9-43.
- Muntean, C. I. (2011). Raising engagement in e-learning through gamification. In *proceedings of the 6th International Conference on Virtual Learning ICVL* (323-329).
- Nielsen, J. (1993) *Usability engineering*. Academic Press, Boston
- Ohnemus, K. (1996) Incorporating Human Factors in the System Development Life Cycle: Marketing and Management Approaches. In *IEEE IPCC96*, 46-53
- Rajanen, D., Clemmenson, T., Iivari, N., Inal, Y., Rızvanoğlu, K., Sivaji, A., & Roche, A. (2017) UX professionals' definitions of usability and UX – A comparison between Turkey, Finland, Denmark, France and Malaysia. In *Proc. of the 16th IFIP TC.13 International Conference on Human-Computer Interaction - INTERACT 2017*. (Forthcoming).
- Rajanen, M. (2006) Different Approaches to Usability Cost-Benefit Analysis. In *proceedings of 13th European Conference on Information Technology Evaluation (ECITE 2006)*, Genoa, Italy.
- Rajanen, M. (2011) *Applying Usability Cost-Benefit Analysis - Explorations in Commercial and Open Source Software Development Contexts*. PhD Dissertation. Acta Universitatis Ouluensis Series A 587. University of Oulu. <http://urn.fi/urn:isbn:9789514296871>
- Rajanen, M. & Iivari, N. (2007). Usability Cost-Benefit Analysis: How Usability Became a Curse Word?. In *Proceedings of the INTERACT 2007*. Rio de Janeiro, Brasil. DOI: 10.1007/978-3-540-74800-7_47.
- Rajanen, M. & Jokela, T. (2004) Analysis of Usability Cost-Benefit Models. In *proceedings of the 12th European Conference on Information Systems (ECIS2004)*, Turku, Finland.

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. Paper 8. <http://aisel.aisnet.org/iris2015/8>

Rogers, Y., Sharp, H., & Preece, J. (2011). *Interaction design: beyond human-computer interaction*.

Rosenbaum, S., Rohn, J. A., & Humburg, J. (2000). A toolkit for strategic usability: results from workshops, panels, and surveys. In *Proceedings of the SIGCHI conference on Human Factors in Computing Systems* (pp. 337-344). ACM.

Rosson, M. & Carroll, J. (2002) *Usability Engineering: Scenario-based Development of Human-Computer Interaction*. Morgan-Kaufman, San Francisco

Saha, R., Manna, R., & Geetha, G. (2012). CAPTCHINO-A Gamification of Image-based CAPTCHAs to Evaluate Usability Issues. In *Computing Sciences (ICCS)*, 2012 International Conference on (95-99). IEEE.

Seaborn, K., & Fels, D. I. (2015). Gamification in theory and action: A survey. *International Journal of Human-Computer Studies*, 74, 14-31.

Werbach, K., & Hunter, D. (2012). *For the win: How game thinking can revolutionize your business*. Wharton Digital Press.