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The rise of motivational information systems: A review of gamification research

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ABSTRACT

Today, our reality and lives are increasingly game-like, not only because games have become a pervasive part of our lives, but also because activities, systems and services are increasingly gamified. *Gamification* refers to designing information systems to afford similar experiences and motivations as games do, and consequently, attempting to affect user behavior. In recent years, popularity of gamification has skyrocketed and manifested in growing numbers of gamified applications, as well as a rapidly increasing amount of research. However, this vein of research has mainly advanced without an agenda, theoretical guidance or a clear picture of the field.

To make the picture more coherent, we provide a comprehensive review of the gamification research (N = 819 studies) and analyze the research models and results in empirical studies on gamification. While the results in general lean towards positive findings about the effectiveness of gamification, the amount of mixed results is remarkable. Furthermore, education, health and crowdsourcing as well as points, badges and leaderboards persist as the most common contexts and ways of implementing gamification. Concurrently, gamification research still lacks coherence in research models, and a consistency in the variables and theoretical foundations. As a final contribution of the review, we provide a comprehensive discussion, consisting of 15 future research trajectories, on future agenda for the growing vein of literature on gamification and gameful systems within the information system science field.

1. Introduction

During recent decades, we have witnessed glimpses of a fascinating emerging development where utilitarian and hedonic systems are in a state of spiraling convergence. Today, the spiral has made a full revolution, and we now see hedonic or entertainment-oriented technologies being re-appropriated for productive use. This development has been titled “gamification” and the phenomenon has quickly cemented itself as being one of the major developments in the information systems (IS) field and other domains. Hedonic information systems initially came about through the re-appropriation of instrumental information technology. Most notably, the first video games emerged from a playful re-appropriation of oscilloscopes – a seemingly utilitarian system (“Tennis for Two” developed by Higinbotham in 1958 – see e.g. Tavinor, 2009). Since then, we have witnessed a wide diffusion of game consoles (e.g. Pong in 1972, Atari 2600 in 1977, Nintendo in 1983, Xbox in 2002 etc.) and other video game applications. Forwarding to today, hedonic systems and software are everywhere, and are developed for the sole purpose of promoting user enjoyment. Furthermore, digital games have penetrated our everyday lives at an increasing pace and have now become a mainstream form of entertainment, enjoyed by people from all demographic groups (see e.g. Williams, Yee, & Caplan, 2008; Williams, Consalvo, Caplan, & Yee, 2009). However, especially during the last ten years, we have come a full circle, and hedonic systems (and especially game designs) are currently merging back into utilitarian systems and even perhaps new strains of utilitarian systems are emerging from hedonic systems.

Games are especially known for their ability to engage and excite, and when playing games, people commonly experience e.g. mastery, competence, enjoyment, immersion, or flow, all of which are characteristic of intrinsically motivated human behavior (e.g. Huotari & Hamari, 2017; Ryan, Rigby, & Przybylski, 2006; Deci & Ryan, 2000; Ryan & Deci, 2000; Agarwal & Karahanna, 2000; Venkatesh, 1999; Webster & Martocchio, 1992; Csíkszentmihályi, 1975, 1990). An essential aspect of playing games is the self-purposeful nature of the activity, as well as the engagement and enjoyment of the activity. It is this nature of playing games that gamification technology attempts to capture, harness and implement into contexts that commonly have a

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more instrumental purpose (Hamari & Koivisto, 2015b; Huotari & Hamari, 2017; Liu, Xun, & Santhanam, 2013; Santhanam, Liu, & Shen, 2016; Vesa, Hamari, Harviainen, & Warmelink, 2017; Liu, Santhanam, & Webster, 2017). When starting a game, a player accepts the contingency of the end result, however, the process is often enjoyable regardless of the outcome (see e.g. Malaby, 2007). Incorporating the engagement and enjoyment of the gameful process into activities outside games is at the core of what commonly is titled gamification; a design approach of employing game elements into different types of systems and services, with the goal of affording gameful experiences (Huotari & Hamari, 2017).

Since its conceptual inception around 2010, gamification has increasingly drawn the attention of academics and practitioners (see Hamari, Koivisto, & Sarsa, 2014). In addition to gaining popular proponents, the approach has gained traction from positive prospects published in business analyses by Gartner (2011) and IEEE (2014) which predict that most companies and organizations will implement gamification in the near future. Consequently, operators in various fields have been attracted by the potential of gamification for inducing motivation and engagement for a diverse range of activities. This has led to gamification being implemented in domains such as enterprise resource planning (Alcivar & Abad, 2016; Herzig, Strahringer, & Ameling, 2012), intra-organizational communication and activity (Farzan et al., 2008b, Farzan et al., 2008a; Thom, Millen, & DiMicco, 2012), science (Sørensen et al., 2016), government services and public engagement (Bista, Nepal, Paris, & Colineau, 2014; Tolmie, Chamberlain, & Benford, 2014; see also Hassan & Hamari, 2019 for a review), work (see Warmelink, Koivisto, Mayer, Vesa, & Hamari, 2018 for a review) and crowdsourcing (Eickhoff, Harris, de Vries, & Srinivasan, 2012; Lee, Ceyhan, Jordan-Cooley, & Sung, 2013; Ipeirotis & Gabrilovich, 2014; see also Morschheuser, Hamari, Koivisto, & Maedche, 2017 for a review), commerce (Hamari, 2015; Hamari, 2013), exercise (Hamari & Koivisto, 2015a; Koivisto & Hamari, 2014), health (Jones, Madden, & Wengreen, 2014; see also Alahäivälä & Oinas-Kukkonen, 2016 for a review), education (e.g. Bonde et al., 2014; Christy & Fox, 2014; de-Marcos, Domínguez, Saenz-de-Navarrete, & Pagés, 2014; Denny, 2013; Domínguez et al., 2013; Farzan & Brusilovsky, 2011; Filsecker & Hickey, 2014; Hakulinen, Auvinen, & Korhonen, 2013; Simões, Díaz Redondo, & Fernández Vilas, 2013; see also Majuri, Koivisto, & Hamari, 2018 for a review), environmental behavior (Lee et al., 2013; Lounis, Pramatari, & Theotokis, 2014), as well as marketing and advertising (Cechanowicz, Gutwin, Brownell, & Goodfellow, 2013; Terlutter & Capella, 2013; Xi & Hamari, 2019), to name a few.

The literature on gamification is rapidly increasing and spreading in many directions, but this is similar to any development that has great potential and which is surrounded by a crowd of hyped enthusiasts. In order to control and take advantage of this development, concerted efforts are needed to harness the literature and existing knowledge to productive use, and to provide the field with an agenda for further research. Gamification is still in its infancy and rapidly developing, but what is actually known of the phenomenon tends to stem from fragmented pieces of knowledge, and from a variety of perspectives. While some attempts have been made to synthesize the literature on gamification, previous reviews have been very focused in their scope. In order to provide both academics and practitioners with a more widespread view on the gamification phenomenon, a larger scale review of the phenomenon should help to map its development and progress, as well as aid in steering future literature and agendas. We firmly believe that gamification is especially an IS/IT phenomenon, since it has at its core the use of leisure information systems (more specifically (video) games) and their design in a variety of utilitarian information system contexts. However, if we consider the host of literature on gamification that has been produced thus far, it appears to be relatively under-represented in IS literature, regardless of it clearly being an IS phenomenon. This suggests that other fields (especially those of education and human-computer interaction) have perhaps shown more innovation and openness in their approach to this prominent technological development. Therefore, it is also important to more broadly initiate a discussion about gamification in IS literature.

In this study, we aim to, firstly, comprehensively review and synthesize the extant literature on the concept of gamification; and secondly, to theorize and delineate a further research agenda for the research of gamification and motivational information systems within the information systems research field. The review draws together the existent knowledge on the topic and presents it in a structured manner. The review process mainly follows the guidelines described by Webster and Watson (2002) and Paré, Trudel, Jaana, and Kitsiou, (2015). Over 800 papers have been categorized, and 273 empirical studies are analyzed in detail to outline the domains in which gamification is being implemented, how it is being implemented, how it has been studied, as well as identifying the kinds of results that have been produced thus far. The findings of the review indicate where research knowledge is already abundant, where further research is needed, and what steps should be taken in future research to develop knowledge on the topic.

2. Background

Information systems discipline has traditionally been characterized as the pursuit of knowledge pertaining to productivity and efficiency (see e.g. Hirschheim & Klein, 2012), and improvement of these. A substantial body of knowledge has sprung from this rational, utility-seeking premise of aiding in the development and construction of efficiently managed and operated organizations and information systems within them. However, this utility-driven lens of information systems was not geared towards capturing the use of varied non-utilitarian information systems that started to heavily appear when information technology had advanced enough in its graphics and calculation power. Information systems seeking to fulfill entertainment-oriented needs challenged the utilitarian premise previously dominating the research and understanding in the IS field (e.g. van der Heijden, 2004). Therefore, the scope of information systems science was expanded by introducing the study of hedonic information systems that deviates from the utility/rational-core of the IS discipline. The first wave of literature started to widen the perspective of IS research into intrinsic and hedonic motivations in the early 1990s by studying the concepts of playfulness and enjoyment in relation to technology acceptance and use (see e.g. Webster & Martocchio, 1992; Davis, Bagozzi, & Warshaw, 1992), and later in 2004 by e.g. van der Heijden (2004) via the development of models that addressed the acceptance and use of hedonic information systems. During the same period, the marketing research field and literature also witnessed a surge of research on hedonic aspects of consumption (see Hirschman & Holbrook, 1982 for an early account). Since then, however, a disconnect between the rational and hedonic veins of IS literature has existed until very recent literature on dual and multipurpose systems (as can be seen e.g. in Wu & Lu, 2013).

When considering these various types of information systems, it seems that gamification has a rather interesting and peculiar role. Traditionally, the information systems field has distinguished between two system types that are designed to address different needs, either utilitarian or hedonic (see e.g. van der Heijden, 2004). Systems defined as utilitarian information systems are commonly designed to serve purposes related to productivity. They seek to increase the efficiency of a given task, and therefore, at their core they serve mainly instrumental purposes. From a motivational perspective, the use of utilitarian systems can be considered as being extrinsically motivated (see e.g. Deci & Ryan, 1985; van der Heijden, 2004); i.e. the system aids the user in reaching a goal that is separate from the system use itself (Davis et al., 1992). The usefulness and benefits of the system thus rise from reaching the external goal more efficiently. Conversely, the use of hedonic information systems is mostly entertainment-driven (van der Heijden, 2004). These systems aim at creating experiences of enjoyment and are

used for the purposes of recreation and entertainment, and for the sake of using the system itself. Therefore, the use of hedonic systems is considered to be autotelic and intrinsically motivated (Deci & Ryan, 1985; Ryan & Deci, 2000), as opposed to systems with utilitarian use objectives. Examples of hedonic systems are entertainment-oriented websites and services, video games, blogs, and social networking sites.

In recent years, information systems have increasingly been designed to meet more varied user motivations and orientations (Gerow, Ayyagari, Thatcher, & Roth, 2013; Sun & Zhang, 2006). The research field has started to acknowledge that many systems serve both utilitarian as well as hedonic needs (Hamari & Keronen, 2017), and increasingly, systems are fundamentally being designed to cater for these needs, i.e. as mixed systems (Gerow et al., 2013). One such type of mixed systems are those with the objective of motivating users toward different individually and collectively beneficial behaviors (Hamari & Koivisto, 2015b; Hamari et al., 2014). These systems are an intriguing combination of both utilitarian (Davis, 1989) and hedonic aspects (van der Heijden, 2004): the goals of the systems' use are related to productivity, however, the means and the design by which the systems promote productivity are hedonic in nature. Whereas traditional utilitarian systems aim for productivity through efficiency and traditional hedonic systems aim for creating fun experiences, these *Motivational Information Systems* can be characterized to aim for "productivity through fun". Therefore, Motivational Information Systems differ from the utilitarian and hedonic information systems in one important, crucial way: the acceptance is mainly driven by usefulness as in utilitarian systems, but the usefulness is determined by the enjoyment of the use. One of the most prominent solutions for addressing motivational challenges has been to draw from one of the pinnacle forms of hedonic information systems, i.e. digital games. This approach is commonly referred to as gamification.

Gamification refers to a design approach of enhancing services and systems with affordances for experiences similar to those created by games (Deterding, Dixon, Khaled, & Nacke, 2011; Hamari, Huotari, & Tolvanen, 2015; Huotari & Hamari, 2012; Liu et al., 2017; Santhanam et al., 2016; Vesa et al., 2017). These "gameful" affordances aim at supporting and motivating the user toward the behavior that the gamified system is targeting, such as healthy behaviors and exercise, participation in learning activities etc. The experiences created by games refer e.g. to senses of enjoyment, flow, autonomy, mastery, accomplishment etc., that are considered to be induced by games and game play (e.g. Ryan et al., 2006). In the context of games, these experiences are often considered to be what make games intrinsically motivating, so that the user wishes to engage with the system simply for the sake of using it. Harnessing similar experiences by implementing gameful affordances in the contexts of the utilitarian functions described above aims at transferring similar motivational effects into the new environment. What makes motivational information systems such as gamification interesting is the fact that the systems at their core motivate and support the user toward a given activity or behavior. This conveys that the system should increase the efficiency and productivity regarding the target behavior. Thus, their usefulness is determined on the basis of whether they manage to do so. Furthermore, in many of the commonly gamified contexts, such as learning or healthy behavior, the activities require long-term commitment and persistence for the results to actualize. On the other hand, the systems features hedonic design, and therefore aim at making the process of using the system enjoyable. When the system use is enjoyable, the chances of engaging with it in long-term may be increased (see e.g. van der Heijden, 2004; Atkinson & Kydd, 1997; Moon & Kim, 2001; Venkatesh, 1999; Mäntymäki, Merikivi, Verhagen, Feldberg, & Rajala, 2014; Mäntymäki & Riemer, 2014; Hamari, 2015; Mäntymäki & Salo, 2013; Mäntymäki & Salo, 2015).

The potential of gamification lies in the restructuring of tasks and activities with game elements and gameful affordances. This may be by dividing a larger whole into sub-tasks with clear goals and providing direct feedback for accomplishments, reframing an activity by establishing a meaningful narrative, or by gathering a social community to provide support. A commonly used theoretical frame for understanding the motivational potential of games is that of self-determination theory (SDT) and its sub-theories (Deci & Ryan, 2000; Deci & Ryan, 1985; Ryan et al., 2006) that consider human motivation to be either intrinsically or extrinsically motivated, depending on whether the activity is performed for the sake of the activity itself or for reasons external to the activity. For a behavior to be intrinsically motivated, it is likely that it results from motivational needs for competence, autonomy and relatedness (Deci & Ryan, 2000; Ryan & Deci, 2000). Competence refers to feelings of mastering the challenge at hand. Autonomy refers to the freedom of choosing what challenges to undertake, and relatedness refers to experiences of recognition and acceptance (Deci & Ryan, 2000). All of these motivational needs are well-documented as being commonly satisfied by playing games (Ryan et al., 2006), which is generally considered to be a highly intrinsically motivated behavior (Rigby & Ryan, 2011). Playing games is usually a voluntary behavior, conducted at one's own instigation, and thus a behavior that promotes autonomy (Ryan et al., 2006). Furthermore, encountering and overcoming challenges that are often adjusted to the optimal level for the player (see e.g. Csíkszentmihályi, 1975, 1990) is essential to gameplay, and is often considered to be a core component of games (Deterding, 2015; Ryan et al., 2006). Thus, playing games commonly provides experiences of competence as the player tackles the challenges of the game. Moreover, the player's relatedness is often catered for by social environments created either within the game or around it (Huang, Cheng, Huang, & Teng, 2018; Ryan et al., 2006).

On an overarching level, gamification can be seen to comprise of three main elements (Hamari et al., 2014): the affordances implemented to a system or service lead to psychological outcomes, and these gameful experiences further lead to behavioral outcomes, i.e. the activities and behaviors that the gamification aims to support and motivate (see Fig. 1). Furthermore, all these elements and the supported activity are situated within a certain context (Hamari et al., 2014; Huotari & Hamari, 2017; Deterding, 2015). The affordances refer to the various elements and mechanics that structure games and aid in inducing gameful experiences within the systems. The psychological outcomes refer to psychological experiences such as competence, autonomy and relatedness, or for example enjoyment and engagement, which games and gamification are commonly considered to promote. The behavioral outcomes of gamification refer to behaviors and activities that are supported through use of the gamification system, such as continued or increased physical activity in the context of exercise gamification, or better learning results in the context of education gamification.

The topic of motivational information systems and especially gamification has gained significant popularity in recent years, which has

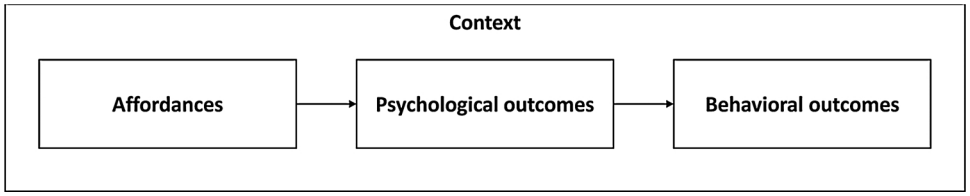

Fig. 1. Overall conceptualization of gamification following Hamari et al. (2014); Huotari and Hamari (2017) and Deterding (2015).

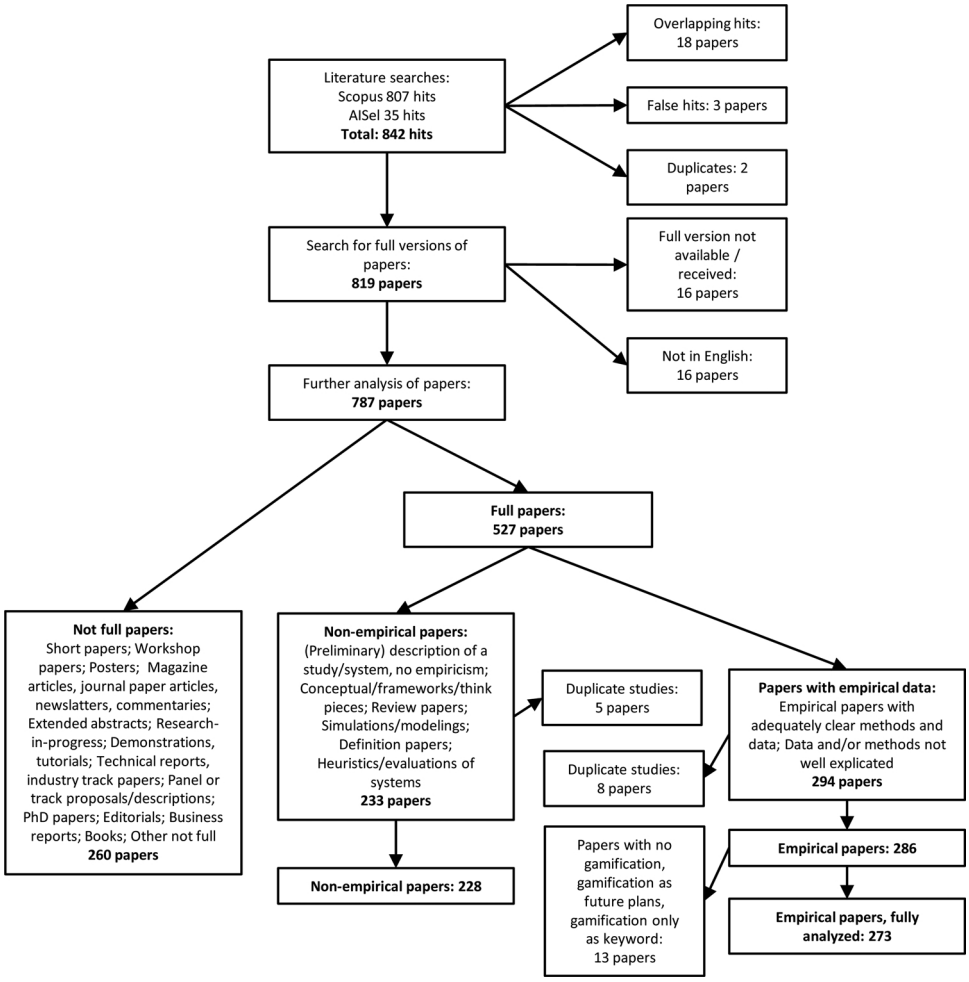

Fig. 2. Flowchart describing the literature review process.

manifested in a great amount of literature being produced on the topic from both academic and non-academic sources. The first attempts to map the literature under the flag of gamification were conducted in early 2014, and formed a review examining the then-current body of 24 peer-reviewed internationally published research papers (Hamari et al., 2014). Since then, the popularity of the topic has increased significantly and the concept has been trending among practitioners and academics. As confirmation of the growth of the topic, academic databases provide proof of the expanding volume of literature found with the keyword 'gamification'. In their review, Hamari et al. (2014) reported that a literature search in the Scopus database with the search terms 'gamification', 'gamif*', 'gameful' and 'motivational affordance' resulted in 330 hits. In June 2015, a similar literature search using only the search term 'gamif*' provided 807 hits. At the time of writing, in June 2016, the latter search provides 1767 hits. In order to maintain currency with the research area, an overview of how the field of gamification is developing is desperately needed. While some literature mapping has been conducted since the Hamari et al. (2014) review (see e.g. Seaborn & Fels, 2015), a general overview of how the phenomenon has been researched and developed is lacking.

3. The Review

3.1. Review procedure

The literature searches were conducted in the Scopus database and the Association for Information Systems (AIS) Electronic Library (AISeL), which were chosen for the reason that they index all of the other potentially relevant databases, for example ACM, IEEE, Springer, and the DBLP Computer Science Bibliography. Conducting the searches in as few comprehensive databases as possible instead of several ones is seen as preferable for purposes of rigor and clarity (see Paré et al., 2015).

The search for literature in the Scopus database was conducted using the search query: TITLE-ABS-KEY (gamif*). The search was limited to include conference papers, articles, articles in press, reviews and book chapters, in order to exclude non-academic publications. In the AISeL database, the search query 'abstract:gamif* OR subject:gamif* OR title:gamif*' was used. The search term *gamif** was chosen as it takes into account all possible forms derived from the root, i.e. the noun *gamification*, and the verb *gamify* in all its forms.

The search fields were defined in Scopus as title, abstract, and keywords, and in AISeL as title, abstract, and subject. These search parameters were used as it is considered that inclusion of the search term in the metadata would indicate that the term is actually relevant for the given paper. With these search queries, we aimed to reach all the academic literature (within the used databases) that is published under the flag of *gamification.* Inevitably, this strategy also led to hits where the term gamification was not of actual relevance to the paper, but where, for example, the abstract contained a mention of gamification as a future prospect. These hits were included in the review, but highlighted as not directly relevant and therefore not included in the full analyses.

The literature search was conducted in June 2015 and resulted in 807 hits from the Scopus database and 35 from the AISeL database. All of the hits were collected into reference management software, where

the references were managed, organized and categorized. The review process was conducted by the first author of this paper. Any cases and categorizations that were unclear were discussed amongst the research team.

On further examination, 2 hits were removed as duplicate entries in the Scopus database and 18 hits were identified as overlapping between the Scopus and AISeL search results. Of the remaining papers, 3 studies were identified as false hits where the paper concerned used the letter combination '*gamif*' to refer to something other than gamification. The final body of literature amounted to 819 papers.

The full versions of the papers were retrieved. Where papers were initially not available for us, we contacted the authors either by email or through academic social network tools such as ResearchGate and requested the full version. Around 30 papers were obtained in this way. The final number of unavailable papers was 16. Additionally, 16 of the papers were identified as not being written in English, and were therefore excluded from further analyses.

The remaining 787 papers were categorized based on the type of publication, whether the papers were full research papers, and whether they contained empirical data. Fig. 2 outlines the literature review process.

286 full papers were identified as containing empirical data. Of these, 13 were further identified as explicitly stating that the studied system contained no gamification, that gamification was part of future plans to develop the featured solution, or the paper contained a mention of the term solely as a keyword. These papers were removed from the further analyses which focused on empirical studies. The final amount of analyzed empirical papers was 273.

In the literature analysis, the studies were coded. As mentioned above, the amount of information coded from the retrieved papers depended on whether they were categorized as empirical or non-empirical. Full analyses were conducted only on empirical full papers. Table 1 outlines the details that were retrieved during the coding process from both empirical and non-empirical papers.

Following the guidelines of Webster and Watson (2002), all of the full papers were analyzed, firstly author-centrically, and then concept-centrically. The units of analysis were defined prior to the analytical process. Author-centric coding was conducted, where the pre-defined units of analysis were checked and coded for each paper as it was read. Through this procedure, a matrix of the coded literature was produced. Continuing the analysis process, a concept-centric approach was then taken where coded literature was then organized based on further units of analysis. As suggested by Webster and Watson (2002), the coded concepts were comprised into frequency tables, which form the core of this review.

Table 2
All Scopus and AISeL hits for *gamif** by year at the time of data gathering (6/2015). False hits, duplicates and overlapping hits removed.

Year	Number of hits
2011	26
2012	92
2013	263
2014	368
06/2015	70*
Total	**819**

*It is noteworthy that due to the natural delay in addition of entries to the repositories, a proportionately smaller number of studies had yet appeared during 2015 at the time of the data gathering.

Table 3
Types of not full papers (N = 260).

Types of not full papers	Frequency
Short papers, research notes	69
Workshop papers	60
Posters	28
Magazine articles, journal paper articles, newsletters, commentaries	19
Extended abstracts	17
Research-in-progress	19
Demonstrations, tutorials	11
Technical reports, industry track papers	8
Panel or track proposals/descriptions	8
PhD papers	3
Editorials	2
Business reports	1
Books	1
Other not full	14

3.2. Bibliometric descriptors

Since 2011, there has been rapidly increasing general interest in gamification, and this has also been reflected by the academic interest shown in the topic. As the literature search hits by year indicate (Table 2), the amount of academic literature on gamification has consistently risen over the past few years.

From the 819 total hits, 260 papers were identified as not being full papers (Table 3). In this category we included all the papers that, e.g. reported research-in-progress or other types of incomplete research, were not peer-reviewed, or were in other formats than research reports. Many of these papers were in fact short conference publications and workshop papers.

The full research papers were categorized based on the form of

Table 1
Details retrieved from the full papers in the reviewed body of literature.

Coded information	Non-empirical, full papers	Empirical full papers	Empirical full papers - *Quantitative experimental studies*
Bibliometric data: Author(s), publication year, publication venue	X	X	X
Type of study: Empirical, (preliminary) description of a study/system, conceptual papers; frameworks; think pieces, review papers, simulations; modelings, heuristics, definition papers	X	X	X
Domain: E.g. education, health and exercise, business and management etc.	X	X	X
Data gathering method: E.g. Implementation/prototype, interviews, observation etc.		X	X
Data type used in analyses: E.g. Log data, interview data, observation data etc.		X	X
Analysis method: Qualitative, quantitative (descriptive, inferential)		X	X
Affordances: E.g. points, narratives, social features etc.		X	X
Outcomes: Psychological outcomes, behavioral outcomes		X	X
Sample sizes			X
Results: Positive, mixed with mostly positive, null or equal positive and negative, mixed with mainly negative, negative; categorized by domain and affordances			X

Table 4
Types of full papers.

Types of papers (duplicates removed)	Frequency	%
Empirical (also unclear methods/data)	273	53.1
Explicitly not about gamification	13	2.5
(Preliminary) description of a study/system, no empiricism	105	20.4
Conceptual papers; frameworks; think pieces	84	16.3
Review papers	19	3.7
Simulations; modelings	11	2.1
Heuristics	5	1.0
Definition papers	4	0.8
Total	**514**	**100**

research reported, e.g. empirical research, descriptive non-empirical research, conceptual work, or literature reviews (see Table 4). After the removal of duplicate studies, 514 full research papers were examined to determine the type of the research conducted and reported. Of the 514 papers, 286 were identified as empirical. However, 13 of these explicitly stated that either gamification was not examined in the paper, that gamification was considered as a future possibility, or the paper simply contained gamification as a keyword without any further mentions. These studies were therefore not included in further analyses. Thus, the final analysis included 273 studies reporting empirical data that was analyzed in the paper. These publications varied greatly in terms of the extent of data gathering and analysis, ranging from large-scale or multi-year experiments to preliminary trials with only a few participants. However, all of the studies were categorized as empirical research papers for the purposes of this review, and for the purpose of gaining the widest possible overview of the research field. Papers describing a future study or a system under development were prominent (105 studies), but as these papers were identified not to contain any actual empirical data, they were excluded from further content analysis.

Conceptual papers, frameworks and think pieces (84 studies) mostly considered ideas and perspectives for developing the understanding of gamification or the study of the phenomenon. The remainder of the body of literature consisted of reviews, simulations on gamification, heuristic papers, as well as papers concentrating on defining the concept of gamification.

Of the full research papers, a clear majority (352 papers) were published in conference proceedings, and only 155 were published in a journal (see Table 5). What potentially follows from the fact that conference publications are the main venue for publication of gamification research is related to the comprehensiveness of the research work. Conference publications are usually limited in length and often not as comprehensive in their discussion of various aspects of the conducted research when compared to journal publications. Thus, the great number of conference proceedings has a potential effect on the theoretical depth of the research on gamification. In their review of gamification literature, Seaborn and Fels (2015) found that the majority of the reviewed papers did not address the theoretical foundations which guided the research, and the lack of theoretical discussions has been acknowledged as a problem in the field. Seaborn and Fels (2015) also observe a disconnection between theory and applied research in their reviewed literature. While the theoretical stances and foundations of gamification were not explicitly mapped in this review, similar observations can be made from the body of current literature; a large proportion of the research papers addressed the theoretical foundations of the work only in passing, via a definition of gamification or presenting related prior research.

Table 5
Publication venues of full papers.

Publication venue	Frequency	%
Conference	352	68.5
Journal	155	30.2
Book chapters	7	1.4
Total	**514**	**100**

Table 6
Domains in empirical, non-empirical descriptive and conceptual papers (N = 462).

Domain	Empirical papers Frequency	%	Non-empirical papers Frequency	%
Education/Learning	129	46.7	67	35.4
Health/Exercise	40	14.5	15	7.9
Crowdsourcing (includes information gathering, knowledge sharing and citizen science)	25	9.1	7	3.7
Social behavior/networking/sharing	14	5.1	2	1.1
Software development/design *	11	4.0	25	13.2
Business/Management	10	3.6	19	10.1
Ecological/environmental behavior	9	3.3	9	4.8
eCommerce/eServices	8	2.9	1	0.5
Software engineering **	7	2.5	5	2.6
Marketing/Consumer behavior	4	1.4	5	2.6
Citizen/public engagement/activity	3	1.1	2	1.1
Entertainment (includes gaming, watching TV, media capturing)	3	1.1	1	0.5
Innovation	3	1.1	2	1.1
Transportation/Mobility	3	1.1	4	2.1
Culture/Tourism	2	0.7	4	2.1
Architecture	1	0.4	0	0.0
Communication	1	0.4	0	0.0
Emergency planning	1	0.4	0	0.0
Politics	1	0.4	3	1.6
Welfare/city/human/public services	1	0.4	4	2.1
Work	1	0.4	2	1.1
Theory ***	0	0.0	12	6.3
Total	**276****		**189**	

* Studies related to design and development of gamification services.
** Software engineering as a field of work/industry.
*** Studies where gamification or an aspect related to it is discussed on an abstract/theoretical level.
**** One study contains 4 different cases in different domains. All of the 4 domains are included in the categorizations.

Nevertheless, the bibliometric descriptors of the current body of literature demonstrate the increasing amount of research that has been published on the topic of gamification. While there is no possibility of knowing whether this trend will continue, the bibliometric results may provide some perspectives which could be applied to future developments. As conference papers often present early research or developing ideas, the abundance of conference publications in the body of literature can reflect how interest in the concept of gamification will likely develop in the future. Additionally, as a large part of the literature reported work-in-progress or preliminary results, this suggests that the amount of literature will also continue to increase in the future.

3.3. Domains

Table 6 outlines the domains of empirical studies, non-empirical descriptive, and conceptual papers. Altogether, 462 research papers were analyzed for their domain. Reviews, definition papers, heuristic and simulations/modelings were excluded, since their contexts were often not clearly definable due to the type of research presented. While domains may evidently overlap (e.g. an empirical study about gamification in education may actually be more concentrated on the workload it creates for the teachers, instead of the effects it has on students), for the purposes of the review, all of the studies were assigned to a single domain which describes the general context where the gamification has

been implemented or considered.

The analysis of domains in the body of literature shows that a clear majority of the empirical research on gamification is conducted in the domain of education and learning. Second largest category of empirical studies is health and exercise, followed by research papers relating to crowdsourcing. These three categories comprise over 70% of the empirical research in the current body of literature. The fourth largest category consists of various social behavior and networking domains, followed by empirical studies which are related to the design and development of gamification services, as well as papers in the business and management domain. The remainder of the domain categories comprise less than ten empirical research papers.

Interestingly, in the non-empirical research papers, education and learning is again the most common domain, but the second largest domain is formed by studies related to the design and development of gamification services. The third most common domain of non-empirical research is business and management. Thus it can be seen that in non-empirical research which potentially contains studies at a preliminary phase of the research process, there is the promise of certain domains gaining more empirical research in the future.

In more detail, the domain of education and learning constitutes nearly half of the published empirical research on gamification, with 129 published empirical papers. In the non-empirical research, more than one third of the publications also stem from the education and learning domain. The education domain has previously been noted as the most popular gamification context for empirical research (Hamari et al., 2014; Seaborn & Fels, 2015). This review stands as further confirmation of these findings indicating that in the expanding field of online learning and training (Panigrahi, Srivastava, & Sharma, 2018) gamification has its share. The attractiveness of gamification in the education domain is rather intuitive, as games in general commonly promote learning and the developing of skills in an inherent manner, and often provide a structured environment where these skills can be practiced (see e.g. Landers & Armstrong, 2015). However, the educational domain has been somewhat riddled with conceptual unclarity as the terms of gamification, game-based learning and serious games are all commonly used to refer to the use of games in education contexts (Landers, 2015). In this review, no distinctions between the concepts were made, and any paper labeled by the authors as gamification has been considered, as specified above.

In the empirical research, health and exercise forms the second largest category for studies. Especially with activities such as healthy eating and physical exercise, extra support and a motivational push may be needed in order to maintain routines (Hamari & Koivisto, 2015a). The gamification approach has been shown to have positive results in this domain in several of the featured studies (Allam, Kostova, Nakamoto, & Schulz, 2015; Cafazzo, Casselman, Hamming, Katzman, & Palmert, 2012; Chen & Pu, 2014; Chen, Zhang, & Pu, 2014; Hamari & Koivisto, 2015a; Jones et al., 2014; Koivisto & Hamari, 2014; Riva, Camerini, Allam, & Schulz, 2014; Watson, Mandryk, & Stanley, 2013).

Furthermore, an interesting development is the large number of research papers on gamification in crowdsourcing. Research examining the combinations of these two fields has previously been mapped by Morschheuser, Hamari, and Koivisto, 2016; Morschheuser et al., 2017, who suggest that the addition of game elements for increasing the motivations of volunteer crowdsourcees is an efficient approach based on empirical research findings.

Regarding the largest domains of empirical gamification research, it can be concluded that the findings of this review support those of Seaborn and Fels (2015), who found health, crowdsourcing and social networking to be the biggest domains for empirical research of gamification, in addition to education.

As a further conclusion, based on the domains of the empirical research, it is evident that gamification seems to be implemented especially in domains where long-term commitment and perseverance are needed for gaining results. These may include learning or the development of healthy or beneficial habits. This idea is supported by the fact that education, health and e.g. domains relating to ecological behavior are among the most popular categories.

Among the non-empirical research, the prevalence of the domains differs from the pattern seen in empirical works, with the exception of education and learning. Non-empirical work has been conducted more in domains such as general software development and the design of gamification services. This is rather expected, as within a field that is still very much in development, plenty of work is required on the conceptualization and design of solutions, before it is feasible to produce empirically testable prototypes or systems. This is evident also from the noticeable number of theoretical papers, present among the non-empirical works.

Table 7
Type of empirical research.

Empirical type	Frequency	Frequency	%	%
Quantitative	165		60.4	
descriptive		*85*		*51.5*
inferential		*80*		*48.5*
Qualitative	46		16.8	
Mixed	62		22.7	
Total	**273**		**100**	

3.4. Methods and data

As shown in Table 7, the empirical research papers most frequently employed quantitative research methods. Mixed methods studies were also numerous, with qualitative research papers featuring in the minority. The category labeled as 'mixed' refers to empirical papers which combined any forms of qualitative and quantitative approach.

The quantitative research papers were further categorized based on the approach taken in their analyses, as either descriptive or inferential. The majority of the empirical quantitative research on gamification is descriptive, meaning that the analyses of the data are often reported as percentages and means drawn from the numerical data. In the inferential studies, some relationship between variables has been examined, and the results are reported. For studies using a mixed methodology, the type of quantitative analyses was not recorded. However, if studies combining qualitative and quantitative research approaches were considered, then the amounts of both descriptive and inferential quantitative research would be higher.

The prevalence of quantitative research in the empirical research on gamification is potentially due to a large part of the research being published in technical and computer science related venues, which commonly employ quantitative approaches. The small number of fully qualitative research papers (16.8% of the empirical studies) is also noteworthy, and may again be a consequence of the disciplines and research fields where the research is published. However, if the mixed methods studies are accounted for, then qualitative research approaches feature in nearly 40% of the empirical studies.

Table 8 reports the data gathering methods employed in the empirical research papers, the types of data used for their analyses, and the analysis methods that were used. The most commonly used method of gathering data (and consequently the most common form of data) was by surveys and questionnaires, with the data being analyzed either qualitatively or quantitatively. The second most common data gathering method used a system implementation or prototype, from which some form of usage or log data was gathered. Also popular were experimental settings and interviews methods. For the data types, various forms of feedback and observation data formed also large categories. Regarding the analysis methods employed, quantitative descriptive analyses as well as qualitative analyses were reported in most studies.

While there was a wide variety of data gathering methods and data types used in the analyses, the research approaches tended to

Table 8
Data gathering methods employed in the reviewed body of literature.

Data gathering method	Frequency	Data type	Frequency
Survey, questionnaire (qualitative and quantitative)	179	Survey data	167
Implementation, prototype	161	Use data, log data	128
Experiment, trial	78	Interview data	48
Interviews	53	Feedback	25
Course, learning session	18	Observation data	21
Observation	16	Test scores, assignment scores	15
Focus group	9	Audio, video recordings, photos	6
Diaries	6	Diary entries, daily reports	5
Course assignments, education related assignments, tests	6	Focus group data, discussion data	5
Data from a system or a platform (existing systems; commercial products)	5	Course attendance data, other course data	3
Workshop	4	Field notes, experiential data (phenomenological data)	3
Data mining	3	Blog texts, forum discussions	2
Video data gathering	2	Delphi method data	1
Case study	2	Psychophysiological data	1
Ethnography	2	Brainstorming data	1
Google blog search	1	**Analysis method**	**Frequency**
Audio data gathering	1	Quantitative descriptive	136
Phenomenological assessment	1	Qualitative	100
Photography	1	Quantitative modeling (T-tests, Regressions, Mann-Whitney U-test, Wilcoxon rank-sum test, Structural equation modeling, Wilcoxon signed rank test, Welch's t-test)	70
Delphi method	1	Quantitative comparisons (ANOVA/ANCOVA/MANOVA, Kruskal-Wallis)	44
Work session	1	Quantitative association-based (Correlations, Chi squares, Factor analysis, Crosstabs, Spearman's rho)	30
Contest	1	Statistical quantitative (Binomial tests, Social network analysis, Growth curve analysis, Cluster analysis, Logistic models, Fuzzy AHP, Granger causality test, Hierarchical linear modeling, Z-test for proportions)	11
Cognitive ability test	1		
Forum discussions	1		

concentrate on certain methods and data types. A popular structure for data gathering was where a gamification implementation or a prototype had been built, then a group of study participants used the implementation and some kind of usage data was gathered. The participants also tended to take part in a quantitative or a qualitative survey that was either numerical or with open-ended questions.

3.5. Affordances

Altogether, 47 different affordances were identified in the studies (see Table 9). These were subsequently grouped based on their type, into achievement/progression-oriented (10 affordances), social-oriented (7), immersion-oriented (5), real world-related (8) and miscellaneous (17) elements. On average, the 273 empirical studies examined implementations or systems with 3.5 affordances. The affordance identifications were formed, depending on how the authors referred to the elements in their paper, without further analysis on similarities or differences between the affordances featured in different studies. This decision was taken due to the amount of the reviewed papers, which would have made a more detailed analysis of the implemented affordances more challenging. Although some overlap between the individual elements may exist (e.g. displaying a score might be very tightly connected to a progress bar in a system), for the purposes of this overview, each element was assigned to only one category.

The most commonly implemented gameful affordances involve various forms of points and scoring. Also different forms of challenges, clear goals, achievements and leaderboards were among the most frequent elements. Generally in game design, points, achievements and leaderboards have been categorized as goal metrics that provide performance feedback to the player (Zagal, Mateas, Fernandez-Vara, Hochhalter, & Lichti, 2005). The prevalence of these affordances in gamification implementations is potentially due to them being easily applicable to various types of existing system (Mekler, Brühlmann, Tuch, & Opwis, 2015).

In this study, the frequency of various challenge/clear goal implementations differs from the findings of previous reviews (Hamari et al., 2014), where such affordances were not as common. In this review, all of the studies which explicitly stated to contain some form of challenge, quest, mission, task or clear goal were categorized into this group. However, it is clear that challenges and goals overlap heavily for example with badge-type affordances, which generally provide a goal to work towards (Hamari, 2017). Similarly for instance, leaderboards and levels may act as goals that a user aims to reach. Therefore, the difference between this and prior reviews with regards to the prevalence of the challenge/clear goal affordances might be due to differences in the coding of the literature.

In the reviewed literature, the application of various achievement or progression signaling affordances is generally the most common way to gamify activities. The second most frequent provision of affordances involved social elements in various forms. Especially, different features common to social networking services, e.g. friending, liking, status updates, commenting and profile pages are often implemented as gamification features. Cooperation and team-based activities also featured frequently among social affordances. Only 25 papers clearly articulated competition as an element, however, gamification implementations with leaderboards or other means of social comparison also promote a sense of competition among users. Therefore, competition as a concept is most likely to be more prevalent in actual implementations, but not necessarily specified in the research reports.

Various immersion-oriented affordances such as the use of stories and narratives, avatars, virtual worlds etc. were featured, but these were not as commonly implemented as achievement and social affordances.

The analysis of the affordances employed in the reviewed empirical literature indicates that the triad of points, badges and leaderboards continues to dominate the landscape of gamification. Several critical

Table 9
Affordances studied in the empirical research papers.

Affordances		Affordances	
Achievement/progression		**Non-digital elements**	
Points, score, XP	138	Real world/financial reward	16
Challenges, quests, missions, tasks, clear goals	91	Check-ins, location data	16
Badges, achievements, medals, trophies	85	Motion tracking	10
Leaderboards, rankings	82	Physical cards	4
Levels	59	Physical playboard	2
Performance stats (includes visualization of agreement in crowdsourcing), performance feedback	46	Real world interactive objects	1
Progress, status bars, skill trees	32	Physical objects as game resources	1
Quizzes, questions	32	Physical dice	1
Timer, speed	23	**Miscellaneous**	
Increasing difficulty	11	Full game (also board games), also commercial gamification systems not described	17
Social		Assistance, virtual helpers	15
Social networking features	49	Virtual currency	10
Cooperation, teams	47	Reminders (to create engagement), cues, notifications, annotations	9
Competition	25	Retries, health, health points	7
Peer-rating, also betting to review work of others	17	Onboarding (safe environment to practice the rules), benefits for beginners	3
Customization, personalization	7	Adaptive difficulty	3
Multiplayer	3	Game rounds	2
Collective voting	1	Warnings	1
Immersion		Penalties	1
Avatar, character, virtual identity	29	Game slogans	1
Narrative, narration, storytelling, dialogues, theme	22	Funny movies	1
Virtual world, 3D world, game world	14	Virtual pets	1
In-game rewards	13	Trading	1
Role play	6	Making suggestions	1
		Virtual objects as augmented reality	1

views regarding the prevalence of these elements have been voiced, suggesting that employing such affordances without further consideration of the context or the users results in mere "pointsification" of the activities (see Deterding, 2015). One reason for the continued popularity of these elements may be that inserting them as an additional layer to an existing system can be achieved without undue effort (Mekler et al., 2015). Another potential explanation for the popularity of the blueprint design of points, badges and leaderboards may be that many gamification design guides and frameworks approach gamification design from a pattern-based perspective (Seffah & Taleb, 2012), and suggest designing gamification implementations by basically choosing the affordances from a given list of elements (Deterding, 2015).

In reality, gamification is difficult to design for three main reasons: 1) games are complex, multifaceted, and therefore difficult to holistically transfer to other environments; 2) gamification involves motivational information system design (Hamari, 2015) which entails an understanding of (motivational) psychology; and 3) the goal of gamification is often to affect behavior, and this adds yet another layer to the scope of gamification design. Moreover, gamification design is targeted to a variety of audiences and activities, as well as serving a range of motivational needs which individuals may have in the varying gamified contexts. Deterding (2015) highlights the tendency of gamification guides and frameworks to promote the idea of a certain design pattern leading to a specific effect. However, as Deterding (2015) notes, from a psychological perspective, the motivational effect of every given situation is the result of "situated, active interpretation". In other words, how an individual perceives the gamification is highly dependent on the nature of the activity, the contextual factors related to it, as well as the specific situation where the system is being used - all in addition to the individual's own personal and demographic characteristics.

As called for by Hamari et al. (2014), some studies looking at individual elements and their effects have started to appear (see e.g. Mekler et al., 2015; Christy & Fox, 2014). These studies have provided valuable information for research and practice by examining a specific relationship between an affordance and an outcome. Given their context dependency, the results of such studies are not universally applicable to all gamification settings, but they still provide much needed support for making design choices.

3.6. Outcomes

The empirical studies were examined for any psychological and behavioral outcomes that were featured in the papers (reported in Tables 10 and 11 respectively). Psychological outcomes were quantitatively studied in 138 of the 273 empirical studies. The analysis of psychological outcomes indicates that the empirical research on gamification is mostly interested in how gamification implementations are perceived and experienced as systems, whether they are enjoyable or useful, and whether the users feel motivated by the systems.

Most commonly, the empirical research papers examined perceptions of using a system, some specific system features, or some other assessments of use experiences. In a large portion of the studies, an implementation or a prototype had been developed and was subsequently studied with its users, so it is not surprising that inquiries regarding user experiences and perceptions are commonplace.

Other frequently studied psychological outcomes reflect the most common reasons for implementing gamification. As games are generally associated with experiences of enjoyment, the application of gamification is often laden with an intention of creating enjoyment for the user. Enjoyment and experiences of "fun" were the second most frequent psychological outcome featured in the empirical research papers. Similarly, gamification is commonly framed as a method for increasing motivation towards various activities and tasks. Consequently, many of the empirical studies examine motivation as a psychological outcome.

Further aspects such as perceived usefulness or effectiveness, or the ease of use or effort required to use a system were frequently examined as psychological outcomes. According to theories on technology acceptance and adoption, these aspects are considered to be important determinants for the continued use of various systems.

Social aspects were also studied in many of the empirical research

Table 10
Psychological outcomes studied in the empirical research papers.

Psychological outcomes		Psychological outcomes	
Overall assessment / general attitude of the use of the gamified system		**Social interaction**	
Perceptions of use, use experience, perceptions of system and features	54	Subjective norm, social influence	7
Preference of system type/features	7	Recognition	5
Perception of course, perception of gamification in education	4	Relatedness	4
Affective		Reciprocity	3
Perceived enjoyment, fun	34	Network effects	3
Engagement	12	Perceived socialness, social context	3
Affect, emotional experience	7	Perceived competition	3
Flow	6	Social comparison	1
Playfulness	3	Social skills	1
Immersion	2	**Psychological states and traits / personality features**	
Cognitive		Motivation (also orientation towards various motivations)	25
Perceived usefulness, perceived effectiveness	23	Interest	10
Perception of learning	8	Perceived competence	9
Perceptions of additional benefits, customer ROI	6	Autonomy	4
Involvement, participation	2	Quality of life, flourishing	4
Perception of contribution	1	Empowerment	3
Effort in use / Experienced challenge		Awareness	3
Ease of use	14	Personality, user types	3
Effort, perceived difficulty, challenge	10	Mood	2
Perceived stress, cognitive load	4	Self-efficacy, confidence	2
Frustration, annoyance	3	Attentional bias	1
Workload	3	Anxiety	1
Perceived physical exertion	1	Perceived control	1
Attitude		Familiarity	1
Satisfaction	8	Identification	1
Attitude	7	Loyalty	1
Predisposition to changes	1	Disengagement	1
Comfort with sharing data	1	Vigilance	1
Perception of one's work	1	Focus	1

Table 11
Behavioral outcomes studied in the empirical research papers.

Engagement/interaction with the system		**Physical etc. measures**	
Behavioral outcomes		Behavioral outcomes	
Participation in a system, system use	39	Physical activity	10
Use intentions, willingness to use, intentions to continue activity	13	Health care activity	6
Participation in discussions	10	Medication over/misuse	2
Course material views, downloads	9	Stress level	2
Course attendance, exam attendance	6	Energy use in exercise, intensity of exercise	2
Effects of gamification on site use	1	Psychophysiological measures	2
Purchase intentions	1	Anxious behavior	1
Knowledge transfer	1	Mental processes	1
Performance		Pain burden	1
Speed, time	34	**Social interaction**	
Amount of contributions/content produced	27	Cooperation	4
Course grade, assignment grade, academic performance	26	Social actions	3
XP, points, score gained	17	Word of mouth	2
Quality of contributions	16	Requests for help	2
Learning, skill progression	12	Recommending intentions	1
Badges earned, tracking of badges	12	Size of network, amount of friends	1
Number of assignments, amount of contributions in class	7	Agreement over content	1
Number of attempts	5	**Miscellaneous**	
Accuracy	3	Ecological behavior	3
Leaderboard positions	3	Functionality of software	3
Acting on time	2	Retention and attrition of users	2
Number of transactions, number of trade proposals	1	Disease knowledge	1
		Behavioral strategies	1
		Behavior change	1
		Amount of problems	1

papers, but there was a wide variation in how the associated variables were measured or studied. Social influence or subjective norms (i.e. one's perceptions of the opinions of meaningful others: Ajzen, 1988, 1991; Fishbein, 1979; Fishbein & Ajzen, 1975) are the most commonly investigated social aspects. The recognition from others and the sense of relatedness with other system users were also frequently studied.

The variety of psychological outcomes in the empirical research is vast, however, due to the wide dispersion of the research models, there is no notable accumulation of knowledge from any given perspective. For example, enjoyment/fun, or usefulness/effectiveness outcomes are often examined with specific instruments developed for a particular study. Furthermore, while many studies have examined, e.g. the perceptions of use of a certain system, these results tend to be specific to the system, and thus do not provide much possibility for generalization.

Compared to the psychological outcomes studied in the empirical papers, the variety of behavioral outcomes (studied in 166 of the 273 empirical papers) is more limited. A clear majority of the empirical works studied interaction with a system, or some specific performance-metric related to its use. Among these metrics, time-related variables for performance were the most frequently examined. Also, a measurement of the amount and quality of contributions to a system was seen to be common.

The behavioral outcomes also reflect the popularity of education as the main domain for the study of gamification. Course or assignment grades, and other forms of measuring academic performance were among the behavioral outcomes that were more frequently studied.

Badges, points, and leaderboards are often considered to be the blueprint of gamification, as many gamification implementations rely on them as affordances. The more frequently examined performance-related outcomes also include the number of badges or points gained, or leaderboard positions.

The psychological and behavioral outcome categories both feature a wide variety of different aspects that have been studied, but even within the outcomes that have been grouped together for this review, there is considerably little consistency across measurement instruments. Even though gamification implementations and their outcomes are highly dependent on context, an improved consistency of how outcomes are measured would increase the comparability of research results, despite their differences in implementation.

3.7. Results in reviewed literature

In their 2014 review, Hamari et al. (2014) noted that the research on the topic of gamification showed several methodological shortcomings. Hamari et al. suggested for example paying attention to samples sizes, experiment timeframes, the use of validated measurement instruments, and the use of controls in experimental studies in future research. Several studies have since acknowledged these suggestions, and have sought to strengthen the depth of research by addressing known gaps (see e.g. Hanus & Fox, 2015; Mekler et al., 2015).

In this review, only the results and the sample sizes from experimental quantitative studies (N = 66) were analyzed, and not those of the whole body of empirical studies. This decision was made in order to limit the analysis to studies where hypotheses were tested, and thus clear indications of the results were provided.

Within this group of controlled experimental quantitative studies, the median sample size was 74.5 and the sample mean was 1165. The sample sizes ranged from 1 to 42,724. A clear increase in the sample sizes is thus visible when compared to the earlier review by Hamari

Table 12
Results of the controlled experimental quantitative studies by domain. The number in italics refers to the percentage from the total number of papers in the given domain.

Domain	Positive	Mixed with positive	Null or equally positive and negative	Mixed with negative	Negative	Sum
Education/Learning	10 *35.7*	9 *32.1*	7 *25.0*	1 *3.6*	1 *3.6*	28
Health/Exercise	4 *30.8*	7 *53.8*	2 *15.4*			13
Crowdsourcing (includes information gathering, knowledge sharing and citizen science)	1 *9.1*	7 *63.6*	2 *18.2*	1 *9.1*		11
Ecological/environmental behavior	1 *33.3*	2 *66.7*				3
Social behavior/social networking/social sharing	2 *66.7*	1 *33.3*				3
Marketing/Consumer behavior		2 *100.0*				2
Business/Management		1 *100.0*				1
eCommerce/eServices			1 *100.0*			1
Innovation		1 *100.0*				1
Software development/design					1 *100.0*	1
Transportation/Mobility		1 *100.0*				1
Work	1 *100.0*					1
Total	**19** ***28.7***	**31** ***47.0***	**12** ***18.2***	**2** ***3.0***	**2** ***3.0***	**66**

et al. (2014) where sample sizes were seen to include around 20 study participants. However, it should be noted that in their study, the body of literature contained empirical research in general, while in this review, sample sizes were analyzed only for a particular type of empirical research papers. Including the whole body of current empirical literature in the analysis could change the median sample sizes reported here, however, improvements are clearly visible in this area.

The results reported in the 66 identified controlled experimental quantitative studies (Table 12) show that while positive research findings are frequent (reported in 28.7% of the papers), a clear majority of the studies still report somewhat mixed results, i.e. the papers report negative or inconclusive results in addition to positive results. In order to further examine the mixed results, they were categorized as either 'Mixed with positive', 'Null or equal positive and negative' or 'Mixed with negative', depending on whether the majority of tests had yielded positive or negative results. Based on this analysis, mixed but mainly positive results can be seen to have been reported in nearly half (47.0%) of the 66 controlled experimental studies. Fully negative results were only reported in 2 of the 66 quantitative experimental studies.

The results of the controlled experimental quantitative studies were also analyzed by grouping the results by study domain, and also categorizing the results based on the affordances employed in the studies. Grouping the results by domain shows that in the largest domain of education/learning, most of the studies reported fully positive results (35.7%, 10 studies of 28), and mixed but mostly positive results were reported in nearly as many studies (32.1%, 9 studies of 28). In the next largest domains (health/exercise and crowdsourcing), most of the studies report mixed but mostly positive results. For the rest of the domains, the number of the studies in each domain was 3 or less, so no meaningful conclusions could be drawn.

The results of the studies were also grouped by the affordances they employed (see Table 13). It is evident that within this set of studies, the triad of points, badges and leaderboards form the top three most common affordances. Drawing further conclusions based on the relationships of the implemented affordances and the results of the studies is difficult, as most of the studies have examined the effects of a gamification system as a whole, or tested several affordances at once. Thus, there is little possibility of identifying which of the affordances actually produced the effects. However, this is not a new observation, and has previously been acknowledged as a problem within the field of gamification research (see e.g. Hamari et al., 2014).

We also identified controlled experimental studies in which the effects of certain affordances had been controlled for (see Table 14). In the current body of controlled experimental studies, only 11 of the 66 studies examine the effects of only a single affordance at a time. Among these, the most studied affordances are points, badges and leaderboards, with points being examined in 4 papers, badges or other achievements in 4 papers, and leaderboards or rankings in 4 papers.

The finding that most of the controlled experimental studies reported mixed results implies that some effects of the featured gamification experiment were positive, while others showed inconclusive or negative effects. This provides further support to the conclusions of previous gamification reviews (Hamari et al., 2014; Seaborn & Fels, 2015) that gamification is not a silver-bullet type of solution for achieving positive results and success, in either the research sphere, or in practice.

The small number of studies with fully negative results is however interesting. The possibility of a publication bias (as mentioned in Hamari et al., 2014) must be taken into account when considering these findings, and authors as well as publication venues may be more likely to publish positive rather than negative or inconclusive results. Whether such a phenomenon has had a significant effect on the current body of literature is not known.

4. Future Research Agenda

This review has presented thus far the most comprehensive and widest look at gamification research; a field which has seen noteworthy increases in the past few years. The reason for conducting such a wide review was twofold: Firstly, attaining a wide overview of the developing field is beneficial for comprehending how gamification research has developed, and what type of knowledge has been gained; and secondly, taking an overarching look at the literature can offer valuable information that will guide future research endeavors (see Paré et al.,

Table 13
Results of the controlled experimental quantitative studies by affordances implemented in the studies. The number in italics refers to the percentage from the total number of papers featuring the given affordance type.

Affordances	Positive	Mixed with positive	Null or equal positive and negative	Mixed with negative	Negative	Sum
Points, score, XP	11	18	4	1	1	35
	31.4	*51.4*	*11.4*	*2.9*	*2.9*	
Badges, achievements, medals, trophies	9	9	5	1	1	25
	36.0	*36.0*	*20.0*	*4.0*	*4.0*	
Leaderboards, ranking	7	10	5	1	1	24
	29.2	*41.7*	*20.8*	*4.2*	*4.2*	
Challenges, quests, missions, tasks, clear goals	7	8	2	2		19
	36.8	*42.1*	*10.5*	*10.5*		
Performance stats (includes visualization of agreement in crowdsourcing), performance feedback	4	8	1			13
	30.8	*61.5*	*7.7*			
Levels	2	5	3	1		11
	18.2	*45.5*	*27.3*	*9.1*		
Timer, speed	5	3	1	1		10
	50.0	*30.0*	*10.0*	*10.0*		
Social networking features	4	4	1	1		10
	40.0	*40.0*	*10.0*	*10.0*		
Real world/financial reward	1	7	1			9
	11.1	*77.8*	*11.1*			
Narrative, narration, storytelling, dialogues, theme	4	4		1		9
	44.4	*44.4*		*11.1*		
Progress, status bars, skill trees	5	2	1			8
	62.5	*25.0*	*12.5*			
Competition	5	3				8
	62.5	*37.5*				
Cooperation, teams	2	4	1	1		8
	25.0	*50.0*	*12.5*	*12.5*		
Quizzes, questions	1	4				5
	20.0	*80.0*				
Assistance, virtual helpers	2	2			1	5
	40.0	*40.0*			*20.0*	
Full game (also board games), also commercial gamification systems not described		3	2			5
		60.0	*40.0*			
Increasing difficulty	3				1	4
	75.0				*25.0*	
Avatar, character, virtual identity,	1	2	1			4
	25.0	*50.0*	*25.0*			
Virtual world, 3D world, game world, simulation	1	3				4
	25.0	*75.0*				
Reminders (to create engagement), cues, notifications, annotations		2	1			3
		66.7	*33.3*			
Motion tracking		3				3
		100.0				
Customization, personalization		2		1		3
		66.7		*33.3*		
In-game rewards	1	1				2
	50.0	*50.0*				
Virtual currency	1	1				2
	50.0	*50.0*				
Check-ins, location data	1	1				2
	50.0	*50.0*				
Warnings	1					1
	100.0					
Adaptive difficulty	1					1
	100.0					
Retries, health, health points		1				1
		100.0				
Collective voting	1					1
	100.0					
Physical dice	1					1
	100.0					
Physical cards	1					1
	100.0					
Physical play board	1					1
	100.0					
Game rounds	1					1
	100.0					
Total	**84**	**110**	**29**	**11**	**5**	**239**

Table 14
Controlled experimental studies examining the effects of one affordance at a time.

Reference	Domain	Affordances	Studied psychological outcomes	Studied behavioral outcomes	Results
Attali & Arieli-Attali, 2014	Education	Points, score, XP Timer, speed Quizzes, questions		Accuracy Speed, time	Mixed results with mostly positive
Buisman & van Eekelen, 2014	Education	Points, score, XP Leaderboards, rankings	Motivation (also orientation towards various motivations) Perceived enjoyment, fun Engagement Involvement, participation	Number of assignments, amount of contributions in class Course grade, assignment grade, academic performance XP, points, score gained	Mixed results with mostly positive
Choi et al., 2014	Crowdsourcing	Real world/financial reward	Perceived enjoyment, fun	Amount produced Quality of contributions	Mixed results with mostly positive
Christy & Fox, 2014	Education	Leaderboards, rankings	Identification		Null results or equally positive and negative results
Hakulinen, Auvinen & Korhonen, 2013	Education	Badges, achievements, medals, trophies		Speed, time XP, points, score gained Badges gained, tracking of badges	Mixed results with mostly positive
Hakulinen, Auvinen & Korhonen, 2015	Education	Badges, achievements, medals, trophies	Perceptions of use, use experience, perceptions of system and features	Speed, time XP, points, score gained Badges gained, tracking of badges Number of attempts	Null results or equally positive and negative results
Hamari, 2013	Ecommerce	Badges, achievements, medals, trophies		Badges gained, tracking of badges Social actions Number of transactions, number of trade proposals	Null results or equally positive and negative results
Landers & Landers, 2015	Education	Leaderboards, rankings		Speed, time Course grade, assignment grade, academic performance	Positive results
Long & Aleven, 2014	Education	Badges, achievements, medals, trophies Retries, health, HPs	Perceived enjoyment, fun	Learning, skill progression	Mixed results with mostly positive
Mekler et al., 2013	Crowdsourcing	Points, score, XP Levels Leaderboards, rankings	Motivation (also orientation towards various motivations) Perceived competence Autonomy	Speed, time Amount produced Quality of contributions	Mixed results with mostly positive
Thom, Millen & DiMicco, 2012	Social networking	Points, score, XP	Amount produced		Positive results

2015). Therefore, within the next sections, we provide an agenda for future gamification research. The agenda is divided into three sections: thematic, theoretical and methodological agendas. As concrete conclusions, we formulate 15 agenda points (five from each perspective) suggesting future directions and foci for gamification research.

4.1. Thematic agenda

Based on the analysis of the reviewed literature, it is clear that the empirical research has concentrated mainly on education and learning, as well as health and exercise. In other words, research has focused on domains where activities and behaviors typically demand long-term perseverance, where activities are complex and multifaceted, goals are difficult to set, and progress is challenging to track and quantify; activities that are commonly riddled with procrastination and other inefficiencies. Based on the amount of research, gamification is considered as both applicable and beneficial for these types of activities, where continuity and long-term engagement is often needed for gaining lasting results.

In addition to the domains that prevail in the body of literature, thematically, a large portion of the existing research is aimed at supporting individualistic motivations such as self-care and self-management. Encouraging communal engagement and cooperative activity is considerably less studied, but would provide an interesting potential avenue of research. This thematic gap can be noted on the level of affordances, as well as on the level of domains. The most commonly implemented affordances such as points and leaderboards often require that other users exist in the system and that one can compare results, but the emphasis of these affordances is still on individual development and progress. Affordances supporting collective behavior, such as cooperation, teams or networking are considerably less used elements in current gamification implementations. On the level of domains, contexts such as learning and health would evidently benefit from collective or cooperative perspectives, but domains that specifically look to support collective activity or well-being, such as citizen engagement for communal development, are clearly in the minority.

As social human beings, we seek senses of relatedness (Deci & Ryan, 2000; Deci & Ryan, 1985; Ryan & Deci, 2000) and collectivity, so collaboration and cooperation are natural behaviors for us to engage in. However, inducing collaboration is a well-known challenge. This is especially so in complex contexts such as societal activities, which are abstract and difficult to perceive, and may easily seem irrelevant to one's everyday life. Games, however, are well-known for their ability to induce collaborative behavior, even among complete strangers, and this is often seen in online multiplayer games. There is ample evidence which indicates that people enjoy playing together (Chen, Sun, & Hsieh, 2008; Cole & Griffiths, 2007; Scharkow, Festl, Vogelgesang, & Quandt, 2015; Teng & Chen, 2014; Teng, 2017; Yee, 2006), and collaboration often emerges seamlessly, effortlessly and organically. Therefore, instead of focusing strongly on individual motivation and behaviors, gamification research could also be beneficial in increasing our understanding of how to induce and maintain collective and collaborative behaviors.

Some interesting glimpses of collective level affordances and goals already exist within the gamification research field. Jones et al. (2014) report a study featuring a gamification system for motivating schoolchildren to consume more fruit and vegetables during school lunches. Their study included school-wide collective goals, cooperative action and collective rewards. Another example comes from Laureyssens et al. (2014), who reported a study on citizen engagement. Through various gameful affordances (including teams and cooperation), they aimed for "augmenting community participation in urban neighborhoods" (Laureyssens et al., 2014). In the field of knowledge and information management, Araújo and Pestana (2017) report their work seeking to support social well-being, team work and skills management in an organizational context via gamification. Moreover, Morschheuser, Hamari and Maedche (2018) revealed that gamified solutions combining both cooperative and competitive structures may prove most effective. More research is, however, needed to better understand how gamification can be harnessed for inducing collective and collaborative behavior.

Thematic agenda point 1) *Future gamification research should seek to explore the possibilities of cooperative and collective gamification approaches.*

Based on the findings of this review, current gamification research is mainly focused on implementing "the blueprint" of gamification: i.e. points, badges and leaderboards (See Table 9; Deterding, 2015; Hamari et al., 2014). However, when considering games, the diversity of elements they contain is vast. Unfortunately, in gamification design, this is often ignored and the implementations are reduced to a replication of the blueprint triad (see e.g. Deterding, 2015). In the current gamification research, progress and achievement-oriented affordances are clearly the most commonly used, whereas e.g. immersion-related affordances (such as narratives and avatars) are much less frequent.

While gamification is promoted as inducing experiences characteristic to games, in non-gameful contexts, the limited perceptions of gamification design signal a limited perception of gameful experiences in general. Most gamification designs are currently focused on achievement-oriented mentalities, and the type of experiences and motivations they afford. However, research on the motivations to play games indicates that the drivers of the behavior are considerably more diverse; and while some players play games for achievement-related gratification, some are motivated by social aspects, some by immersing themselves into stories and roleplay, and some by a combination of these elements (see e.g. Hamari, Hassan & Dias, 2018; Hamari & Tuunanen, 2014; Kallio, Mäyrä, & Kaipainen, 2010; Yee, 2006). Therefore, aiming to comprehensively explore gameful experiences and design gamification to cater for a wider variety of motivations is a theme that may be considered in future research (see Morschheuser, Hassan, Werder, & Hamari, 2018 for a gamification design review).

Beyond the diversity of experiences that game mechanics afford, there have also been new developments in gaming technology. For example, recent developments and successes in virtual reality technology and other forms of immersive, reality-augmenting designs (e.g. those implemented in the recent Pokémon Go game), may offer interesting future directions for gamification research. There are signs that this is beginning to happen, and interesting findings on virtual and augmented reality based gamification has been published in the contexts of education (Reitz, Sohny, & Lochmann, 2016) and health (Yates, Kelemen, & Sik Lanyi, 2016).

Thematic agenda point 2) *Future gamification research should seek to diversify the use of gameful affordances, and concurrently develop an understanding of what constitutes and creates gameful experiences.*

It is notable that gamification research is highly concentrated in terms of the domains in which it is investigated. The popularity of the domains of education and learning as well as health and exercise has been highlighted in this review. Especially, the depth and breadth of research in the education and learning domain sets an example for future research; in addition to the sheer number of research papers, studies conducted in the education field range from testing a single gamification element in a controlled experiment (e.g. Denny, 2013; Christy & Fox, 2014), to large scale gamification of semester-long classes or courses (e.g. Hanus & Fox, 2015; de-Marcos et al., 2014). Other domains such as crowdsourcing, social behavior and networking, and software development have also started to gain a place in the research field, but the majority of these domains have only been investigated by a handful of studies. Furthermore, while the potential of motivational systems such as gamification has been largely noted in information management and general information system science fields (see e.g. Liu et al., 2017; Hamari & Koivisto, 2015a; Araújo & Pestana, 2017; Blohm & Leimeister, 2013; Morschheuser et al., 2017), the extent of empirical research examining e.g. gamification in management and

business contexts is still very limited. Beyond the fact that some specific domains remain understudied, the narrow scope of domains sheds a shadow on the entire field of gamification research. Heavy emphasis only in a few domains affords an unbalanced view of how gamification works. The reason for this is that the contextual factors affect the outcomes of the gamification in the different domains and therefore, applying results from one field to another might not provide similar results.

Moreover, domains such as citizen and public activity, or welfare and social services, are contexts which increasingly call for engagement and collaborative approaches (see e.g. Bista et al., 2014; Sanchez-Nielsen & Lee, 2013). However, these domains have not yet attracted the attention of researchers to any significant degree. Evidently, the gamification of domains such as citizen and public activity requires ways of engaging large groups of people with varying characteristics and backgrounds, and is therefore a challenging task. Nevertheless, by accepting the challenges and tackling the issues found in these domains, more impactful gamification solutions could potentially be developed.

Thematic agenda point 3) *Future gamification research should seek to widen its thematic perspective with respect to the domains which are being investigated.*

Gamification commonly is focused on the positive impact of technology on human motivation and behavior (see e.g. Deterding, 2015; Seaborn & Fels, 2015): research has tended to take a myopic and narrow view that has zoomed in on the benefits that can be derived from gamification. As scholars have assumed and expected positive effects from gamification, the research settings and experiments have so far lacked resolution to detect any negative effects that extend beyond the confines of the dependent variables in any given study. This is also indicated by the relatively small portion of studies that have either reported or acknowledged negative results in the research literature (Table 12; Hamari et al., 2014; Seaborn & Fels, 2015). Nevertheless, a large part of the theoretical discussions indicate that gamification can also have adverse effects. For example, although game elements are often implemented in order to create positive affect, many of the affordances may, for example, increase the sense of competition, even if creating this type of experiences was not the actual goal. A competitive environment may potentially discourage users, and thus have detrimental effects on the activity that the gamification originally aimed to support (Liu et al., 2013; Santhanam et al., 2016; Vesa et al., 2017). Furthermore, the goal of gamification commonly is to provide structure to activities, and to divide them into steps with clear and attainable goals (see e.g. Hamari, 2013; Landers & Armstrong, 2015). In the terms of Caillois (1961): gamification brings activities to the ludus end of the ludus (structured play) – paidia (freeform play) continuum. While the structuring provided by a gamified system may help users to reach set goals, it may also limit the means by which they can be reached. When provided with paths of action that are too concrete or strictly defined, then creative action and thinking may diminish. This can further harm the activities that the gamification was intended to support. This is noteworthy especially in organizational contexts, in domains related to management and work. As highlighted by Liu et al. (2017), the gamification aspects implemented to an information system should not obstruct the instrumental goals of the system.

Moreover, given the ubiquity of gamification and quantification in practically all fields of modern-day life, our lives are being increasingly measured and monitored, be it for our own self-interest or for the interests of some other organization or entity. How this increasing presence of gamification and quantification will affect our lives on a more holistic level is still unclear.

Thematic agenda point 4) *Future gamification research should seek to explore the potential negative, adverse or non-preferable effects of gamification and how to mitigate them.*

It is clear that gamification emerged as a technological phenomenon, and especially as a phenomenon of human-computer interaction. Gamification is primarily thought to entail computers and software that affect people (and more specifically the explicit elements which feature in contemporary games). This is natural if we consider that gamification mainly arose from the success and popularity of video and online games during recent decades (Vesa et al., 2017). However, if we think about games more universally and from a historical perspective, then digital games are also a rather new phenomenon (Mäyrä, 2008). In the past, games have commonly consisted of rituals and other non-artefact driven activities constructed by human dynamics, and within different forms of organizing (see e.g. Huizinga, 1955). However, if we consider the variety and degree of gamification, we can immediately notice that this broader perspective is almost completely absent, both in terms of temporality and technology (see e.g. Hamari et al., 2014; Seaborn & Fels, 2015). So, what if we could broaden our understanding and perspective of how gamification can be manifested? What if we could conceptualize that gamification is not only an (information) technology or human-computer interface, but also a social innovation which stems from how social dynamics are being shaped and how organizations are being structured. Thus, as well as borrowing game design from games, we should also be borrowing player and organizational practices (Vesa et al., 2017).

Thematic agenda point 5) *Also relating to the theoretical agenda, we suggest future gamification research considers gamification not only as an innovation of human-computer interaction or information system, but also as organizational and individual practices reminiscent of those which may be observed in games.*

4.2. Theoretical agenda

Gamification is a new area of research in information systems, and in addition to the obvious thematic gaps that exist, gaps also exist in our theoretical and conceptual understanding of the phenomenon. This not only leads to a partial view of gamification, but also to biases and shortcomings in research designs which are deployed in the investigation of gamification. Therefore, future research should seek not only to fill the thematic gaps, but also to address the following theoretical gaps which overshadow current research efforts.

The strongest focus in the discussions around gamification centers around the effects of gamification on human behavior (see e.g. Tables 10 & 11 ; Seaborn & Fels, 2015). Considering that the main premise behind gamification is to affect motivations and behavior (Huotari & Hamari, 2017), this focus is evident and intuitively understandable. Therefore, it might not be surprising that significantly less attention has been paid to issues and aspects which precede the effects of gamification. This indicates that neither the theoretical nor the empirical issues of the overall gamification context are yet complete. If no attention is paid to the determinants which lie behind the success of the phenomenon, outside the gamification affordances themselves, then we will fail to see the forest for the trees. For example, while gamification might have positive effects on the users who choose to adopt it, what will be the effect on the bulk of users who will not adopt the gamification features? Some research has already begun to explore issues such as the adoption of gamification (Hamari & Koivisto, 2015a, 2015b; Herzig et al., 2012), moderating demographic factors (Bittner & Schipper, 2014; Koivisto & Hamari, 2014), and the effects of personality (Butler, 2014; Hall, Glanz, Caton, & Weinhardt, 2013). However, these studies have only begun to scratch the surface of the contextual and individual aspects which affect gamification use. Targeting specific questions relevant to e.g. certain demographic groups could yield new interesting veins of research, such as the work by Talaei-Khoei and Daniel (2018) exploring the benefits of gameful interactions for cognitive abilities and transferability of these abilities for seniors. Therefore, the future research agenda on gamification should look to expand its focus in a way that gamification research becomes less tightly focused on the affordances and outcomes of gamification, and also investigates aspects that precede the effects of gamification on human behavior and motivation, such as attitudes and beliefs or personality and demographic issues.

Research investigating the different determinants of why people play different types of games could prove useful in these endeavours (e.g Hamari & Keronen, 2017).

Theoretical agenda point 1) *Future gamification research should pay more attention to the pre-determinants/requirements of gamification success, instead of only the effectiveness of gamification for those users who have already chosen to adopt it.*

Moreover, gamification applications are inherently motivational information systems that attempt to support people in their goals and tasks related to the system use (Hamari & Koivisto, 2015b). In more specific terms, gamification can be seen to make goals more SMART (Burke, 2014; Hamari, 2013, 2015); that is, more Specific, Measurable, Attainable, Realistic and Time-bound. According to goal-setting theories and decades of research, such goals assist individuals towards the attainment of their objective (Locke & Latham, 2002; Mann, De Ridder, & Fujita, 2013). This phenomenon has been observed and postulated in the context of gamification in various works (Burke, 2014; Hamari, 2013, 2015; Landers, Bauer, & Callan, 2015). Although several studies have discussed the relationship between gamification and goal-setting (see e.g. Hamari et al. 2018), there is a current dearth of literature relating to goals themselves in gamification. Therefore, for a future agenda on gamification, we suggest an investigation into the relationship of the effects of gamification, depending on what kinds of goals users have, how goal-oriented they are, and what kinds of tasks they look to accomplish. Users do not share the same types of goals, nor do they have the same orientations toward them. For example, some users may be more oriented towards the outcomes of goals, whereas other users are more concerned about the process of reaching their goals (Locke & Latham, 2002; Mann et al., 2013). Therefore, a pertinent question is what kinds of gamification initiatives might be better suited to users, depending on their goals and the orientation they have towards them? Goals differ regarding their defining characteristics, for example in their difficulty or specificity (Elliot & Harackiewicz, 1994; Freund, Hennecke, & Riediger, 2010; Mann et al., 2013), hence they differ in their attainability and goal seeking outcomes (Freund et al., 2010; Hackel, Jones, Carbonneau, & Mueller, 2016; Landers et al., 2015; Lunenburg, 2011; Mann et al., 2013). Therefore, the design principles will differ depending upon the goals they address, and a single design solution cannot be expected to fit every situation (Koivisto & Hamari, 2014; Mann et al., 2013; Wang, Schneider, & Valacich, 2015).

Theoretical agenda point 2) *Future research into the effectiveness and adoption of gamification should take into account the role of the user, their goals (within the information system), and their individual attributes.*

In addition to the factors related to users, the usage context as well as the nature of the gamified service need to be given more attention. How the users perceive the gamification is highly dependent not only on the users' characteristics, but also on how they perceive the context for the gamification (the domain or the environment where the gamification takes place), as well as the specific activity they are encouraged to perform (see e.g. Hamari, 2013). Gamification has been heavily implemented in the education context where it seems to fit rather intuitively: learning new skills, especially in an institutional setting such as a school, has traditionally been imbued with a similar structure, i.e. progressing in steps and receiving feedback for each step. Thus, the gamification of such a context does not feel particularly inappropriate or awkward. However, when gamifying areas such as health or social services, the context is evidently a lot more sensitive. For example, the gamification of an eCommerce service might be perceived differently than the gamification of a social networking service. The former is potentially perceived as a very utilitarian context, and playful or gameful elements might lessen the perception of seriousness and divert the customers away from the service. However, gamifying a social networking service would not cause such a reaction, due to the context being more casual in the first place.

The lack of acknowledging the contextual factors in research suggests a lack of the theoretical understanding surrounding the phenomenon; the factors affecting human behavior, which in the case of gamification is more often than not the focus of the systems and the research conducted on them. When not acknowledging, for example, the environment of the gamification as well as the specific characteristics of the gamified activity, we risk producing research results which in reality are not applicable outside the very specific setting of a given study. Moreover, we ignore the chance for developing more comprehensive theoretical understanding of the phenomenon.

Theoretical agenda point 3) *Future gamification research should incorporate the contexts in which the gamification is deployed and investigated more strongly into research models.*

By way of its many motivational affordances, gamification can primarily be seen to attempt to provide users with feedback. Gamification provides three types of feedback: 1) cognitive, 2) affective, and 3) social. Cognitively, gamification commonly uses data on a user's behavior to derive points and other indicators of progress, thus providing instrumental cognitive data about the users' actions. From this perspective, gamification can be seen as a decision support system for the self, quantifying individual rather than organizational activities. Affective, motivational feedback is at the core of many gameful affordances as game design elements often aim for positive emotional arousal, such as enjoyment, excitement or interest. Finally, many gamification affordances are inherently social; e.g. high score lists afford social comparison (Festinger, 1954), and mutual goals can afford sense of community and strengthen 'we-intentions' (Tuomela, 1995). However, while gamification functions through these feedback systems and loops, neither the current theoretical understanding of gamification nor the empirical literature have made any serious inquiries into the different types of feedback that gamification affords. It appears that feedback functions as an essential mediator between the interaction with a gamification and the resulting psychological outcomes. Whilst prior literature has investigated the resultant psychological states and experiences (such as e.g. usefulness, enjoyment and perceived competition), it appears that the link between gamification affordances and resulting psychological states is still unexplored. Thus, it is unknown through which mechanisms gamification produces the psychological effects it aims to achieve.

Theoretical agenda point 4) *Future gamification research should pay more attention to the different types of feedback, which kinds of gamification affordances are best equipped to deliver them, and the effect that the feedback has on system users.*

The current understanding of gamification highlights that its effects proceed in a linear chain of events. This is reflected in both the theoretical and empirical literature on gamification. For example, the most cited definitions of gamification by Deterding et al. (2011) and Huotari and Hamari (2012); Huotari & Hamari, 2017, both conceptualize gamification as a process within which the implemented elements linearly proceed to affecting psychological states and experiences, and eventually user behavior. Similarly, the main body of empirical literature on gamification (as seen in this and previous reviews) treats gamification as following a similar process. Even though this is understandable from the perspective of economizing and simplifying empirical research design, it offers a rather limited view of the multifaceted complex systems and processes that gamification entails. Gamification is a dynamic, cyclical, two-way process in which the technology, the users, and the contextual factors of the system all contribute to the outcomes which are achieved. Gamification affects the behavior of the users, who continue the behavior, but not as the same "clean slates" as when they first adopted the system. So, it is clear that the behavior is altered directly due to the effect of the gamification, and that new patterns of behavior result in new responses to the gamification itself.

Evidently, studying the process of gamification empirically is very challenging, and addressing these questions most likely calls for the adoption of qualitative research approaches that can capture the many facets of the complex phenomenon. However, simply acknowledging

the multifaceted nature of the gamification beyond the current linear conceptualizations that are seen in literature and practice would be a step forward.

Theoretical agenda point 5) *Gamification research and its theoretical conceptualizations should make an acknowledgement of the dynamic, cyclical nature of gamification.*

4.3. Methodological agenda

While the body of literature on gamification has been growing steadily, some common issues still hinder the development of the field. Firstly, the research field is very scattered in terms of the research models and variables which are used, especially when studying experiences and attitudes. While variables such as enjoyment are often included in the research models examining gamification, there are considerably few studies using similar or validated measurement instruments for a particular variable. Therefore, comparing research results or conducting any comprehensive meta-analyses poses a significant challenge. In order for the research field to develop, a consistency in measurement instruments and research models is needed across studies, in order to gain comparable results. Furthermore, many empirical studies rely on reporting only descriptive statistics, even though conducting some form of inferential analyses could also be feasible in many cases.

Methodological agenda point 1) *Future gamification research should aim for consistency in measurement instruments and research models, as well as developing the depth of analyses to go beyond a mere description of data.*

Secondly, most of the empirical research on gamification is conducted without control groups. While many of the studies are motivated by the question of whether the gamification approach is effective or not, in many cases, the studies eventually fail to accurately answer the question due to a lack of control groups. Furthermore, even if empirical approaches are used, a large proportion of the studies rely simply on user evaluations. Previous literature reviews have already pointed out these shortcomings (Hamari et al., 2014), and the amount of controlled, experimental research settings has increased as the field has matured. However, as noted in this review that out of 227 studies using quantitative methods (165 quantitative studies and 62 mixed methods studies), only 66 studies were identified as controlled experiments, there are still considerable steps to be taken in order to strengthen the research field.

Methodological agenda point 2) *Future gamification research should increasingly employ controlled experimental research methods, in order to gain knowledge on the actual effects of gamification.*

Thirdly, a common methodological problem within the gamification research field has been the study designs, which more often than not do not control between the various affordances implemented in the studied systems. Many studies examine the effects or perceptions of gamified systems containing several different elements, but as a whole. In these types of research settings, identifying which element actually causes the observed effects becomes impossible. Furthermore, investigating how much the different affordances contribute to the results is similarly very challenging, if none of the elements are controlled for. As reported in the analyses, only 11 of the 66 controlled experimental studies examined the effects of individual affordances. Thus, both research design and the overall research field would benefit from more work which identifies the effects of different affordances, as more information could be gained on the kinds of gamification elements that actually work. However, it must be remembered that even when controlling for the effects of a certain affordance, the contextual factors as well as individual user characteristics are likely to affect the results. For example, positive findings regarding the effectiveness of leaderboards for a class of schoolchildren does not guarantee that a similar leaderboard design would produce similar results in a work place setting.

Methodological agenda point 3) *Future gamification research should seek to control for the effects of the individual affordances used in a given gamification implementation. In addition, when investigating the effects of the affordances, the contextual characteristics of the setting should also be taken into account.*

Fourthly, as previously mentioned, the empirical research on gamification has been limited in terms of sample sizes, as well as experimental timeframes. Developments on this front can be seen to have taken place, when comparing the results of this review with the findings of the earlier review by Hamari et al. (2014), and the sample sizes of quantitative experimental studies have increased considerably. Yet, there are still several studies with only small groups of study participants. One explanation for these small samples is the nature of the studies, as many papers report preliminary exploratory research by testing a prototype or a concept. However, in order to advance the field in general, research must eventually move beyond isolated works with prototypes and aim for more theory-informed confirmatory studies. Furthermore, short timeframes pose an evident threat to the validity of study findings. Especially, novelty has been shown to have an effect on users of gamification services (Farzan et al., 2008b; Koivisto & Hamari, 2014), and with short time periods for data gathering, the risk of findings being skewed by the novelty of the implementation is elevated.

Methodological agenda point 4) *In future gamification research, the sample sizes of studies should be large enough to increase methodological rigor, as well as to amplify the transferability and explanatory power of the results. Furthermore, the time spans of studies should be long enough to enable novelty effects in the data to be minimized.*

Fifthly, in many research papers the reporting of the methods, data, analysis and results is unclear. Part of this problem is potentially caused by the abundance of conference publications which duly limits the space available for research papers, and therefore, limits the details that can be included. While this is naturally not an excuse for poor reporting, in some cases it may have contributed to the quality and clarity of the reports. In any case, an encouragement of precise and thorough reporting would enable much more efficient diffusion of research results.

Methodological agenda point 5) *In future gamification research, attention should be paid to clear and comprehensive reporting of research.*

4.4. Limitations of the review

In this review, we have followed the suggestions by Paré et al. (2015) to ensure its quality, in terms of both rigor and relevance. The review procedure has been described in detail to ensure the clarity of the process, and to enable replication of the procedure. Furthermore, the goals of the review have been explicitly stated in order to ensure the suitability of the chosen methods for the expressed goals.

However, the chosen perspective and methods limit the review in different ways. The present review focuses on the phenomenon of gamification on an overview level. There is evidently variation, for example in how gamification has been defined in the different publications, or how the various affordances have been defined and implemented. Due to the goal of comprehensively overviewing a substantial body of literature, there has been no possibility to go into further detail of individual studies. In the coding and analysis processes, some abstraction has obviously been necessary, which has consequently caused some specifics of the studies to be lost.

Furthermore, the literature search was limited to the Scopus and AISeL databases. While we are confident of the comprehensiveness of our literature search, it is nevertheless possible that some publications have been missed due to either not being among venues indexed in these databases, or due to indexing errors within the databases (as is the case with any review study). In any case, the potential number of missed publications is likely to be meager, and their inclusion would not foreseeably affect the results of the review to any notable degree.

Declaration of interest

No conflicts of interest exist.

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