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Gamification in theory and action: A survey ☆

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ABSTRACT

Gamification has drawn the attention of academics, practitioners and business professionals in domains as diverse as education, information studies, human–computer interaction, and health. As yet, the term remains mired in diverse meanings and contradictory uses, while the concept faces division on its academic worth, underdeveloped theoretical foundations, and a dearth of standardized guidelines for application. Despite widespread commentary on its merits and shortcomings, little empirical work has sought to validate gamification as a meaningful concept and provide evidence of its effectiveness as a tool for motivating and engaging users in non-entertainment contexts. Moreover, no work to date has surveyed gamification as a field of study from a human–computer studies perspective. In this paper, we present a systematic survey on the use of gamification in published theoretical reviews and research papers involving interactive systems and human participants. We outline current theoretical understandings of gamification and draw comparisons to related approaches, including alternate reality games (ARGs), games with a purpose (GWAPs), and gameful design. We present a multidisciplinary review of gamification in action, focusing on empirical findings related to purpose and context, design of systems, approaches and techniques, and user impact. Findings from the survey show that a standard conceptualization of gamification is emerging against a growing backdrop of empirical participants-based research. However, definitional subjectivity, diverse or unstated theoretical foundations, incongruities among empirical findings, and inadequate experimental design remain matters of concern. We discuss how gamification may to be more usefully presented as a subset of a larger effort to improve the user experience of interactive systems through gameful design. We end by suggesting points of departure for continued empirical investigations of gamified practice and its effects.

1. Introduction

The last 15 years has seen the rise of the digital game medium in entertainment, popular culture, and as an academic field of study. The success of digital games in the commercial entertainment industry – seen in record-breaking console sales and massively occupied online multiplayer environments – has spurred research into their effects and relevance in the digital age. The notion of the solitary teenaged white male gamer is no longer relevant: the average gamer is 30 years old, is 45% likely to be female, tends to play puzzle, board or casual games, and is likely a part of the 62% who play games socially (Entertainment Software Association, 2013). Although *digital* games are a relatively new development, games have existed in human cultures since the dawn of recorded culture as tools for entertainment, relationship-building, training, and arguably survival (McGonigal, 2011). Games are firmly entrenched in human culture, continuing to influence our social and leisure lives on a scale unprecedented and yet historically anticipated.

The gains made by the digital game medium has motivated its adoption for pursuits beyond entertainment. An emerging strategy in this area is *gamification*, which has been largely, though inconsistently, referred to as the selective incorporation of game elements into an interactive system without a fully-fledged game as the end product (Deterding, 2012; Deterding et al., 2011a, 2011c). In general, the term is used to describe those features of an interactive system that aim to motivate and engage end-users through the use of game elements and mechanics. As yet, there is no agreed upon standard definition; likewise, there is little cohesion with respect to theoretical underpinnings and what gamification encompasses. Even so, numerous efforts have sought to take advantage of the alleged motivational benefits of gamification approaches despite a lack of empirical research and standards of practice for design and implementation. Academic response has been polarized, ranging from outright rejection to curiosity

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expressed in exploratory papers and symposiums. The combination of its conceptual infancy and this dissonance among scholars poses an opportunity for the exploration of gamification as an object of study, an approach to design, and a computer-mediated phenomenon.

In this article, we present conceptual and practical findings from a systematic survey of the rapidly emerging academic literature on gamification. Our goals were threefold: (1) to systematically explore the theoretical and conceptual aspects of gamification in order to assess whether there is consensus on gamification as a distinct term and concept; (2) to provide a multidisciplinary review on the state-of-the-art of applied gamification research; and (3) to establish what links, if any, there are between theoretical work and applied work on gamification. In the first part of this paper, we offer an analysis of gamification from a theoretical perspective, including gamification as an evolving term, efforts to operationalize gamification as a concept, criticisms from major figures and concerns arising from its conceptual foundations and related work, and related concepts. In the second part, we present a multidisciplinary survey of gamification in action, particularly how it has been applied in computer-based systems, for what purpose, and the nature and results of empirical research. In the third part, we provide a synthesis on the links between theoretical and applied gamification work. We end this paper with a summary of findings, including suggested trajectories for future research.

2. Survey methods

A survey of the literature was conducted to produce a systematic deductive analysis of the concept of gamification and a review of applied human participant research on computer-mediated gamification systems. We used a meta-synthesis approach, which seeks to provide a well-rounded understanding and ultimately a consensus on the conceptualization of an object of study by carefully describing and then comparing and contrasting an array of sources on the topic that may be qualitative, quantitative or mixed in nature (Jensen and Allen, 1996; Heyvaert et al., 2013). A major challenge in finding appropriate sources was the diverse use of the term "gamification", which produced a range of false positives that described similar but distinct concepts. It is likely that some human participant research on what is now called gamification – work that predates the coining of the term – has been missed; a historical review of play and games beyond the last two decades is outside the scope of this survey, but may be integral to understanding the development of the concept and enriching its theoretical base, as well as providing its forerunners with due recognition.

A rigorous search of the academic literature was undertaken in all subject areas using EBSCOhost, JSTOR, Ovid, ProQuest, PubMed, Scopus, and Web of Knowledge (Table 1). This selection of databases was informed by the multidisciplinary nature of human–computer interaction research: a wide variety of databases and subject areas was necessary to capture applicable research in domains that publish to venues outside of human–computer studies. A comprehensive search using the search query "gamification OR gamif*" and reviewing sources of the types book, academic journal, report, conference materials, dissertation, thesis, and working paper yielded a combined total of 769 results on July 30, 2013. Given the early state of gamification research in studies on human–computer interaction and the tendency in this field to publish to conferences first, the vast majority of source types were conference papers, and to a lesser extent journal articles. The term "gamification" is novel and not established as a subject or thesaurus term; thus, keywords determined how papers were filtered, and criteria were established to ensure that the papers included for review met the definition established in this paper. The use of the "gamif*" keyword was an inclusive strategy meant to ensure the presence of papers that involved studies of gamification systems whose descriptions use the words "gamified", "gamify", "gamifying", or "gamifiable", all of which are grammatically valid alternatives to "gamification" when used as a verb.

The choice of inclusion or rejection of theoretical and implementation papers were made by the authors. In cases of doubt, how the keywords were used in the full article and which theoretical foundations of gamification were referenced was reviewed. However, the selection process was unexpectedly subjective; contributing factors are discussed in Section 3.2.1.

Here, theory papers encompass both conceptual papers – those that attempt to define the gamification as a concept – and theoretical papers – those that propose an explanation of the underlying nature of gamification. We define "theory" as an accumulation of possibly appropriate, already existing explanatory models from other domains that need to be tested with respect to gamification. This is in keeping with the historical trajectory of theory work in human–computer interaction: while the earliest work started with scientific theories based on observation and test–retest methodology, modern trends in theory production consider a variety of disciplinary approaches (Rogers, 2012). Theory papers were determined by the use of the keywords "concept", "conceptualize", "conceptualization", "term", "terminology", "framework", "define", "defining", "definition", "theory", "theorize", and "theorizing". Thirty-six papers passed an initial title-based screening. One non-indexed paper was added at the author's discretion based on its relevance despite the early stage of the work. Upon review of the abstracts, a total of 12 papers were selected.

To be included as an implementation paper, four criteria had to be met: (a) original, peer-reviewed empirical research was

Table 1
Databases accessed, query method, and search results.

Database	Query (if modified by search engine)	Source types (if available)	Total
EBSCOhost		Books, Academic Journals, Reports, Conference Materials	79
JSTOR	((gamification) OR (gamif*)) AND ((cty:(journal) AND ty:(fla OR edi OR nws OR mis)) OR cty:(book))	Articles, Books, Miscellaneous	30
OVID			75
ProQuest		Scholarly Journals, Dissertations and Theses, Conference Papers and Proceedings, Reports, Working Papers	262
PubMed			14
Scopus	ALL(gamification OR gamif*) AND (LIMIT-TO(DOCTYPE, "cp") OR LIMIT-TO(DOCTYPE, "ar") OR LIMIT-TO(DOCTYPE, "ip"))		255
Web of Knowledge	Topic=(gamification) OR Topic=(gamif*)		54
All databases			769

conducted and findings reported; (b) this research involved human participants; (c) the study was substantial (e.g. data was collected within an experimental setup or over a period of time or using validated instruments); and (d) gamification as defined in this paper – the use of game mechanics instead of a fully-fledged game in non-game contexts – was explored through an interactive system (hereafter "system"). An initial 60 papers were considered for inclusion. Four papers were found to be recurrences of the same work; papers referring to the same system were included only if new results were provided, otherwise the latest paper was referenced. Seven papers were inaccessible or presentation-only. Four additional papers were found after perusing the bibliographies of papers found through the database search. A final 30 papers were included. One paper discussed two systems, bringing the final system count to 31.

3. Gamification in theory

In the past few years, gamification has emerged as a trend within the business and marketing sectors, and has recently gained the notice of academics, educators, and practitioners from a variety of domains. Even so, gamification is not a new concept, having roots in marketing endeavors, such as points cards and rewards memberships, educational structures, most notably scholastic levels, grades, and degrees, and workplace productivity (Nelson, 2012). The rise (or re-emergence) of gamification is thought to have been brought about by a number of converging factors, including cheaper technology, personal data tracking, eminent successes, and the prevalence of the game medium (Deterding, 2012). To this list we suggest the addition of the game studies movement generally, which continues to develop a methodically considered framework of the nature, design and impact of games, and – particularly relevant to gamification – those essential aspects that make game(ful) experiences immersive, engaging and fun.

One contribution of this paper is to clarify the terminology and concepts associated with gamification. We begin by defining the overarching category of games, which, like gamification, is subject to multiple definitions and uses. In clarifying what is meant by "game", we construct a platform for developing a relative understanding of gamification. Foundations established, we then use this base to determine whether or not gamification is an original concept, evaluate uses of the term, and distinguish the concept from related ideas.

3.1. Conceptualizing "games"

Games are subject to the elephant test: instantly recognizable, they are nonetheless hard to define. A range of descriptions and conceptual expositions appear in the literature. Huizinga (2000) defines games as non-serious but intensely engaging voluntary activities structured by rules and secretive social boundaries. For Avedon and Sutton-Smith (1971), games are voluntary activities bounded by rules, but further require conflict between equal parties and an unequal end result. Crawford (1984) requires games to be representations of some reality, be predicated on interaction between the system and the user, and provide conflict but also safety through simulation. In their influential work, game designers Salen and Zimmerman (2004) define a game as "a system in which players engage in an artificial conflict, defined by rules, that results in a quantifiable outcome" (p. 80). Juul (2003) proposes that all games have the six main features: rules; variable; quantifiable outcomes; value-laden outcomes; player effort; player investment; and negotiable consequences, with respect to real life effects.

A number of common threads run across these definitions – rules, structure, voluntariness, uncertain outcomes, conflict, representation, resolution – alongside subtle and not-so-subtle differences. Games emerge from a variety of combinations of these criteria in different proportions, and whether an experience is a game or gameful is determined by participant perception.

3.2. Conceptualizing "gamification"

In contrast to games, gamification might be considered easier to define than it is to conceptualize. While no standard yet exists, most sources agree that gamification is generally defined as the use of game elements and mechanics in non-game contexts. However, a deeper view of gamification, including theoretical foundations, overarching purposes, and standards for practice, requires further development.

In two seminal efforts, Deterding et al. (2011a, 2011c) sought to establish a conceptualization of gamification based on the work of industry practitioners, academics and others to date. In their efforts to unearth the history of the term, the authors discovered a mesh of interrelated concepts and previous endeavors in human–computer interaction and beyond: the notion of *funware* (Azadegan and Riedel, 2012) and *funology* from industry; academic work, particularly by Malone (1982), on extracting qualities of play – *ludic qualities* – inspired by video games and other playful scenarios; the emergence of *serious games* as an area of study in the last two decades; an array of alternative terms for gamification, including "productivity games", "surveillance entertainment", "behavioral games", "game layers", and "applied gaming"; and similar but distinct concepts, such as McGonigal's (2011) *alternate reality games*, *games with a purpose*, and *pervasive* or *augmented reality games*, all of which bring reality into the typically fantastic and representational world of traditional gaming. Despite this varied landscape of theoretical trends and taxonomical options, the authors observed that not all examples of gamefulness outside of games could be placed under these headings or along these research paths, despite outwardly forming an increasingly cohesive whole. Ultimately, the authors acknowledged "gamification" as the accepted term for a distinct concept they define as "the use of game design elements in non-game contexts" (Deterding et al., 2011a, p. 9).

Deterding et al. (2011a) suggest that gamification involves applying elements of "gamefulness, gameful interaction, and gameful design" with a specific intention in mind (p. 10). Here, *gamefulness* refers to the lived experience, *gameful interaction* refers to the objects, tools and contexts that bring about the experience of gamefulness, and *gameful design* refers to the practice of crafting a gameful experience. While gamification may or may not call for a serious context, it does require that the end system is not a fully-fledged game. As the authors point out, this is less straightforward than it sounds given the subjectivity involved in distinguishing a full game from a system which merely uses one or more game elements (for instance, how many game elements does it take until a gamified system becomes a game?), the range of accepted definitions for "game", and the role of the participant in interpreting the system as being a game, gameful, or otherwise. Further, game elements are themselves difficult to specify; the authors' first efforts to consolidate levels of abstraction derived from the literature are presented in Table 2. The authors call attention to how inherently subjective the process of categorizing gameful systems is as well as how the early states of theoretical discourse and empirical research are contributing factors.

The conceptualization of gamification in industry has largely been the domain of Zichermann and associates. Zichermann and Linder (2010) define gamification as a tool for supplementing branding initiatives through the application of game elements and mechanics. Zichermann explicitly examines motivation from a psychological perspective, breaking it down into *intrinsic motivation* – where a behavior is enacted or an activity is undertaken

Table 2
Taxonomy of game design elements by level of abstraction from Deterding et al. (2011a, p. 12).

Level	Description	Example
Game interface design patterns	Common, successful interaction design components and design solutions for a known problem in a context, including prototypical implementations	Badge, leaderboard, level
Game design patterns and mechanics	Commonly reoccurring parts of the design of a game that concern gameplay	Time constraint, limited resources, turns
Game design principles and heuristics	Evaluative guidelines to approach a design problem or analyze a given design solution	Enduring play, clear goals, variety of game styles
Game models	Conceptual models of the components of games or game experience	Mechanics–Dynamics–Esthetics (MDA); challenge, fantasy, curiosity; game design atoms; Core Elements of the Gaming Experience (CEGE)
Game design methods	Game design-specific practices and processes	Playtesting, playcentric design, value conscious game design

because it aligns with one's inner values – and *extrinsic motivation* – where external rewards such as money or status are offered in exchange for engagement in particular behaviors or activities. According to Zichermann, intrinsic motivation is unreliable and variable; therefore, catering to core intrinsic values may not be possible or necessary. Zichermann argues that one strategy is to craft extrinsic motivators – external controllers of behavior – such that they feel like or become internalized as intrinsic motivators. In a later article, Zichermann (2011) argues that money, a traditional extrinsic motivator, can decrease motivation while also improving performance. He suggests that designers should consider both extrinsic and intrinsic motivation and use both monetary and non-monetary incentives. He further points out that generic intrinsic motivators may be more effective than specific intrinsic motivators given individual variability in what is intrinsically motivating. While the notion that greater ties to intrinsic motivation produces greater satisfaction is supported by empirical evidence and established knowledge of human motivation (Deci et al., 1999; Ryan, 2012), more research on how to design for intrinsic motivation using extrinsic motivators as well as the effects of non-monetary incentives on motivation is needed to validate this approach.

Cunningham and Zichermann (2011) provide a design path and list of game elements and mechanics illustrated by examples. Design considerations include determining what kind of players a system will support, how mastery can be achieved, methods of onboarding (the process of orienting new users to a system), and the role of the social engagement loop. Essential game mechanics are feedback and reinforcement; pattern recognition; collecting; organizing; surprise and unexpected delight; gifting; flirtation and romance; recognition for achievement; leading others; fame and getting attention; being the hero; gaining status; and nurturing and growing. The authors provide numerous examples illustrating these mechanics in practice; see Cunningham and Zichermann (2011, p. 80). However, game designers such as Bogost (2011a) and Robertson (2010) have critiqued the authors' claim that these mechanics are essential and questioned whether these elements provide or contribute to a gameful experience.

Positioned within the service system design sector, Huotari and Hamari (2012) also propose a break from Deterding et al.'s (2011a) conceptualization of gamification as a non-fully-fledged game, instead suggesting that the focus should be on the user experience, whatever form the final product might take. Hence, they define gamification as "a process of enhancing a service with affordances for gameful experiences in order to support user's [sic] overall value creation" (Huotari and Hamari, 2012, p. 19). The focus on the designed experience is an attempt to circumvent the problem of game elements as, roughly defined, not being unique to games, and thus invalidating the notion of gamification. Further, the idea that experiences can only be designed *for*, not *guaranteed* as outcomes for every user, is highlighted by this definition. The authors point out that some common definitional criteria of games – for example, voluntariness – are lost in the above conceptualizations of gamification. However, they note that not all of the common criteria they specify are required for a game to be a game.

Viewing it as a tool for business strategy, Werbach and Hunter (2012) suggest that gamification is game thinking in practice: the process of designing products, services, and systems as a game designer would. They define gamification as "[the] use of game elements and game-design techniques in non-game contexts" (Werbach and Hunter, 2012, p. 275/2018).[1] Game elements are defined as the pieces that comprise the game – dynamics, mechanics, components – similar to Deterding et al. (2011a). However, gamified systems are not necessarily game-like; instead, according to the authors, they are designed to take advantage of human psychology in the same way that games do. The authors consider gamification to be a more effective and rewarding alternative to traditional motivation structures in business, such as monetary rewards, because the game element itself is rewarding (i.e. intrinsically motivating). Gamification, they argue, is also a way of making existing extra-entertainment games that are poorly designed – like the scholastic system, and especially grades – more engaging and meaningful, with demonstrable positive effects. The authors specify non-game contexts as internal (within the business), external (customers and end-users), and behavior-changing. Aside from the business frame, Werbach and Hunter's notion of gamification is analogous to that of Deterding et al. (2011a).

At the intersection of the conceptualizations provided by Deterding et al. (2011a), Werbach and Hunter (2012), and Huotari and Hamari (2012), and considering Zichermann's definition without reference to a specific end goal, a standard definition of gamification is emerging: *the intentional use of game elements for a gameful experience of non-game tasks and contexts*. Game elements are patterns, objects, principles, models, and methods directly inspired by games. A point of contention is the extent to which gamification differs from games; for the purposes of this paper, we will draw the same distinction between games and gamification as Deterding et al. (2011a), and rely on the reported perspectives of researchers, designers and perhaps users in determining whether a system is an example of gamification or otherwise.

3.2.1. Other uses of the term

Gamification has been used to describe two additional concepts: (1) the creation or use of a game for any non-entertainment

[1] The Kindle version of this text does not provide print page numbers; instead, pages are dynamically generated based on the styles applied to the content, which modulate the number of total digital pages. In this case, the quote can be found at location 275 out of 2018.

context and/or goal, and (2) the transformation of an existing system into a game. In these cases, games are either inserted into an existing system, replacing or augmenting existing structures, or the system is converted into a game. "Gamified", "gamify", and "the gamification of" are action words and phrases widely used to refer to the application of these concepts rather than gamification as defined in this paper. Numerous examples exist; for instance, Eickhoff et al. (2012), Manna et al. (2012), McNeill et al. (2012), Neves Madeira et al. (2011), O'Mara (2012), Renaud and Wagoner (2011), Rouse (2013), Terlutter and Capella (2013).

In education, the term "gamification" has been used to refer to digital game-based learning (DGBL) and serious games generally. For instance, Kapp (2012) defines gamification as the use of "game-based mechanics, esthetics and game thinking to engage people, motivate action, promote learning, and solve problems" (p. 10). Kapp goes on to tackle common criticisms of gamification, including distinguishing gamification from pointsification and acknowledging that making a game is no easy task. Nevertheless, his assertions lack evidence and his criteria may be too broad, by his own estimation: his later discussion on how gamification is distinguished from serious games raises more questions about similarities and a conflation of factors than clear-cut answers. Ultimately, Kapp determines that serious games are a subset of gamification (i.e. one way in which gamification manifests). Gamification is the process that gives rise to serious games, defined as a transformation of educational content into a game. This view is not shared by everyone in gamification research; indeed, the very existence of such concepts as *serious gamification* – the use of game elements in serious contexts – call this interpretation into question (Werbach and Hunter, 2011).

The inconsistent use of the term "gamification" serves to impede attempts to define it but also exposes its multiplicity. This raises questions about the real differences between gamification and games and complicates how to draw the line between systems that incorporate some aspects of games and systems that are or use fully-fledged games.

3.2.2. Criticism

Gamification has been widely criticized by academics and game designers who are familiar with the prevalent "stock" approach to gamification: *pointsification*, or gamification that exclusively relies on points, badges and leaderboards (Bogost, 2011a; Kapp, 2012; e.g. Lawley, 2012; Robertson, 2010). Game designer Margaret Robertson states that such approaches mean "taking *the thing that is least essential to games* and representing it as the core of the experience" (Robertson, 2010, para. 4, emphasis retained). In his thesis, Chang (2012) contends that gamification in its widest usage (e.g. pointsification) is a techno-utopian fantasy with a complicated past that privileges the virtual and ultimately does not and cannot live up to the claims of its proponents.

Games scholar Ian Bogost is perhaps gamification's most vocal critic. In one article, Bogost (2011b) claims that gamification is "exploitationware", a perversion and simplification of the game medium created by marketers and big business for the purpose of easy profit. In another article, Bogost (2011a) criticizes the term for being vague and thus offering the means by which games can be reduced to their essential components and then used to provide an easy approach to crafting gameful experiences. He fundamentally disagrees with Zichermann – whom he calls the "Dark Lord" of the gamification movement – particularly with respect to his conceptualization of game mechanics (Bogost, 2011a). But while his criticism of Zichermann and gamification as expressed in industry and marketing sectors may withstand scrutiny, it also reveals a constricted lens on the larger concept of gamification. For instance, when Bogost claims that gamification "proposes to replace real incentives with fictional ones" (Bogost, 2011a, Exploitationware, para. 5) he seems to be referring to gamification strategies that focus on extrinsic rewards, to the neglect of gamification systems that were designed with intrinsic motivation in mind. Similarly, gamification is not the exclusive property of any one discipline or industry; as we show in this paper, the concept has been used, discussed, researched, and expanded in many sectors outside of marketing, from which Bogost derives most of his examples.

Disciplines outside of game studies and game design consider a more positive outlook. A social psychological perspective on gamification is provided by Antin (2012), who argues that the empty, virtual rewards derided by members of the anti-gamification camp are not the driving factors behind participation motivation, even if the designers themselves do not know it; instead, social factors such as self-efficacy, community and peer approval reward users and encourage their continued involvement. One goal of this work is to investigate whether these views hold by exploring how pervasive such disparaged implementations as pointsification are within gamification research and what empirical findings reveal about the reasons behind participation motivation in gamified systems.

3.2.3. Related concepts

Gamification has emerged within a varied, intersecting landscape of game concepts that have grown together, inspired one another, and share many commonalities. Indeed, Bouca (2012) contends that gamification is but the fruit of a larger cultural reconfiguration driven by the pervasiveness of games and technology: the *ludification* of culture. This argument is supported by numerous examples. In her influential work, McGonigal (2011) introduces alternate reality games (ARGs), "antiescapist" games that seek to intrinsically change how people think and behave in their everyday lives. Similar in context and goals, ARGs may be considered the fully-fledged counterpart to gamification. Prestopnik (2013) proposed the term *game taskification* to describe the incorporation of non-entertainment tasks into an existing game or game world; here, the task becomes an integral part of the gaming experience. *Gamenics theory* and *servicenics thoery* are comprised of a collection of principles and heuristics derived from Nintendo Games that can be used to increase the usability and enjoyment of other games and applications (Yamakami, 2012). Gamification as an emergent property of a system created and controlled by end-users may be considered as an example of *emergent gaming*, which is "… the use of features in a game to achieve goals or create content not designed into the game by its creators" (Benson, 2012, p. 202). *Human computation games* or *games with a purpose* (GWAP) harness human knowledge and ability by bringing masses of people together to tackle large problems (Von Ahn, 2006). As games continue to be accepted as objects of value, further trajectories are anticipated.

The role of games in design, as well as the design of games, has had great influence on the playing field. *Game design patterns* are "semiformal interdependent descriptions of commonly reoccurring parts of the design of a game that concern gameplay" (Björk and Holopainen, 2005, p. 34) used by game designers, but which could be applied in gamified systems. Scholars and practitioners in and outside of the gamification sphere have used the term *gameful design* in reference to gamification. Deterding et al. (2011a) consider gamification to be an instance of gameful design – gamification is gameful design in practice. However, Lee and Doh (2012) consider gamification and gameful design to be separate entities at odds with each other. For instance, gamification focuses on extrinsic motivation while gameful design focuses on intrinsic motivation. Their conceptualization of these terms appears to be in

response to dominant marketing and business perspectives of gamification.

The alternate use of the term “gamification” to refer to the creation of games for reasons outside of entertainment and the transformation of an existing system, service or object into a game is seen in other, similar trends. *Storyfication* is the creation of a narrative structure from non-narrative elements, such as in video editing software (Morneau et al., 2012). *Includification* is a design strategy that aims to integrate inclusive design practices and accessibility in game design practice (Barlet and Spohn, 2012). While the use of “-ification” as a rhetorical strategy has been derided for its implications of ease and repeatability (Bogost, 2011b), it continues to be employed as a descriptor of design strategies.

The lines among these related concepts and gamification are not stark. Beyond the fluidity of the term "gamification," it is possible to imagine categorizing a given system under more than one label. Although beyond the scope of this paper, an analysis of how researchers, practioners, and users make sense of systems in relation to one or more of these related concepts, as well as gamification, may be fruitful for conceptual cohesion or distinction, as appropriate.

3.2.4. *Frameworks and theoretical foundations*

Few frameworks outlining theoretical foundations and how gamification systems can be analyzed exist. Sources and underlying theoretical models are highlighted in Table 3.

Aparicio et al. (2012) developed a framework based on self-determination theory, in particular the concepts of autonomy (personal will to action), competence, and [social] relatedness (Ryan and Deci, 2000a). The framework is divided into four parts. The first is “identification of the main objective”, or outlining the reasons behind the use of gamification. The second is “identification of the transversal objective”, or what intrinsically motivating factors the system seeks to provide. The third involves determining what game mechanics will be used based on how they relate to the concepts of self-determination (see Table 4). The final part of the framework involves how to evaluate the framework in applied systems. As of yet, this framework has not been applied, and work on analysis methods and case studies is underway.

Table 3
Theoretical foundations used in gamification frameworks.

Theoretical foundations	Sources
Self-Determination Theory (Ryan and Deci, 2000a)	Aparicio et al. (2012), Nicholson (2012)
Intrinsic and Extrinsic Motivation (Ryan and Deci, 2000b)	Blohm and Leimeister (2013), Nicholson (2012), Sakamoto et al. (2012)
Situational Relevance (e.g. Wilson, 1973)	Nicholson (2012)
Situated Motivational Affordance (Deterding, 2011)	Nicholson (2012)
Universal Design for Learning (Rose and Meyer, 2002)	Nicholson (2012)
User-centered Design (Norman, 1988)	Nicholson (2012)
Transtheoretical Model of Behavior Change (e.g. Prochaska and Marcus, 1994)	Sakamoto et al. (2012)

Table 4
Game elements by self-determination theory concepts in Aparicio et al.'s (2012) framework.

Autonomy	Competence	Relation
Profiles, avatars, macros, configurable interface, alternative activities, privacy control, notification control.	Positive feedback, optimal challenge, progressive information, intuitive controls, points, levels, leaderboards.	Groups, messages, blogs, connection to social networks, chat.

Table 5
Game design elements, dynamics, and motives from Blohm and Leimeister (2013).

Game element: mechanics	Game element: dynamics	Motives
Documentation of behavior	Exploration	Intellectual curiosity
Scoring systems, badges, trophies	Collection	Achievement
Rankings	Competition	Social recognition
Ranks, levels, reputation points	Acquisition of status	Social recognition
Group tasks	Collaboration	Social exchange
Time pressure, tasks, quests	Challenge	Cognitive stimulation
Avatars, virtual worlds, virtual trade	Development/ organization	Self-determination

Blohm and Leimeister (2013) consolidate a number of sources toward the development of a service-based gamification strategy. These “gamified service bundles” are comprised of a core offering based on desired usage objectives and a gamification layer made up of game design elements (see Table 5). The framework is meant to elucidate how gamification can operate on intrinsic and extrinsic motivators to bring about behavioral change and reframe activities such as learning.

Nicholson (2012) proposes a user-centred framework for *meaningful gamification* – gamification built upon intrinsic, or internal, motivation rather than extrinsic, or external, motivation. Extrinsic motivation has been shown to produce a variety of negative effects, including decreased intrinsic motivation (Deci et al., 2001). Nicholson outlines a number of core theories that could inform a more intrinsic gamified strategy for meaningful engagement. *Organismic integration theory*, a sub-theory of self-determination theory, proposes a continuum of motivation intentionality mediated by internal and external methods of control, starting from a lack of intentionality (no interest or motivation), moving through extrinsic motivation at different levels of external or internal control, and ending with internally-controlled or autonomous intrinsic motivation (Ryan et al., 1997). In particular, this theory suggests that meaningful game elements are intrinsically motivating regardless of any external rewards that may be associated with them. *Situational relevance* requires that the user makes decisions about what is meaningful. *Situated motivational affordance* points to the necessity of a match between the user's background and the gamified setup; an understanding of context is essential. *Universal design for learning* considers how to provide the best experience for a diverse range of users in three ways: diverse presentation of content, mastery through a multitude of activities, and multilinear learning paths. Nicholson finally argues that *user-centered design* – placing the user at the center of the experience and designing with their needs and desires in mind – links these otherwise disparate theories together.

In a similar effort, Sakamoto et al. (2012) developed a value-based gamification framework for designers aiming to encourage and harness intrinsic motivation. The framework is comprised of five values: (1) information, as in prompt and necessary; (2) empathetic values, based on virtual characters and social engagement; (3) persuasive values, a particular form of information that provides a future outlook based on current behaviors, actions and outcomes; (4) economic values, related to collection and ownership; and (5) ideological values, defined as beliefs implicitly supported through stories and other message formats. This framework is not stand-alone, but is meant to complement existing mechanics-based frameworks.

3.2.5. Synthesis of frameworks and theoretical foundations

A common thread among these diverse frameworks is the purpose behind the use of gamification: specifically, the interrelated concepts of motivation, behavior change, and engagement. To this end, the psychological theory of intrinsic and extrinsic motivation developed by Ryan and Deci (2000b) is a consistent choice among authors, even while their interpretations of this theory and the sub-theories they reference vary. In the literature reviewed, gamification is consistently positioned as a tool that may be used to facilitate extrinsic and intrinsic motivation to accomplish specific tasks through the selective use of game elements.

Variation in the use of terms and concepts suggests a lack of deep understanding among those applying Ryan and Deci's theory of motivation to gamification. For instance, advocates such as Zichermann argue that extrinsic motivators should be designed with the goal of addressing intrinsic factors. However, whether a given motivator – game element, feedback, piece of information – is perceived as extrinsically or intrinsically motivating depends on individual and contextual factors (Deci et al., 1999). Indeed, Deterding (2011) proposes that a given element may be both intrinsically and extrinsically motivating for certain people in certain situations at certain times.

In focusing on providing a positive experience for the end-user through motivational methods that are intended to be intrinsic, these frameworks adhere to a user-centred approach to gamification. Towards this end, Nicholson (2012) provides a high-level overview of specific theories that may be used to inform the design of user experience in support of intrinsic motivation. Aparicio et al. (2012), Sakamoto et al. (2012) and Blohm and Leimeister (2013) provide models of how specific aspects of theory can be represented in concrete game elements. The service-oriented motives outlined by Blohm and Leimeister (2013) and Sakamoto et al.'s (2012) value-based framework can be mapped to the three aspects of self-determination theory presented by Aparicio et al. (2012); for example, social recognition and exchange can map to social relatedness.

However, these frameworks differ in three ways. The first is in whether they address specific sub-theories, for example, self-determination theory in the case of Aparicio et al. (2012). The second is in their level of granularity, or the degree to which aspects of theories and sub-theories are linked to specific game elements. The third is in their interpretation of values, especially the relative effectiveness of extrinsic motivation. These differences suggest that the domain of application may benefit from gamification frameworks developed within and for that domain.

The reviewed literature indicates a consensus in three areas: design theory; theoretical constructs; and theoretical framework. User-centred design is a consistent choice for design theory, given mentions of its tenets across papers, as well as explicit mention by Nicholson (2012). Drawing from the domain of psychology, the primary theoretical constructs are intrinsic and extrinsic motivation as grounded in self-determination theory (SDT). The gamification-specific frameworks reviewed were developed in isolation and there is, as yet, no evidence of their completeness; these frameworks need to be applied in order to determine their applicability and convergence.

4. Gamification in action

Gamification is a multidisciplinary tool spanning a breadth of domains, theories of thought, methodology, and reasons for implementation. Empirical work across disciplines has begun to explore how gamification can be used in certain contexts and what behavioral and experiential effects gamification has on people in the short and long terms. Here, we present a survey of the existing literature on gamification in action: applied examples of gamification implemented into systems and evaluated with human subjects. Three questions guided the review process: (1) What was the purpose for using gamification? (2) What gamification techniques were used? and (3) What findings from human participants research were reported? The results of these inquiries are summarized in Tables 7 and 8. Papers surveyed are organized by application domain; in addition to a review of each paper, a summary is provided for domains in which a number of examples of gamification exist. Many papers featured comprehensive studies that focused on exploring questions above and beyond any gamification aspect; only results relating to gamification are discussed here.

4.1. Terminology

Game elements often interrelate and can bear similar, if not the same, names. For instance, “levels” and “levelling” can refer to ranks acquired by [experience] points, as in traditional role-playing games, but can also refer to stages or areas in a game world. In both cases, progression is the key factor; the difference is related to what it is applied: the person or environment. To avoid confusion, terms will be used as outlined in Table 6.

Table 6
Legend of game element terminology.

Term	Definition	Alternatives
Points	Numerical units indicating progress.	Experience points; score.
Badges	Visual icons signifying achievements.	Trophies.
Leaderboards	Display of ranks for comparison.	Rankings, scoreboard.
Progression	Milestones indicating progress.	Levelling, level up.
Status	Textual monikers indicating progress.	Title, ranks.
Levels	Increasingly difficult environments.	Stage, area, world.
Rewards	Tangible, desirable items.	Incentives, prizes, gifts.
Roles	Role-playing elements of character.	Class, character.

4.2. Multidisciplinary review of applied gamification research

4.2.1. Education

Education applications of gamification refer to using game elements for scholastic development in formal and informal settings. In a study of an online multiple-choice question (MCQ)-based learning system, Denny (2013) investigated how badges could be used to motivate participation. Results showed that badges motivated the number of answers submitted and duration of engagement, without impacting response quality. However, badges did not affect the number of questions authored or perceived quality of the learning environment. Additionally, students who did not use badges submitted four times the amount of answers required, indicating that the activity was intrinsically motivating regardless of the gamification features employed. Page views of the personal badge scoreboard over time indicated that interest in viewing, if not collecting, badges was not uniform across students, suggesting that students were motivated for different reasons.

Domínguez et al. (2013) developed a gamification plugin for the Blackboard e-learning platform. Majors and the students associated with them were randomly assigned to control and experimental groups. The experimental group was trained to use the plugin and optional gamification features, which included 36 challenge achievements resulting in trophies, and seven participation achievements resulting in badges/medals. A leaderboard featuring a comparison of self to others by the number of

Table 7
Basic study information for the surveyed implementation papers.

Domain	Source	Sample size and demographics	Duration	Study design	Data capture
Education	Gåsland (2011)	25 Norwegian undergraduate students aged 21–25 for the usability study; 44 (6 female) for the questionnaire	One semester	Evaluation	Usability test, questionnaire
	Foster et al. (2012)	~300 First year undergraduate students per year	One semester compared to two previous semesters	Comparative evaluation	Assessment, interviews
	Li et al. (2012)	14 (10 female) Adults aged 19–62	One study	Comparative evaluation	Assessment, questionnaires
	McDaniel et al. (2012)	138 undergraduate students	One semester	Evaluation	Focus groups, questionnaire
	Denny (2013)	1031 Undergraduate students (516 in experimental condition)	26 Days	Comparative evaluation	Metrics, questionnaire
	Domínguez et al. (2013)	211 Undergraduate students (131 in experimental condition)	One semester (150–180 h)	Comparative evaluation	Metrics, assessment, questionnaire
	Goehle (2013)	60 Undergraduate students	One semester (16 weeks)	Evaluation	Metrics, questionnaires
	Snyder and Hartig (2013)	~40 Students in-residence (aged 17–65) each week; ~169 different players in two years	Once a week for two years	Evaluation	Metrics, questionnaire
Online communities and social networks	Cramer et al. (2011)	15 (5 female) Foursquare users for the interview; 47 (7 female) Foursquare users aged 15–47 for the questionnaire	One 30–150 min session for the interview; one 10–25 min questionnaire	Survey	Interview, questionnaire
	Bista et al. (2012a, 2012b)	~400 Participants	One year	Evaluation	Metrics
	Frith (2012)	36 (16 women) Frequent users of Foursquare	One 25–90 min session	Survey	Interviews
	Thom et al. (2012)	~400,000 Employees of a worldwide enterprise	4 Weeks	Comparative evaluation	Metrics
Health and wellness	Cafazzo et al. (2012)	20 Youth aged 12–16 with Type I diabetes	Interview sessions of unknown duration; 12-week pilot	Evaluation	Metrics, questionnaire
	Hori et al. (2013)	2 (1 female) Graduate students in first study; 10 (3 males) business workers aged 20–30 in the second study; 11 (4 male) business workers aged 20–60 in the third study	2 Weeks for first study; 40+ min for the second study; 70 min for the third study	Comparative evaluation	Metrics, questionnaires
	Rose et al. (2013)	20 Participants with Type I diabetes	1–3 Months	Usability evaluation	Metrics, self-reports
	Stinson et al. (2013)	15 (5 per cycle) Youth aged 9–18 diagnosed with cancer in the first phase of the usability study; 26 (18 in the first cycle) youth in the second phase of the usability study; 14 youth in the evaluation study	3 Cycles for the first phase of the usability study; 2 cycles for the second phase; 14 days for the evaluation study	Usability and clinical evaluation	Metrics, questionnaire
Crowdsourcing	Liu et al. (2011)	55 (36 Japanese and 19 foreign travelers) participants	6 Weeks	Comparative evaluation	Metrics
	Witt et al. (2011)	30 (2 female) Participants	Survey open for 1 month; duration of session unknown	Evaluation	Questionnaire
	Mason et al. (2012)	20 Citizen scientists experienced with tiger watching	3 Weeks	Evaluation	Metrics
	Massung et al. (2013)	48 (19 male) Participants aged 17–59 (mean=27, SD=10.4)	2 Weeks	Comparative evaluation	Metrics, semi-structured interviews
Sustainability	Liu et al. (2011)	20 (8 female) Members of 6 families, aged 15–58	4 Weeks	Comparative evaluation	Metrics, questionnaire
	Gnauk et al. (2012)	12 (3 female) Participants aged 23–45 (mean=27)	One session of unknown duration	Evaluation	Usability test, questionnaire
	Berengueres et al. (2013)	Unknown college students	4 Weeks	Comparative evaluation	Metrics
Orientation	Depura and Garg (2012)	~300 New recruits of a Fortune 100 company	Two sessions of unknown duration	Evaluation	Metrics, questionnaire
	Fitz-Walter et al. (2012)	121 Students for the usage study; 13 (5 female) students aged 18–28 for the questionnaire	4 Weeks for the usage study; unknown duration for questionnaire	Evaluation	Metrics, questionnaire

Table 7 (*continued*)

Domain	Source	Sample size and demographics	Duration	Study design	Data capture
Computer science and engineering	Passos et al. (2011)	13 Developers	4 Months	Evaluation	Metrics
	Fernandes et al. (2012)	7 Childcare workers in first study; 17 graduate students in the second study	One session of unknown duration for each study	Evaluation	Metrics, questionnaire
Research	Musthag et al. (2011)	36 Students	3 Days	Comparative evaluation	Metrics, questionnaires
	Rapp, Marcengo (2012)	157 Participants	4 Days	Evaluation	Metrics, questionnaire
Marketing	Downes-Le Guin et al. (2012)	1007 Participants	1 Week	Comparative evaluation	Metrics, questionnaire
Computer-supported cooperative work	Bagley (2012)	9 (4 female) Participants	Unknown duration	Evaluation	Questionnaire

achievements completed was provided; 44% of the experimental group used the gamification features. Scores overall and on practical assignments were greater for this group, but performance on written assignments and participation suffered. Qualitative commentary revealed that some students did not enjoy the competitive elements, especially leaderboards.

Gamification was used to support an informal, unstructured activity in an electromechanical class (Foster et al., 2012). Achievements were developed with several goals in mind, including safety, preparation, device selection, and use of specific engineering design concepts. Students were provided with the achievements in advance of the activity; during the activity, instructional staff encouraged students to aim for completing achievements. A comparison of the gamified version of the activity to two previous, non-gamified offerings showed that the safety achievements successfully generated safer behaviors, and the achievements overall provided a learning structure, including cues and guidance, for students to pursue learning goals. However, many students needed external motivation in the form of challenges issued by the instructional staff to become and remain engaged.

Gåsland (2011) developed a collaborative question-and-answer e-learning system called “StudyAid” was developed for students to learn course material and study for a final exam. A survey revealed that the system was generally considered useful and easy to use. However, the gamification elements did not have a large impact, perhaps due to the nature of the task (studying), how the system was framed (as work rather than fun), and the “cold start” problem associated with new systems that are devoid of content. When asked, 80% of respondents did not consider it to be a game.

Goehle (2013) augmented the open source homework application WeBWorK with a number of gamification elements: experience points based on progression through homework tasks, levels after reaching certain milestones through accumulating experience points, a progress bar, achievements, and rewards in the form of extra credit. Achievement metrics showed that at least half of the students who completed 90% of the homework put in extra effort to obtain achievements. A post-course survey completed by 29 students revealed that 93% tracked their progress and 89% sought to acquire achievements. In a few randomly distributed surveys throughout the term, students consistently mentioned that the system made them feel recognized, complementing the metric results. However, the authors could not conclude what effect, if any, gamification had on the performance of students in the course.

Li et al. (2012) developed GamiCAD, a gamified tutorial system to help new users learn AutoCAD through missions, scoring (numerical and qualitative in the form of stars), game levels, time pressure, mini-games, and rewards in the form of bonus levels. Results showed an increase in engagement, enjoyment and performance among novice users; in particular, there was a 20–76% increase in speed of completion that was significant for four tasks.

A badge overlay was implemented into a learning management system by McDaniel et al. (2012) to motivate students towards specific behaviors desired by teaching staff, for instance providing comprehensive feedback to fellow students. Students were allowed to choose one of four learning modules, but all students were encouraged to use the badge system that was displayed on a leaderboard. The authors found that the leaderboard motivated some students to seek out achievements and badges, including “hidden” badges. Some students engaged in extra-course discussions to figure out how these badges could be accessed. However, there was only a marginally positive response overall to the use of achievements in the course. Half of the students were motivated to achieve badges upon seeing that a friend had done so. Slightly more female students than male students responded positively to

Table 8
Theory used, system design, and results from the surveyed implementation papers.

Domain	Source	Purpose	Theory	Gamification elements	Results	Findings
Education	Gåsland (2011)	Support learning activity	N/A; definition from Deterding et al. (2011c); operant conditioning (Skinner, 1953) and ludic heuristics (Malone, 1982) for game mechanics	Points, progression	Mixed	Gamification elements did not impact all users' experiences consistently
	Foster et al. (2012)	Support learning activity	N/A	Achievements	Positive	Improved safety and understanding of learning goals
	Li et al. (2012)	Improve existing tutorial system	N/A; definition from Deterding et al. (2011a); flow (Csikszentmihalyi, 1988), ludic heuristics (Malone, 1982, 1981) for gamification elements	Challenges, levels, rewards, time pressure, points, mini-games	Positive	Improved engagement, enjoyment, and learning
	McDaniel et al. (2012)	Encourage participation	N/A	Badges, leaderboard	Mixed	Gamification modestly affected performance
	Denny (2013)	Encourage participation	N/A; definition from Deterding et al. (2011b)	Badges	Positive	Increased contributions, longer engagement, preference for badges
	Domínguez et al. (2013)	Increase student motivation and engagement	N/A; definition from Deterding et al. (2011b); flow (Csikszentmihalyi, 1991)	Levels, challenges, badges, leaderboards	Mixed	Increased initial motivation, better practical and overall score, but poor written performance and participation in class
	Goehle (2013)	Encourage students to do homework	N/A; definition from Deterding et al. (2011a, 2011c)	Points, progression, achievements, rewards	Positive	Gamification elements motivated most students
	Snyder and Hartig (2013)	Improve participation	N/A	Rewards	Positive	Improved participation and engagement
Online communities and social networks	Cramer et al. (2011)	Encourage location-sharing	N/A	Points, badges, status	Mixed	Gamification elements could engage but also demotivate
	Bista et al. (2012a, 2012b)	Track behaviors in a system; encourage honest participation	N/A; definition from Deterding et al. (2011b) and Cunningham and Zichermann (2011)	Points, badges	Positive, Positive	Badge allocation allowed behavior tracking; potential increase in engagement and collaboration
	Frith (2012)	Encourage mobility	N/A; definition from Deterding et al. (2011b)	Points, badges, status, leaderboard	Mixed	Encouraged mobility but some gamification elements demotivational
	Thom et al. (2012)	Explore affect of removing gamification	Extrinsic and intrinsic motivation (Deci et al., 1999)	Points, badges, leaderboard	Negative***	***Negative results support use of gamification; participation decreased on removal
Health and wellness	Cafazzo et al. (2012)	Encourage daily blood glucose measurements	N/A	Points, rewards	Positive	Rates increased by 50%
	Hori et al. (2013)	Encourage smiling	N/A; definition from Deterding et al. (2011b)	Levels	Positive	Amount of smiles increased, leading to positive social outcomes
	Rose et al. (2013)	Improve behavior compliance	N/A	Points, challenges, avatars, progression	Positive	Improved compliance, reduced blood sugar, improved quality of life
	Stinson et al. (2013)	Improve participation	N/A; definition from Deterding et al. (2011b)	Roles, status, rewards, badges, challenges	Positive	High compliance and satisfaction
Crowdsourcing	Liu et al. (2011)	Encourage participation	N/A; definition from Zichermann and Linder (2010)	Points, status, badges, leaderboard	Positive	Improved response speed and quality
	Witt et al. (2011)	Improve participation	Extrinsic and intrinsic motivation (e.g. Deci et al., 1999)	Points, leaderboards	Mixed	Game elements not consistently effective or well received
	Mason et al. (2012)	Encourage participation	N/A	Points, badges	Mixed	Most images positively identified; effect of gamification elements not addressed
	Massung et al. (2013)	Encourage participation	Extrinsic motivation (Deci, 1971); definitions from Deterding et al. (2011c) and Cunningham and Zichermann (2011)	Points, badges, leaderboards	Mixed	Gamification increased performance but not significantly
Sustainability	Liu et al. (2011)	Encourage behavior change	N/A; definition from Zichermann and Linder (2010)	Avatars, achievements, rewards, points	Mixed	Improved awareness but no statistically significant results
	Gnauk et al. (2012)	Engage customers	Self-determination theory (Ryan and Deci, 2000a); rewards framework from McGonigal (2011); design justification from Cunningham and Zichermann (2011); definition from Deterding et al. (2011c)	Points, leaderboards	Positive	High usability and user experience ratings
	Berengueres et al. (2013)	Encourage use of recycling bin	N/A	Immediate, affective avatar-based feedback	Positive	Usage rates increased threefold and users preferred the gamified bin over a regular bin

Table 8 (*continued*)

Domain	Source	Purpose	Theory	Gamification elements	Results	Findings
Orientation	Depura and Garg (2012)	Support onboarding process	N/A	Leaderboards, badges, mini-games, rewards	Positive	Social bonding, increased knowledge of company, increased productivity
	Fitz-Walter et al. (2012)	Support orientation and encourage exploration	N/A; definition from Deterding et al. (2011b)	Challenges, leaderboards, rewards	Positive	Generally well-received and engaged students
Computer science and engineering	Passos et al. (2011)	Make programming fun	N/A; definition from Corcoran (2010) and Takahashi (2010)	Badges	Mixed	Some individuals and teams were more engaged than others
	Fernandes et al. (2012)	Elicit and rate requirements	N/A; definition from Deterding et al. (2011a, 2011b)	Points, levels, roles	Positive	Participants enjoyed the experience and project managers appreciated the requirements outcomes
Research	Musthag et al. (2011)	Encourage participation	N/A; definition from Gamify, Inc. (2010)	Rewards	Positive	Incentives improved performance
	Rapp, Marcengo (2012)	Increase quantity of reliable feedback	N/A; definition from Deterding et al. (2011a)	Points, rewards, challenges, leaderboards	Positive	Improved quantity of data
Marketing	Downes-Le Guin et al. (2012)	Improve experience and data quality	N/A; definition from Cunningham and Zichermann (2011)	Narrative, levels, avatars, rewards	Mixed	Engagement unaffected but higher satisfaction
Computer-supported cooperative work	Bagley (2012)	Encouraging participation to populate database	N/A; design framework from Deterding et al. (2011a); definition from Deterding et al. (2011c) and Cunningham and Zichermann (2011)	Status, points, badges	Mixed	Age and familiarity with games were factors affecting interest and use

the gamification elements, suggesting to the authors that gender bias with games was not an issue.

Snyder and Hartig (2013) developed a voluntary online quiz system to engage time-restricted medical residents in certification-related activities. Metrics showed that there was a 70% correct response rate and 80% participation. A post-questionnaire revealed that 96% appreciated the difficulty level, 67% were content with the frequency, and 30% desired more questions. The authors speculate that the well-defined space of a gamified setup contributed to quiz engagement, but research on the impact on performance in certificate achievement is needed to see how these results transfer.

4.2.2. Online communities and social networks

Online communities and social networks offer individuals the opportunity to engage with like minds, generate discussion and build relationships around specific topics. In two papers, Bista et al. (2012a, 2012b) outlined the design of a government-sponsored online community for individuals receiving welfare interested in returning to the workforce. In their first paper, the authors show how gamification metrics reveal patterns of behavior in the system; for instance, the temporary VIP badge is conferred to users upon regular login, and a graph showing when users receive this badge indicates an increase in regular logins. In this way, the authors showed that gamification can be used to track user interactions with the system. In their second paper, rewarded interactions are shown to increase engagement and cooperation. Statistical analysis was not conducted, so whether gamification elements had a significant impact on user behavior is unknown.

Cramer et al. (2011) investigated how people were motivated to use Foursquare, a location-sharing app known for its use of status in the form of “mayorships” earned by frequent customers. Results indicated that motivation through gamification was mixed. For example, motivation dropped when mayorships were perceived to be unobtainable. However, the gamification elements were found to motivate behavior around identity and ownership, resulting in social conflicts between regulars vying for recognition.

Frith (2012) investigated the ways in which game elements in Foursquare motivated certain behaviors. His results suggested that people enjoy collecting badges and carrying out certain tasks, including “badge hunts”, whereby a user sets out to explore new territory just for the sake of earning a badge. He found that certain extreme users called “jumpers” would “game the system” by exploiting IP address changes to artificially change locations and collect badges. Like Cramer et al. (2011), Frith found that mayorships could lead to potentially negative outcomes, such as “mayorship battles” between early and late adopters that in some cases lead to cheating. The points system was generally well-received and was found to generate the “surprise and delight” factor – when a person was presented with unexpected information about themselves – prevalent in social media. The leaderboard was found to be demotivational in the face of power users who always dominated the rankings.

In a twist not previously explored, Thom et al. (2012) investigated the effect of *removing* gamification features in a gamified social network for a large multinational organization after 10 months of use. Results over a four-week period showed that their removal reduced contributions of photos, lists, and comments across multiple features (photos, lists and profiles). This effect remained when countries were compared, although participants in India continued to post comments on profiles to a greater degree than those in the US. The authors conclude that the removal of gamification features has a negative impact on user participation.

4.2.3. Health and wellness

Applications in health range from personal healthcare to professional development. Cafazzo et al. (2012) developed a mobile application to support children diagnosed with Type 1 diabetes based on design principles derived from interviews with the children and their caregivers. The application awarded points based on frequency of measurement of blood glucose levels taken throughout the day and entered into the app. Results showed an average of eight rewards given; notably, two high achievers did not redeem points, suggesting that the end reward was not motivating all users' behavior equally. Significantly, there was a 50% increase in daily average blood glucose measurement.

Hori et al. (2013) developed an application to help improve the particular communication skill of smiling during social interactions. The app provides visual and vibration feedback when the user smiles; levels are progressed as the frequency of smiles increases. Two prototypes were developed over a series of studies investigating the effects of the app in different contexts. Results showed that users were motivated to make their friends and themselves smile, but this effect did not translate to the other person or people involved in the social interaction. Even when users' social skills were low, they were perceived by conversational partners to be attentive.

Rose et al. (2013) empirically studied the effects of a mobile diabetes monitoring app called *mySugr* on the compliance behavior of people with diabetes. According to the authors, despite its importance, 73% of people with diabetes do not document their progress, and 57% enter incorrect data. Results showed that testing frequency improved by 10–20%, blood sugar level decreased by 0.4–1.1%, and quality of life was subjectively reported to have increased. By the end of the three-month period, 85% of participants continued to use the application.

In an effort to engage young cancer patients in the process of writing a pain diary, Stinson et al. (2013) developed an app called "Pain Squad" that has users take on the role of recruits on the lookout for pain, represented as a tangible antagonist. Users "rise through the ranks" by capturing their pain records in twice-a-day missions, and obtaining badges and rewards, such as videos by actors from popular cop series, after filling out a certain number of reports. The researchers first designed a cancer-centred pain questionnaire based on an arthritis diary for young people. Two prototypes – one low-fidelity and one high-fidelity – were then developed and tested in a usability study. The researchers then incorporated the usability results into a final prototype for evaluation in a clinical feasibility test. Average compliance was 88%; participants reported day and night, on weekdays or weekends, and consistently over the two-week period, with no statistical differences; there were no gender differences or differences based on initial treatment location. Satisfaction was high, the app was considered easy to use and did not intrude into daily activities.

4.2.4. Crowdsourcing

Crowdsourcing harnesses the power of large numbers of people for a specific purpose. Liu et al. (2011) developed UbiAsk, a mobile crowdsourcing application for human-powered image-to-text translation. The application uses a number of gamification features to encourage participants to translate images provided by foreign travelers. The researchers found that half of requests for translation were responded to within 10 min, three-quarters of requests were responded to within 30 min, and each request received 4.2 answers on average. However, how these results compared to the non-gamified version was unclear. Further, the authors warn that these results may address social psychological incentives rather than gamification.

Mason et al. (2012) created a human-powered tiger identification platform that harnesses the pattern recognition abilities of people to confirm and supplement the accuracy of their stripe recognition software. Users were presented with a matching task: determining whether two images were from the same or a different tiger; they received points and badges upon accurate identification. 300 responses were collected, 220 of which were confirmatory and 80 of which were indecisive. The authors conclude that 73% recognition was the best achievable identification rate in this context. No control was used, so the effect of the gamification features is difficult to determine.

Three applications featuring different motivational strategies were developed by Massung et al. (2013) towards the goal of engaging non-activist participation in pro-environmental activities. The first app featured the widely-used "pointification" gamification method; the second featured monetary rewards; and the third did not use a motivational strategy (acting as the control). Participants were tasked with collecting data on shop owners who were willing to join the "close the door" campaign to conserve energy. A statistical difference was found between the control and financial apps in terms of points and shops added, all with mid to high effect sizes. Environmental disposition was not a significant factor. Qualitative data indicated that despite the success of the financial initiative, 75% of those users compared to 100% using either of the other two apps expressed interest in using the app again, indicating decreased intrinsic engagement.

Witt et al. (2011) investigated what motivates users who engage in an online idea competition and what effect game mechanics might have on motivation. Two point systems – game points for completion of actions and social points for engaging in social behaviors, like rating and commenting on other users' ideas – and a leaderboard were integrated into the competition. Questionnaire results about the game mechanics fell into the "Neither Agree nor Disagree" category. The authors speculate that the design of the system, including confusing placement and presentation of the leaderboard, contributed to these mixed results. However, the authors noted that those who ranked flow, enjoyment and task engagement highly also ranked the game mechanics highly, suggesting that gamification may complement the experience for some users.

4.2.5. Sustainability

Sustainability applications seek to support and encourage sustainable behaviors, such as reducing the amount of resources used, investing in recycling initiatives and renewable forms of energy, and reusing material wherever possible. Berengueres et al. (2013) created an affective avatar-based recycling bin that presents immediate, positive and affective feedback in the form of emoticons and sound. A comparison of usage rates between the "emobin" and a typical recycling bin indicated that the former generated a threefold increase in recycling behaviors when placed at different times in the same space, and overwhelming preference for the former when both were placed side-by-side for the same period of time. The authors state that this is an example of gamification; however, the key design elements – avatars and affective feedback – are not exclusively gameful, and may instead be considered playful, ludific or funological in nature. This may instead be an example of successful affective interface design rather than gamification. This example highlights the quandary of gamification: the fuzzy boundary between gamification, play and games.

Gnauk et al. (2012) developed a realtime, human-controlled energy management system called MIRABEL that uses gamification elements in place of traditional monetary incentives to motivate customers to use the system, especially to tackle tasks computers

find difficult, such as managing unpredictable, weather-dependent renewable energy resources like wind and solar power. Gamification elements include points, specifically EarthSaver Points (ESP), and leaderboards (e.g. comparing to the average user and one-on-one competitions with family and friends). Results showed high usability – 84/100 on the System Usability Scale (Bangor et al., 2008) – and high scores on the AttrakDiff scale of perceived pragmatic and hedonic quality (Hassenzahl et al., 2003). However, the gamification elements were not specifically investigated or commented on by participants.

Liu et al. (2011) developed a sustainability system called EcoIsland, which was installed on a display in the home and presented sustainable use data in the form of a virtual island with avatars representing family members. Unless the family engaged in sustainable behaviors, the water level rose, threatening to sink the island. Users earned points as virtual currency by completing tasks (achievements), such as using public transportation. They also set target CO_2 emissions and used mobile phones to report on sustainable actions taken. A post-survey revealed that 85% of users developed an increased awareness of the environmental ecology, but metrics data did not reveal any statistically significant findings, perhaps due to the short length of the study or small number of participants, which also coincided with a holiday season in that country.

4.2.6. Orientation

Depura and Garg (2012) developed an onboarding platform for pre-joining engagement and post-joining orientation that featured a number of gamification elements. Badges were given based on social interactions; in the pre-joining group, roughly 85% of participants received the badge for maximum social interactions. Leaderboards were based around quiz results and the onboarding minigame. Rewards were given to top performers. Post-questionnaires for each onboarding group showed that the majority of invitees registered and most of these completed all pre-joining activities; the majority of new hires registered and most of these completed all activities. New hires rated the experience: 1% “average”, 49% “good” and 50% “awesome”. Less than half found the game format appealing, the content interesting, or learned something new. However, none of these responses were statistically examined.

Fitz-Walter et al. (2012) created a gamified QR code-based mobile application for orienting incoming undergraduate students. Game mechanics included thematized, time-released challenges of varying difficulty to motivate exploration and social participation, a leaderboard, and rewards (prize draw entry). Questionnaire results showed that the majority of users agreed that the application was easy to use, fun to use, and motivated exploration. Usage data indicated that the majority of users completed at least one and up to four challenges, with 17.4% completing nine or more. The survey showed that the majority of students desired to find out more about the university, most were driven to acquire prizes, and most were motivated to complete the challenges.

4.2.7. Computer science and engineering

Fernandes et al. (2012) developed a requirements elicitation and analysis tool using a gamified role-based setup. Roles were derived from the “Six Thinking Hats” method of parallel thinking-based discussion and idea generation (De Bono, 1995) — black for critiques, white for facts and numbers, etc. Points were earned by contribution, and each participant had an opportunity to contribute by providing a new requirement or ranking and commenting on existing requirements each round. Questionnaires revealed that satisfaction with the game mechanics was high, although amusement tended to be lower, perhaps due to the choice of the term - for example, "/>“amusement”. Questionnaires delivered to project managers showed that they were highly satisfied with the number and quality of the contributions. No statistical analyses were drawn, nor was this method compared to a traditional requirements elicitation and analysis approach.

Passos et al. (2011) conducted a case study around a gamified software development method involving a challenge–punishment–reward feedback loop and achievements in the form of medals. Achievements were solo (individual, regardless of project) and group-based (specific to a project). Metrics revealed mixed results. Individual rate achievements showed most developers completing at least half of the first level tasks, with one developer reaching the second level. Project managers were interested in the findings and in particular how performance can be tracked by the system and engage certain users. The authors outline a second iteration of the system featuring many more game elements.

4.2.8. Research

Some researchers are considering new ways of incentivizing user studies towards collecting data of greater quantity and quality. Musthag et al. (2011) developed an incentive structure for investigating how participants can be motivated to provide quality data in an intensive study setting: high workload (multiple lengthy questionnaires) over three days (time investment) while burdened by technology (chest sensors). Three incentive structures were built into the application: “uniform”, where each question answered was worth 4 cents; the game-inspired variable, where each was worth 2–12 cents, randomly attributed; and “hidden”, which was similar to variable except that participants are not told how much they had earned until after the study, much in the same way that lotteries and casino games operate. Results showed that the uniform and variable incentives were similarly effective (but the uniform if preferred to save costs) while the hidden incentive scheme was not effective.

In an effort to increase the quantity of reliable feedback from users in a field study, Rapp, Marcengo (2012) developed a gamified mobile application called “WantEat” that was tailored for research conducted around a cheese festival. Points were given for actions, such as writing reviews and tasting cheese with other participants, achievements could be unlocked, progress could be tracked in a leaderboard, and rewards could be earned. The reward distribution was used to facilitate research questionnaire deployment. Additional missions were offered to enlist users in more intense research activities. Metrics and subjective analyses of the application showed that ratings of ease of use, usefulness, efficacy and engagement were high. However, participants were not motivated to meet new people or comment on other people's reviews. Unexpectedly, participants continued to use the application even when rewards were no longer offered (e.g. after achieving the max point level). It is unclear whether participants were motivated regardless of the gamification features or if the gamification features were affecting performance.

4.2.9. Marketing

Marketing research looks into how user experience and data quality and collection rates can be optimized. To investigate the effect of presentation mode on survey engagement and data quality, Downes-Le Guin et al. (2012) conducted an experiment comparing four styles of presentation: text only, decoratively visual, functionally visual (images are related to content), and gamified. The gamified version featured a narrative layer comprised of levels, a customizable avatar, and rewards in the form of avatar assets, such as swords, and public presentation of the completed avatar. Participants were randomly assigned to one of the presentation modes. In the gamified mode, only 58%

completed the survey, a rate significantly worse than the other modules, which had completion rates of 93–94%. However, the gamified and visual modes produced greater overall satisfaction. To capture engagement, two "trap" questions were used: one for consistency (answering the same at different times in the survey) and one for comprehension (select the answer requested by the question). Results showed that engagement did not differ across modes.

4.2.10. Computer-supported cooperative work

Computer-supported cooperative work (CSCW) involves technological systems aiding collaborative work efforts between people. Bagley (2012) designed a framework for sharing high quality search patterns reliant on user participation in roadmap creation. The game elements of points, derived from ratings and usage statistics, ranks, for example "Explorer" achieved at 5000 points, and badges, for example "Navigator" and "Cartographer", were implemented as key components in a prototype. Results from a post-test survey indicated that age and lack of gaming experience online influenced the results; the author recommends educating first-time users about gamification elements.

4.2.11. Summary of applied research

Gamification has been applied and researched across many domains, from sustainability to health and wellness to education. Findings from this survey indicate that the top fields for gamification research are education (26%), health and wellness (13%), online communities and social networks (13%), crowdsourcing (13%) and sustainability (10%).

A large majority (87%) of applied gamification research did not mention or address theoretical foundations. Three exceptions exist. The first two are Thom et al. (2012) and Witt et al. (2011), who referenced the work of Deci et al. (1999) on extrinsic and intrinsic motivation with respect to research design and interpreting findings. The third is Gnauk et al. (2012), who used self-determination theory (Ryan and Deci, 2000a, 2000b) to conceptualize gamification with respect to extrinsic and intrinsic motivation and then justify their use of the rewards framework outlined by McGonigal (2011), which is a design strategy that seeks to optimize intrinsic motivation through gameful elements. Two papers (Gåsland, 2011; Li et al., 2012) cited operant conditioning (Skinner, 1953), ludic heuristics (Malone, 1982, 1981) and flow theory (Csikszentmihalyi, 1991, 1988) in their choice of game elements for gamification. 65% of papers defined gamification; 45% used Deterding and colleagues' definition of gamification and 23% used Zichermann and colleagues' definition. Where not defined, gamification was presented in a self-evident way or defined without reference to any source.

By and large, gamification has been employed to encourage end-user participation (65%) and change behavior (32%), with the goal in one case being a combination of both (encouraging more honest participation). In three cases (10%), gamification was used to improve enjoyment. In a further three cases (10%), gamification was used as an analytical strategy to capture and track data in a system. In one case, the goal was to explore the effect of removing gamification from a system.

Gamification elements employed across the 31 systems surveyed include points (18), badges (15), rewards (11), leaderboards (11), challenges (6), status (5), progression (3), achievements (3), avatars (3), mini-games (2), roles (2), narrative (1), time pressure (1), and feedback (1). According to the game element taxonomy provided by Blohm and Leimeister (2013), the majority (81%) of elements express the collection dynamic, with 35% expressing the competition dynamic, 26% the status dynamic, 23% the challenge dynamic, and 13% the development/organization dynamic; however, not all elements are accounted for by this model.

Research strategies include standalone evaluations (58%), four of which were usability studies and one of which was a medical trial, controlled comparisons (35%), and two surveys. Most studies (65%) employed a mixed methods setup using multiple instruments. Data capture methods included questionnaires (19), metrics (22), learning or behavioral assessments (3), usability assessments (4), interviews (4), and one focus group. However, few studies ran statistical analyses and only one study (Massung et al., 2013) provided a standard measure of effect size, despite many cases having adequate sample size and available data.

Findings concerning the effectiveness of gamification were mostly positive (61%), but there were a fair amount (39%) of mixed results. Eight out of 11 (73%) comparative studies showed positive results, while the rest were mixed. More research is necessary to determine if these results are significant and reproducible.

5. Synthesis of theory and applied research on gamification

Gamification is a term employed in diverse ways but with an emerging standard definition that sets it apart from related concepts. While not without its critics, gamification is being increasingly explored across a variety of domains as it matures as a tool and area of study. Findings from our survey of theoretical papers and applied research reveal four major issues. First, there is a lack of adherence to the emerging standard definition of the term "gamification". Second, theoretical foundations are inconsistently referenced and interpreted. Third, there is a gap between theory and practice – where theory is empirically unexamined and applied work lacks reference to theory – which serves to limit the growth of the field as a whole. Fourth, there is a pressing need for empirical studies that employ comparative and/or longitudinal designs to validate what effect, and the extent of the effect, gamification features have on participants' performance and enjoyment as well as to identify best practices. We elaborate on these issues below.

5.1. Gamification in theory

While the boundaries between gamification and related concepts are not always clear, our survey findings suggest that gamification is a distinct concept under active development. Gamification has two key ingredients: it is used for non-entertainment purposes, and it draws inspiration from games, particularly the elements that make up games, without engendering a fully-fledged game. In this way, gamified systems are game-like, but not a game. This sets gamification apart from serious games, games with a purpose (GWAPs), alternate reality games (ARGs), and similar concepts that describe fully-fledged games. Gamification can be distinguished from *playification*, which encompasses such concepts as funware, funology, Malone's (1982) ludic qualities and ludification, in the same way that play can be distinguished from games: gamification is a subset of the overarching category of playification, a type of playification that involves structure and goal-oriented play. However, drawing a distinction between these concepts can be difficult at the design criteria and implementation level. The emo-bin system by Berengueres et al. (2013) provides a clear example of this. Avatars and affective feedback *are* used in games, but not exclusively, and lend themselves to the more general categories of play and affective interface design. Like play and games, these ill-defined boundaries mediated by factors such as personal perception may never be resolved.

While foundational underpinnings are somewhat varied, our findings suggest an emerging consensus in two areas: extrinsic and intrinsic motivation, particularly as expressed through self-determination theory (theoretical foundation) and user-centred

design (design strategy). The frameworks developed by Aparicio et al. (2012), Nicholson (2012), Sakamoto et al. (2012), and Blohm and Leimeister (2013) are all founded on empirically validated and widely accepted psychological theories of motivation. This theoretical base proposes an investment in intrinsic, or internally-driven, motivation above and beyond a reliance on extrinsic, or externally mandated, motivators. The most commonly stated objective behind using a gamified approach is to encourage behavior change in end-users, whether that behavior change involves increased participation, improved performance, or greater compliance. Overall, the current state of gamification theory argues that game elements can meet these goals by catering to the intrinsic values of end-users: a user-centred approach, characterized by a focus on the needs and desires of end-users in the design of systems.

5.2. Gamification in action

Findings from our review of applied gamification research show a wide range of interest but a largely limited playing field. While applied gamification research is found across a number of domains, the survey findings suggest that it is largely the domain of education, and to a lesser extent health and wellness, online communities, crowdsourcing, and sustainability. Similarly, the limited array of game elements explored in these studies suggests that pointsification – points, badges, leaderboards – is a pervasive gamification strategy. Perhaps disciplinary conventions, a lack of consolidation among fields, and the early state of gamification research encourage replication and limited creativity in application.

5.2.1. Impact on participants

In general, our findings paint a positive-leaning but mixed picture of the effectiveness of gamification. The reasons for mixed results appear to be context-specific: similar implementations of gamification in different domains did not necessary impact participants in the same way. Additionally, outcomes were either negative and positive, or positive and neutral. For instance, Domínguez et al. (2013) reported increased initial motivation, better practical and overall scores, but poor written performance and participation in a gamified learning system. In contrast, Downes-Le Guin et al. (2012) found that engagement in a gamified marketing questionnaire was unaffected, even though users reported higher satisfaction. In some cases, as with Gåsland (2011), Passos et al. (2011), and Witt et al. (2011), the effects of gamification varied among individuals. Some studies showed that demographic variables and the expectations attached to those variables had an impact on the effectiveness of gamification factors. For instance, Bagley (2012) showed that age and familiarity with gaming contributed to interest and use. In contrast, McDaniel et al. (2012) found an unexpected marginally significant effect of gender indicating that female students were just as, if not more, engaged by gamification factors as male students. Although this result went against the authors' expectations, we suggest that it may instead highlight a common misconception (i.e. that women are less interested in games than men). Finally, early positive results may be subject to the phenomenon of regression to the mean due to the novelty factor associated with gamified systems, which are still new. Further, the file-drawer effect – where null or negative results are not considered or published – may also be at play. Overall, these studies may serve to downplay concerns about gamification being perceived as a "panacea" (Kapp, 2012) while also providing sufficient, if initial, evidence to support continued research on the effects of gamification for end-users of interactive systems.

5.2.2. Study design

The state of gamification research design is best characterized as mixed methods and single-study, employing a range of measures and instruments towards the capture of both quantitative and qualitative data in one-off experiments. An important drawback across studies is the lack of statistical treatment of empirical data, even when sample size is sufficient and the data are available. As a result, standard measures of effect size are not available. Further, there is a lack of comparative and longitudinal study designs, despite the literature suggesting that gamification effects, especially if they rely on extrinsic motivation, may be temporary or even damaging over time (Deci et al., 1999) unless participants never stop engaging with the gamified system (Cunningham and Zichermann, 2011). Only one study (Thom et al., 2012) implemented a crossover design involving the removal of gamification features. These issues may be a result of disciplinary convention as well as the early state of gamification research.

5.3. Gamification in theory and action

Our findings show that the majority of applied research on gamification is not grounded in theory and did not use gamification frameworks in the design of the system under study. Subsequently, theoretical considerations are not addressed by or in the majority of empirical findings. Many papers also did not define gamification. These two issues point to a major gap between theory and practice in gamification research. However, the three exceptions – Thom et al. (2012), Witt et al. (2011) and Gnauk et al. (2012) – show an initial consensus on attributed theoretical foundations that is also reflected in our review of gamification theory papers, namely, extrinsic and intrinsic motivation as reflected in self-determination theory (Deci et al., 1999; Ryan and Deci, 2000a).

The present body of applied gamification research suggests that success might be improved across the board if the design of gamified systems – especially extrinsic motivators – is informed by end-users' intrinsic motivators. The challenge is to accommodate individual differences in *what* is intrinsically motivating while also meeting the objectives, requirements, and restrictions of the designer (or client). Findings from the theoretical survey suggest that user-centred design methodology may help elucidate intrinsic motivators for a given user population. There may not be an ideal gamified system – an optimal combination of game elements, mechanics, and dynamics that always works – instead, gamified systems may need to be selectively designed given the individual makeup of the end-user population or even be designed flexibly and inclusively, allowing for personalization and customization, to accommodate individual users.

What the state of gamification theory and the issues around resolving criteria for gamified systems in practice suggest is the notion of gamification as an approach to design. Instead of describing the gamified system, gamification refers to the mindset of the designer inspired by games. The notion of game design patterns (Björk and Holopainen, 2005) provides a foundation upon which gamification practice could be, and may already informally being, built. Indeed, Deterding et al. (2011a) suggest that gamification is but gameful design in practice. If gamification is a method by which end-user engagement, if not behavior, can be shaped and directed, scholarly focus on ethics in gamification-based design practice may be on the horizon. As the field matures, the veracity of this notion and its repercussions are sure to become clear.

5.4. Trajectories for future research

Our findings reveal several points of departure for future research. We outline as follows:

- *Exploration of the space.* While our survey revealed that a range of contexts and game elements are being explored, certain contexts and elements continue to receive more focus than others. As gamification research matures, we expect the playing field – in terms of application domain and elements explored – to diversify. We encourage researchers to consider a range of goals, contexts and elements – perhaps similar to those suggested by McGonigal (2011, p. 125) of her fully-fledged ARGs.
- *Study design.* A common issue in the empirical studies surveyed is their design. Specifically, most studies did not run statistical analyses (and subsequently could not generate effect sizes), did not isolate the gamification effect (for example, by using a control and comparing gamified and non-gamified systems), and were short-term and/or one-off in nature. Going forward, one-off studies will need to be replicated, comparative and longitudinal designs employed, and meta-comparisons run to draw stronger, generalizable conclusions about the value of gamification for end-users.
- *Isolate the effect of gamification.* Due in part to the study design issues discussed, it is difficult to isolate what effect (if it exists) gamification has on end-users. Beyond statistical analyses and comparative studies, we propose the following possibilities for future research:
- *Empirically explore theory.* A major issue illuminated by our findings is the disconnect between theoretical and applied work on gamification. Theoretical work, while useful for explaining the potential inner workings of gamification, has not been empirically validated with respect to applied gamification work. Likewise, applied work may reference theory but does not explore its validity empirically. We encourage researchers to explicitly explore the proposed theoretical underpinnings in applied work. This likely means the formulation of a multidisciplinary team of researchers. At the very least, given that our findings showed a diverse array of interpretations and uses of established theories, we suggest that research teams consider involving or employing the services of experts (e.g. psychologists, philosophers of motivation, etc.) on the theory they opt to explore.
- *Empirically explore proposed gamification frameworks.* One finding of our review of theoretical papers showed that while there was some consensus among theorists on foundational underpinnings, there was a lack of consensus on proposed gamification-specific frameworks. Further, to the best of our knowledge, the proposed gamification-specific frameworks have not been explored through applied research. Future research could determine their applicability and consolidate these frameworks if necessary.
- *Use existing instruments.* Several existing theories argued to be applicable to gamification have already been operationalized in other disciplines into models and instruments meant to test their effect on individuals. For instance, the Intrinsic Motivation Inventory is a widely validated instrument that measures several factors related to self-determination theory and may be used to assess motivation after participants' subjective experience with (gamified) interactive systems (Deci and Ryan, 2005). Researchers should consider using these instruments to determine the theoretical and practical relevance of theory-informed gamified systems, for example by revealing whether and how particular game elements or sets of elements are intrinsically or extrinsically motivating alone and together.
- *Remove gamification elements.* One way that the effect of gamification can be measured – especially longitudinally – is by removing gamification features from the system. Further, it has been suggested that gamification features, especially those that cater to extrinsic motivation, may lose effectiveness or even decrease motivation over time (Deci et al., 1999). Only one study (Thom et al., 2012) has featured this approach; more work is needed to clarify the effect of removed gamification elements on participant's motivation.
- *Determine the usefulness of particular game elements.* Since gamification in action is defined by applying a limited number of game elements to an interactive system, future research should aim to isolate the most promising and least promising game elements in particular contexts for particular types of end-users. This will only be possible after considerable exploratory work has been done.
- *Validate suggested design approaches.* Several design approaches to gamified systems have been proposed but not empirically explored. For instance, Zichermann (2011) suggests that extrinsic motivators should be designed to appear as or become intrinsic motivators. This is supported by knowledge of human motivation (Deci et al., 1999; Ryan, 2012), but, as yet, no research has sought to validate this design approach in practice. Further, *how* to design intrinsically-motivating extrinsic motivators is unclear. Future research could extrapolate findings from studies on intrinsic motivation to the design and evaluation of extrinsically-motivating gamification elements that influence end-users' motivation intrinsically.

6. Conclusion

Gamification is a developing approach for encouraging user motivation, engagement and enjoyment in non-gaming, computer-mediated environments with an early collection of empirical work supporting its potential for beneficial effects in certain contexts. While the term remains inconsistently used, the concept of gamification is slowly gaining focus: a standard definition of gamification is emerging, and initial frameworks based on foundational psychological theories, including self-determination theory and intrinsic and extrinsic motivation, have been collectively proposed. A multidisciplinary effort to research the effects of gamification on human participants is nascent, but there is a pressing need for the exploration of a wider range of game elements across contexts, stronger experimental designs, and investigations of several trajectories. More empirical, mixed methods research that employs statistical analysis and reports effect sizes for standard elements, dynamics and experiences is necessary to substantiate the initial positive effects reported. Likewise, comparative studies that employ controls are needed to ascertain what effects gamification has above and beyond other aspects of the system and in comparison to other approaches, such as a fully-fledged game. Despite its theoretical grounding in human motivation, few studies have empirically investigated the effects of extrinsic and intrinsic motivators in gamified systems. The subjective nature of the survey filtering process – necessary due to the inconsistent use of the term – limits this work, as does the lively state of the field. The subjective nature involved in determining whether or not a system exhibits gamification is expected to become less so as efforts to narrow down gamification as a concept continue. While a challenge for survey work, the present vitality of gamification as an area of practice and research is advantageous to its growth, potentially drawing greater and swifter attention to the pressing issues and paths of study outlined in this paper. Only continued theoretical deliberations, playful, practical explorations, and rigorous evaluation with end-users will reveal whether or not gamification is here to stay.

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