Chapter

Threats Arising from Software Gamification

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Abstract

The appearance of gamification dates back about a decade and since this tool has been increasingly used not only in the entertainment sector but also in the industry, army, education, health and others. Studies suggest that this approach may provide added value outcomes, in particular in the users' motivational and engagement areas, in a wide range of fields such as customer relations, skills learning, physical exercises, health management, etc. On the other hand, the consequences and potential risks related to its use remain insufficiently understood and have started to become the object of research in the last years. This chapter aims at exploring and deepening the understanding of the possible threats resulting from the use of software gamification at both the individual and collective levels. To do so, an integrative literature review was carried out on studies examining the negatives effects and challenges of this tool so as to identify the possible adverse impacts arising from them. Overall, results would show that an inadequate gamification design and implementation and its implications in terms of a flawed rewarding system and ethical issues may entail perils such as demotivating users, engendering mistrust, health issues and tarnishing the gamification credibility as well as that of the management in charge of it.

Keywords: gamification, engagement, motivation, risks, threats

1. Introduction

The impressive growth of the gaming sector in the last decades [1] constitutes one of the major elements to understand the rational of gamification. Indeed, the massive use of video games has triggered the interest of scientists and several industrial sectors to know what renders this cyberactivity motivating [2]. Fundamentally the objective being to identify and use the engaging components of video games in other activities with other purposes than gaming so as to increase the participation of the users concerned (customers, employees, students, etc.) [3].

Since 2010s gamification has been growing as both a subject of study and as a tool for stimulating users' activities [1, 4]. In particular, it is usually designed and used for promoting and supporting users' motivation and engagement and it has been applied in a quite wide range of areas such as entertainment, business, health, education, military, etc. [5].

The increasing use of gamification in the last decade attracted the attention of researchers and thus led to a growing number of studies in this field. However, it could be stated that despite its rapid development the academic attention to this

field is rather recent [6]. According to the available papers in research databases (see section Approach), it seems that the efforts to understand the dimensions and characteristics related to this tool and its use have been unequally distributed. Indeed, theorising on the gamification concept and studying its main advantages through concrete applications are the most explored areas. Studies on the effectiveness of this approach relative to its goals in different contexts are also rather frequent, although to a lesser extent. On the other hand, despite the production of useful and interesting literature review studies on detecting and grasping the limitations, negative consequences, unintended side effects, challenges and risks of gamification, this topic appears to be one of the least covered areas so far and probably insufficiently understood [7–9]. Since the information systems do influence users' behaviour [10], it is meaningful to examine the possible harms caused by gamification, which overall remain under addressed and represent an area needing further research.

Within this frame, this chapter aims at exploring the following question: What are the possible threats arising from the use of gamification at both the individual and collective levels?

An integrative literature review [11] was chosen as a means to seek answers and to develop insights into the mentioned research question that constitutes the scope of this study. The rest of this chapter is organised as described hereafter:

The next section concerns the notional part of this chapter, that is the grasping of gamification as a concept, with examples of definitions and differentiation with similar concepts as well as the semantic mapping on the main notions arising from this subject. Then, the research approach and the protocol employed to operate the analysis are presented. The following section displays and describes the results from the integrative literature review. Finally, the last section includes the discussion on the results, their implications, ideas on possible future research, conclusions and limitations of this study.

Through this integrative literature review, this paper contributes to discern perils that may result from gamification and suggests to take them into consideration during both the design and the outcome evaluation phases of this tool.

2. Grasping gamification

Understanding the nature, the purpose and the components of gamification is probably the pre-requisite to explore the potential threats that may result from the use of this approach. Precising the content of the gamification concept and its boundaries has been the object of studies [6]. As a result, the theorization work on gamification produced several definitions on this subject. For instance, Zicherman and Cunningham [12] define this concept as "*…changing the way of thinking and using some gaming rules in order to increase the interest of learners and to solve problems*".

Huotari and Hamari [13] share many concepts of the previously cited definition by referring to gamification as "*the process of enhancing services with motivational affordance for gameful experiences*". Seaborn and Fels [14] define it as "the intentional use of game elements for a gameful experience of non-games tasks and context".

Detering et al. [6] describe this concept as "*…the use of game design elements in non-game contexts*". This definition is quite generic, comprehensive and implicitly involves the motivational and useful aspects of this tool.

Beyond the degree of explicitness in citing the major components of gamification in the definitions, the leading thread of resorting to game elements and

applying them in non-game like activities consists in the attempt to combining the pleasant to the useful.

The obvious tie between the terms *gamification* and *game* deserves to be clarified. Whilst game refers to an activity whose main purpose is entertaining, gamification uses games principles in a non-game activity aiming at changing attitudes and behaviours [15].

It is probably also useful to make the distinction between gamification and game-based learning. In the latter participants embark in their learning process through game playing, whereas in the former the learning takes place in a non-game context and requires the endeavour, knowledge and skills of participants to reach their goals [16].

The concept of *serious games* could also be regarded as quite close to that *of gamification*, yet their differences lie in the fact that the former is a complete game setting for non-recreational purposes on a serious subjects whereas, as mentioned previously, the latter adopts game elements in other non-game systems contexts [6].

Another concept that probably needs to be addressed is that of *play*. Games imply a set of norms and regulations to reach an objective usually through competition, unlike *play* which rather involves a free improvising behaviour with a sense of enjoyment [17]. However, gamification has also been described by resorting to aspects of *play*: "Gamification is the application of gameful or playful layers to motivate involvement within a specific context" [18]. The distinction between these two concepts is based on the previous analysis made on the specificities of *paidia* (i.e. play) and *ludus* (i.e. games) [19]. In other words, games would result from the formalisation of *play* through the establishment of rules, norms and explicit objectives. For its part, gamification relates to games, which in turn has ties with *play*, and aims at benefiting from the stimulating features of these two concepts [20]. These are all definitions that suggest a possible lack of consensus concerning the explicit inclusion of the notion *play* when defining gamification. Yet, some industrial sectors criticise the insufficient components of *play* in the gamification design and consider that, if included, they could probably render the gamified solution more engaging [6].

The connexions of '*gamification*' with '*games*' and '*play*', constitute a web of major concepts related to one another of this research topic. In fact, each one of these terms is polysemic, thus in each of them coexist several meanings. In addition to the thorough and articulated definitions on *gamification, games* and *play* provided by the authors mentioned previously, a semantic mapping [21] of these concepts as well as with of those related to main purpose of gamification (i.e., '*engaging*' and '*motivating*' users) is developed here below to have a synthetic overview on how these notions tie with one another, on the meanings they share or that differentiate them.

2.1 Semantic mapping of gamification, game, play, motivation and engage

2.1.1 Goal

The aim of this section is providing a holistic scheme so as to visually display the concepts semantically related to the main terms of this study (gamification, game, play, engage, motivation) independently of their specialised definitions mentioned previously. Based on the distinctions and sameness between the meanings arising from these main words, it is intended to highlight the notions that would match the purpose of gamification and those that would diverge from it and could represent potential threats.

2.1.2 Method

We looked for the dictionary definitions [22] of the main concepts to grasp this tool (i.e., *gamification, game, play, motivation, engage*). The key words (terms directly related to this research topic) defining each of these concepts were included in the semantic net around the word they are related to. For example, the definition of gamification was: *Transformation of a product/story into a game.* The association between the gamification definition and the term *game* as a key concept on which this definition is based, is represented with the arrow linking *gamification* with *game.* In turn, the key word *game* was subject to a new cycle of search definition whose key words were also included in this semantic net with the corresponding

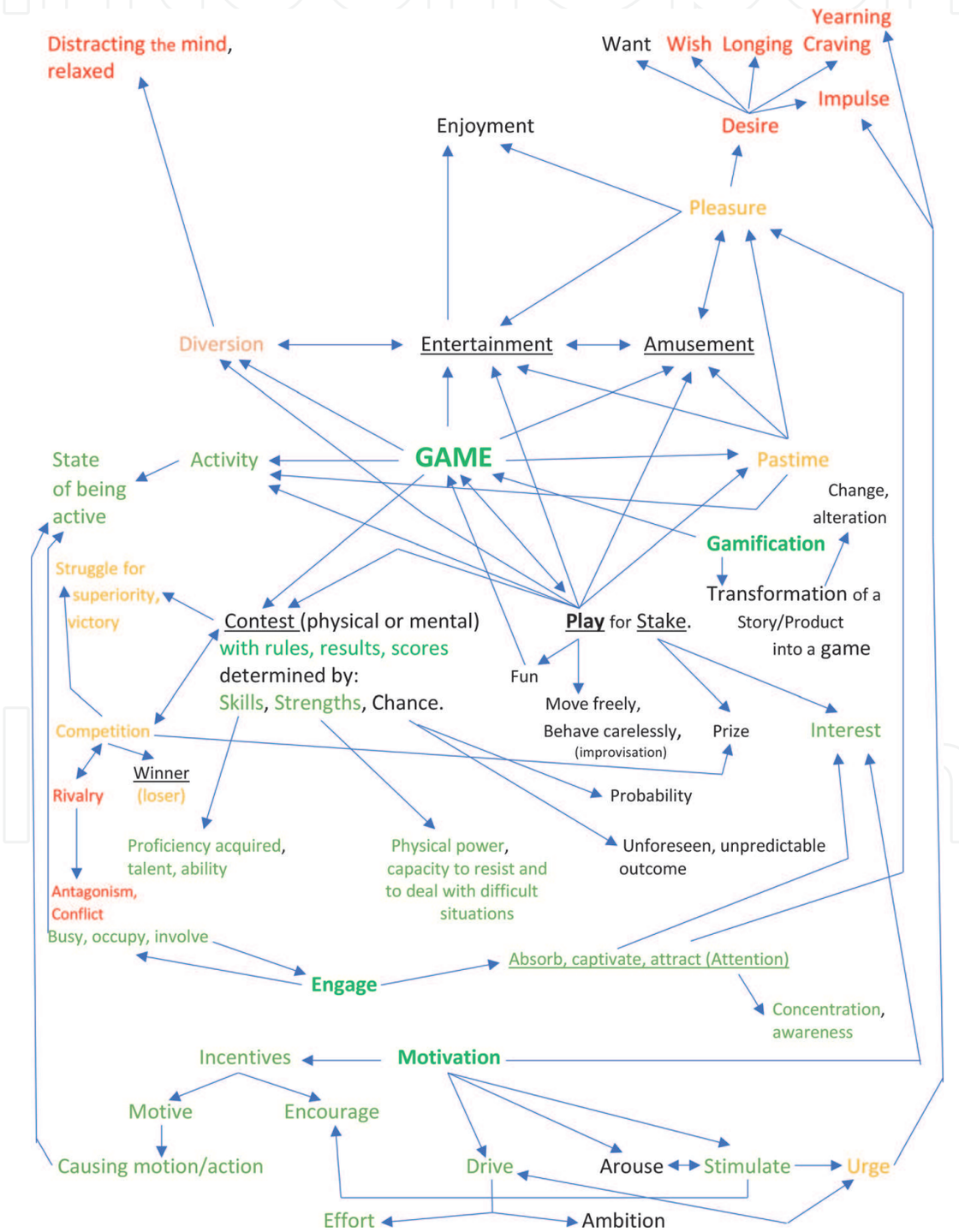

Figure 1.
Semantic net graphic of Gamification, Game, Play, Engage and Motivation.

arrows tying *game* with to each of the key words sustaining its meaning. Then, each of these key words went through the definition search. The same proceeding was applied over again until the key words of the new definition were the same ones as those previously found or were out of the scope of this research. This process was undertaken for the five mentioned words in one integrated mapping. Finally, the meaning-based connections between the identified terms were underlined or coloured according to their degree of compatibility with the gamification purpose as described in 2.1.3.

2.1.3 Results of the sematic mapping

The graphic illustrates the results of the semantic mapping (**Figure 1**) which shows the obvious and expected link between *gamification* and *game*. In turn, *game* shares an important common ground with *play.* Although often gamification definitions do not resort to the notion of *play,* this conceptual intersection between *play* and *game* might raise the question as whether these two concepts could be separated from each other.

In principle, the areas in green are affordances, psychological and behavioural outcomes that gamification is meant to promote [7], whereas the words in red represent those that the tool is not supposed to foster and may designate risky areas [7, 9]. The words in black and underlined would be affordances, psychological and behavioural outcomes that gamification would use and aim at in moderation.

On the other hand, the orange coloured text would highlight those indicating a possible risk for the gamification approach to deviate from its purpose.

We are aware that there is not always a clear cut between these notions and that much can be debated about how these concepts relate with gamification. The last section of this chapter deepens and expands the analysis on these issues.

3. Research approach

To investigate the possible threats resulting from gamification, an integrative literature review approach was implemented [11, 23]. This approach intends to gather relevant observations and findings of existing literature review studies enabling to deepen insights into the issues and trends likely to provide elements of answer to the research question. In particular the aim is identifying the unintended side effects, challenges and limitations of gamification detected and analysed in the included studies from which may be inferred the possible perils arising from gamification, and thus compensating the shortage of papers studying specifically the threats resulting from this tool.

The mentioned approach consists in three phases:

1. The choice of words for the search of studies was intended to be as broad as possible given the previously mentioned dearth of papers covering specifically the threats of gamification. Consequently, several words were used to refer to the possible adverse impacts of gamification. The terms chosen to search the studies in all used databases were: *literature review, gamification, risks, disadvantages, threats, negative impacts, unintended side effects*.

The four inclusion criteria were: 1) Published peer reviewed papers 2) Literature review studies 3) Written in English 4) Papers that examine, at least partially, the negative consequences and/or threats of gamification. Were excluded: 1) Posters

2) Non-published studies 3) Studies written in other languages than English. Literature review papers on empirical studies about gamification implementation pros and cons were privileged so as to increase the chances to identify frequent trends about the research question of this chapter.

2. To check the relevance of the literature review studies a closed question was used: *Does the study provide explicit information on the negative outcomes of gamification (limitations, side effects, risks, threats, challenges)?* In practical terms, the title of all the studies detected was analysed to verify whether it referred explicitly or implicitly to the research question. If yes, the abstract and key words were in turn analysed to corroborate that the mentioned gamification issues were covered by the study. Then the paper was scrutinised to further reassert that it provides an explicit description/synthesis of the challenges, unwanted effects, negative impacts of gamification solutions so as to ensure the match of the study with the purpose of this chapter and finalise the selection process. Due to the scarcity of literature review papers on this specific research question identified through the databases, other literature review studies matching the inclusion criteria were found via references.

3. A manual content analysis was carried out to detect the items or paragraphs related to the mentioned gamification's issues linked to the search words. The leading thread to conduct this content analysis was the question "what challenges/risks/threats/negative impacts were encountered when implementing gamification?". The identified items/texts from the selected studies are summarised and described in Section 4. Besides, all the identified items/texts are listed in **Table 1** and constitute the measures of this phase. Since, as expected, some items were the same or very similar across the included studies, based on their commonalities they were grouped in homogeneous categories (gamification issues) and the frequency of items per category relative to the total number of identified items was calculated (**Table 2**). In turn, these categories went through two processes. First, they were grouped in clusters according to their ties with the functions or fields of gamification, with the purpose of reaching a more synthetic overview and detecting the areas of gamification where dysfunctions were observed or reported. Secondly, for each of the categories the open question was posed: "*What are the potential adverse impacts of these items*?" [24], so as to explore and infer the possible threats that may arise from them at both the individual and collective/organisational levels. This second process led to the identification of perils that could result from the mentioned categories. The result of this analysis with all the mentioned components is described and synthesised in 4.2 and **Table 3** respectively.

4. Results

The search was carried out by employing the key words mentioned earlier in the following databases through the University of Maastricht: Clarivate Analytics, JSTOR (filters used: science & engineering, journal articles), PubMed, MEDLine (Ovid SP), Clarivate Analytics (filters used: medicine, health & life science), EBSCO host APA PsycArticles (filters used: psychology & neuroscience, journal articles), Google Scholar and Maastricht University online library.

	Included Literature Review Studies	Identified Items/texts on Limitations, Challenges and Negative Unintended Side Effects of Gamification
1.	"Does gamification work? A literature review of empirical studies on gamification". J. Hamari, J. Koivisto and H. Sarsa (2014). [25]* Number of examined studies included in this review: 24	• Gamification might not be effective in utilitarian contexts • Results of gamification may not be long term • Some users did not find gamification engaging
2.	"The dark side of gamification: How we should stop worrying and study also the negative impacts of bringing game design elements to everyone". S. Hyrynsalmi, J. Smed and K. Kimppa (2017) [9]* Number of examined studies included in this review: 26	• Users might be optimising the end-result game (ex. Position in leader boards) and not the task at hand • Some gamified solutions may be simplistic, childish and therefore demotivating • Some gamified solutions may encourage users to perform behaviour only when rewarded. • Gamified solutions may distract users from the main purpose • Risks of replacing intrinsic motivation with pursuit of extrinsic rewards • Ethical issues: ex. taking advantages of users, infringing their autonomy. • Lucrative gaming elements for one user can be detrimental to teamwork
3.	"A systematic review of gamification in e-Health". L. Sardi, A. Idri and JL Fernandez-Aleman. Journal of Biomedical Informatics, 17 (2017), [26]* Number of examined studies included in this review: 46	• Effectiveness of the gamification solutions can lessen when relying on only one game element. • There is no unified framework for evaluating gamification principles and outcomes. • Users might feel motivated and excited about the gamification elements, but the interest declines over time • Gamification elements are sometimes perceived to be meaningless and not helpful in terms of the system's healthcare purposes • Gamification solutions are not users-centred as they overlook the traits and demographics characteristics of potential users. • Some rewards were judged to be irrelevant or exaggerated • Gamified health solutions do not integrate health professionals in their development • Cheating may increase as users might work to achieve higher levels solely for their sake of rewards • There is a significant lack of control between the elements of gamification and thus various elements were viewed as a single one
4.	"Gamification of enterprise systems – A synthesis of mechanics, dynamics and risks". M. Schmidt-Kraepelin, S. Lins, S. Thiebes S. and Sunyaev A. (2019), [27]* Number of examined studies included in this review: 62	• Quality of tasks might suffer if gamified elements distract from the main purpose of the activity • Low implementation quality of mechanics and dynamics which might lead to dysfunctional reward system or interaction concepts and may result in users' demotivation. • If underlying rules are not clearly defined, it enables cheating, which can lead to rejection of implemented game elements by other employees

Included Literature Review Studies	Identified Items/texts on Limitations, Challenges and Negative Unintended Side Effects of Gamification
	• Monitoring and surveillance of both the performed activity and the performing employee are likely to breach privacy rights • An overemphasis of competition might lead to decreasing participation and not appeal to employee. Competition might undermine cooperation, which is needed in business contexts • A decreased effectiveness can occur once the novelty of gamification has worn off. • By excessively granting extrinsic rewards, the underlying intrinsic motivation can be undermined
5. "Gamification in health behaviour change support systems – A synthesis of unintended side effects". M. Schmidt-Kraepelin, S. Thiebes, S. Stepanovic, T. Mettler and A. Sunyaev (2019), [7]* Number of examined studies included in this review: 33	• Undermining intrinsic motivation • Motivation decreases over time • Unfulfilled expectations (generated by gamification solutions) • Distraction from health purpose • Trivialising the health context • Reduced usability: confusing/too complex interface • Cheating the self • Incorrect reward • Execution overuse due to wrong rewards • Cheating others • Overemphasised peer pressure (competition) • Exaggerated punishment • Feeling of manipulation • Discouragement due to failure in competitions • Privacy infringements • Fostering behaviour that harms third parties
. Total included Literature Review Studies: 5 . Total studies on gamification reviewed by the five included Literature Reviews: 187	Total: 42 identified items

Table 1.
Included literature review papers, number of studies on gamification examined by them and the 42 identified items/texts on limitations, unintended negative side effects, risks and challenges of gamification. () numbers in brackets allud to the bibliographic references.*

All databases together, the search conducted beginning of September 2020 produced 1696 hits from which 2 literature review studies were selected. Due to the considerable dearth of literature review papers about our research topics, 3 other studies that met the inclusion criteria were found via references. Consequently, altogether 5 literature review papers were selected and included, which in total analysed 187 studies on gamification and identified 42 negative unintended side effects, limitations, risks and challenges about its implementation, all of them listed in **Table 1**.

Although the methods and the examined gamification contexts somewhat vary across the five selected literature review studies, they yielded to an important extent common and/or converging gamification issues as described here below.

For instance, in their literature review Hamari et al. [25] aimed at measuring the effectiveness of gamification by examining 24 peer reviewed empirical studies on gamification in different contexts. In particular, the areas explored referred to the

used *motivational affordances*, and their impact in terms of *psychological* and *behavioural* outcomes. In terms of gamification issues, the results of this study would indicate that gamification may be less compatible with utilitarian contexts, with some profile of users and would only have a short-term impact. Methodologically though, it is noteworthy remarking that 17 (out of the 24-peer reviewed empirical studies) utilised qualitative users' perception measurements only without using control groups. Moreover, most of their experiment timeframes were quite short and consequently the novelty effect might have impacted users' perceptions. In addition, the motivational affordances as well as the psychological/behavioural outcomes varied between the studies.

Hyrynsalmi et al. [9] tackled more straightforwardly the issues arising from this tool from a researcher perspective. Indeed, their research question aimed at exploring *"how researchers have perceived the negative side effects of applying gamification?"*. To do so, authors carried out a systematic literature review (SLR) that included 26 literature review studies about gamification on which they implemented a content analysis that led to the definition of two categories of negative consequences: 1) Limitations of gamification (i.e., moderate or less optimal outcomes of gamified system), which could be demotivating, detrimental to teamwork or distracting users from their core activity. 2) Harmful consequences (i.e., gamified solution producing users' questionable and potentially unethical behaviours), that may lead to problem of ethical nature. It is important underlining that this SLR relied on secondary studies and thus lacks the detailed information on specific issues that primary studies may provide.

Sardi et al. [26] also run a SLR, but they focused their study to explore the advantages and shortcomings of gamification in e-health. Several research questions were addressed, among which the one that relates to our integrative review: "Which challenges are most frequently encountered during gamification?". In total the authors included 46 studies that were examined via structured questionnaire to extract data from them to answer the research questions. The challenges identified were also around the decline of users' interest over time, the poor design of gamified solutions and the ethical issues. Besides, other important issues were detected, namely the inadequacy of rewards, the poor tailoring of the gamified solutions and the lack of united framework for evaluating gamification principles and outcomes. This SLR provides a more holistic analysis of the challenges associated with gamification, but it specifically examined the e-health sector only.

Schmidt-Kraepelin et al. [27], studied the use of gamification in Enterprise Systems (ES). Apart from exploring how gamification could increase ES end-user acceptance, the authors raised and examined the research question that is quite linked to our integrative review: What risks are related to applying gamification in ES contexts? Altogether, 62 studies (quantitative and qualitative) on gamification were selected and analysed. The focus of this literature review was centred on gamification's mechanics, dynamics (Zichermann and Cunningham 2011) and risks. In total 339 mechanics and dynamics were identified (172 empirically confirmed). The negative consequences of gamified Enterprise Systems (perceived risks) amounted 59 risks, which were categorised in seven master-risks. The found risks relate to areas similar to those identified in the previous studies, in particular the ethical issues, the declining impact of gamification over time, the grabbing of users' attention at the expenses of the main purpose and the dysfunctional rewards. Concerning the last point, the authors state how a moderate quality of gamification mechanics and dynamics adversely impacts the rewarding system, which in turn leads to users' demotivation. On the other hand, the interaction between the mechanics and dynamics is not analysed in this study.

Finally, Schmidt-Kraepelin et al. [7] examined the consequences of gamification as a means to support behavioural change in the health domain. The authors run a literature review with the aim of exploring the research question "*what unintended side effects may occur when implementing gamification in the health behaviour change support systems*?". In this literature review 33 studies were included; peer reviewed papers were prioritised. Data was processed through manual content analysis and by using an open coding approach, which yielded 16 potential unintended side effects linked with motivational issues (undermining intrinsic motivation, motivation decreasing over time), rewarding system inadequacies, distraction from the core purpose of the activity, ethical matters, poor match with the context and low-quality system interface. The moderate running-in of this tool is worthy of note and thus requires cautiousness about its impact evaluation.

The detailed information about this phase is presented in **Table 1**, which lists the titles of the included literature review studies and describes the 42 unintended negative side effects, risks and challenges of gamification identified by them.

4.1 Classifying the 42 identified items on limitations, risks, challenges and unintended side effects of gamification

Despite the different methods used and the variety of gamification contexts examined in these studies there are clear similarities among the 42 identified items on the risks, challenges, limitations and side effects of gamification. Consequently, items sharing analogue meanings or belonging to the same gamification area/function were set in the same cluster. In other words, the listed 42 items in **Table 1** went through a grouping process and based on their commonalities and semantic consistencies a total of 11 categories were constituted.

For instance, the four items referring the short-term impact of gamification and its decline over time were grouped in the same category (Short-term impact of gamification on users' motivation).

The same goes for the two items related to the poor users-centred gamified solutions and the absence of integration of health professionals' input in gamification development (None or insufficient tailoring in the gamification design and development).

The three items alluding to gamified solutions not fitting the demands of the environment constituted the category 'Mismatch between gamification and its context'.

The item stating the absence of united framework for evaluating gamification principles and outcomes is related to the two previous categories albeit as a cause of them rather than as part of them, hence its status as one item category (Lack of evaluation tool).

The four items associated with gamified elements deviating users' attention from their core duties and activities were grouped under the category 'Possible over-emphasis on hedonic elements at the expenses of the utilitarian purpose'.

The four items related to users taking unfair advantage of gamified systems were placed in the 'Cheating' category.

The four items linked with the possible misuse of gamification (surveillance, manipulation, exploitation and infringing privacy and autonomy of users) formed the category 'Moral and Legal Principles Matters'.

The six items referring to the impact of poorly designed gamified solutions on users' motivation and engagement were set in the category 'Usability of gamified solutions and users' motivation'.

The seven items stating the inconsistent rewards generating demotivation or misbehaviour constitute the category 'Unsound encouraging/punishing'.

Categories of gamification issues	Items x Category	Frequency
Possible over-emphasis on hedonic elements at the expenses of the utilitarian purpose	• Quality of tasks might suffer if gamified elements distract from the main purpose of the activity [27] • Gamified solutions may distract users from the main purpose [9] • Users might be optimising the end-result game (ex. Position in leader boards) and not the task at hand [9] • Distraction from health purpose [7]	4/42
Short term impact of gamification on users' motivation	• A decreased effectiveness can occur once the novelty of gamification has worn off. [27] • Users might feel motivated and excited about the gamification elements but the interest declines over time [26] • Results of gamification may not be long term [25] • Motivation decreases over time [7]	4/42
None or insufficient tailoring in the gamification design and development	• Gamification solutions are not users-centred as they overlook the traits and demographics characteristics of potential users [26] • Gamified health solutions do not integrate health professionals in their development [26]	2/42
Lack of evaluation tool	• There is no unified framework for evaluating gamification principles and outcomes. [26]	1/42
Mismatch between gamification and its context	• Gamification elements are sometimes perceived to be meaningless and not helpful in terms of the system's healthcare purposes [26] • Gamification might not be effective in utilitarian contexts [25] • Trivialising the health context [7]	3/42
Cheating	• If underlying rules are not clearly defined, it enables cheating, which can lead to rejection of implemented game elements by other employees [27] • Cheating may increase as users might work to achieve higher levels solely for their sake of rewards [26] • Cheating the self [7] • Cheating others [7]	4/42
Moral and Legal Principles Matters	• Monitoring and surveillance of both the performed activity and the performing employee are likely to breach privacy rights [27] • Taking advantage of users, infringing their autonomy. [9] • Feeling of manipulation [7] • Privacy infringements [7]	4/42
Usability issues of gamified solutions and users' motivation	• Effectiveness of the gamification solutions can lessen when relying on only one game element. [26] • There is a significant lack of control between the elements of gamification and thus various elements were viewed as a single one. [26] • Some gamified solutions may be simplistic, childish and therefore demotivating [9] • Some users did not find gamification engaging [25]	6/42

Categories of gamification issues	Items x Category	Frequency
	• Reduced usability: confusing/too complex interface [7] • Low implementation quality of mechanics and dynamics which might lead to dysfunctional reward system or interaction concepts and may result in users' demotivation [27]	
Unsound encouraging/punishing (explicit or implicit)	• Some rewards were judged to be irrelevant or exaggerated [26] • Some gamified solutions may encourage users to perform behaviour only when rewarded [9] • Exaggerated punishment [7] • Execution overuse due to wrong rewards [7] • Incorrect reward [7] • Unfulfilled expectations (generated by gamification solutions) [7] • Fostering behaviour that harms third parties (doc 3)	7/42
Weakening cooperation, teamwork	• An overemphasis of competition might lead to decreasing participation and not appeal to employee. [27] • Lucrative gaming elements for one user can be detrimental to teamwork [9] • Overemphasised peer pressure (competition) [7] • Discouragement due to failure in competitions [7]	4/42
Overemphasis on extrinsic motivational elements and users' intrinsic motivation	• By excessively granting extrinsic rewards, the underlying intrinsic motivation can be undermined [27] • Risks of replacing intrinsic motivation with pursuit of extrinsic rewards [9] • Undermining intrinsic motivation [7]	3/42

Table 2.
Categories of gamification issues, the identified items (unintended side effects, limitations, risks and challenges of gamification) per category with the bibliographic reference number in brackets of the study that originally detected them, the frequency of the mentioned items per category relative to the total number of items.

The four items indicating that competition-like gamified solutions may take place at the expenses of cooperation were grouped under the cluster 'Weakening cooperation, teamwork'.

Finally, the three items showing the negative impact of gamified solutions linked with extrinsic rewards on intrinsic motivation of users formed the category 'Overemphasis on extrinsic motivational elements and users' intrinsic motivation'.

These categories are presented with their corresponding items and the frequency of the mentioned items per category relative to the total number of items (**Table 2**).

4.2 Threats of gamification

In turn, these eleven categories with their respective items went through a double processing whose aim is to facilitate the identification of threats and their localisation in relation to the organisational areas/functions of gamification. That is: 1) Grouping them according to the major areas/functions of the gamification system where these limitations and unintended side effects have been observed or

reported. 2) Inferring the threats that could arise from them by exploring the potential adverse impacts of their items.

The content analysis suggests that the design and development phase of the gamification system, its rewarding system and the ethical sphere are the gamification areas/functions associated with the detected issues. Although it could be stated that most identified negative impacts of gamification result from insufficiencies in the design and development phase, some of them are associated more specifically to particular domains of gamification, hence the formation of two other areas/functions of gamification (i.e., Flawed Rewarding System and Ethical Issues). As for the threats, some areas and/or mismanagement of this tool could lead to perils, namely a loss of gamification/management credibility, low productivity, users' demotivation, an atmosphere of mistrust tied with health and ethical issues. Each of these areas/functions of gamification with their respective categories are described below, along with the possible threats that arise from them.

4.2.1 Inadequate gamification design and development phase

This area of gamification is composed of several categories. The category "None or insufficient tailoring in the gamification design and development" that leads to a "Mismatch between gamification solution and its context". Moreover, design deficiencies result in "Usability issues of gamified solutions" as well as in two other categories "Gamified elements distracting from the main purpose" and "Cheating". This scenario may be worsened by the "Lack of evaluation tool" which would prevent from ensuring the learning process required to adjust and improve the gamification system. At the organisational level, an inadequate design and development of gamification, would, through its implementation dysfunctions, impact adversely the credibility of both the gamified system and that of Management [26, 27]. It would also imply a productivity loss and thus a low cost-effectiveness as well as a low implementation quality of mechanics and dynamics that would engender problematic interactions and an inefficient reward system [27].

Moreover, from a user stand point, "Gamified elements distracting from the main purpose" would suggest, at least partially, the engaging effect of flow [9]. Whilst this emotional state may serve the purpose of gamification (engaging and motivating), it may also put at risk users with gaming addiction history [9] and with attention deficit disorders (ADD) [28]. The nature of this category, due to its health-related impact, may be regarded as an extension of the "Ethical issues". Finally, although the "Usability issues of gamified solutions" are not elements of the rewarding system per se, they would also have a demotivation impact on users like a flawed rewarding system does [9].

4.2.2 Flawed rewarding system

As a function, the rewarding system is probably the gist of the gamification process. The observed "Unsound encouraging/punishing" measures produce unintended effects such as "Some gamified solutions may encourage users to perform behaviour only when rewarded", "Users' Motivation declines over time", "Execution overuse due to wrong rewards" or even "Fostering behaviour that harms third parties" which can have ethical consequences [7]. Besides, the over use of competition as a means to increase users' engagement might weaken "cooperation and teamwork" [9, 25], with the risk of deteriorating the interactions and the atmosphere among users [7]. Furthermore, the gamified solution that "overemphasise the extrinsic motivation" could eventually hinder users' motivation [8, 9, 18].

Areas/ functions of gamification	Categories of gamification issues	Items (limitations, unintended side effects, challenges of gamification) x category	Possible Threats	Frequency of items x Areas/ functions of gamification
Inadequate gamification design and development	None or insufficient tailoring in the gamification design and development	• Gamification solutions are not users-centred as they overlook the traits and demographics characteristics of potential users • Gamified health solutions do not integrate health professionals in their development	• Hindering the credibility of the gamified system as well as that of management [7, 26]	20/42 (47.6%)
	Mismatch between gamification and its context	• Gamification elements are sometimes perceived to be meaningless and not helpful in terms of the system's healthcare purposes • Gamification might not be effective in utilitarian contexts • Trivialising the health context	• Productivity loss [27] • Low cost-effectiveness	
	Lack of evaluation tool	• There is no unified framework for evaluating gamification principles and outcomes		
	Usability issues of gamified solutions	• Effectiveness of the gamification solutions can lessen when relying on only one game element. • There is a significant lack of control between the elements of gamification and thus various elements were viewed as a single one • Low implementation quality of mechanics and dynamics which might lead to dysfunctional reward system or interaction concepts and may result in users' demotivation • Some gamified solutions may be simplistic, childish and therefore demotivating	• Demotivating users [8, 9, 27]	

Areas/ functions of gamification	Categories of gamification issues	Items (limitations, unintended side effects, challenges of gamification) x category	Possible Threats	Frequency of items x Areas/ functions of gamification
		• Some users did not find gamification engaging • Reduced usability: confusing / too complex interface		
	Cheating	• If underlying rules are not clearly defined, it enables cheating, which can lead to rejection of implemented game elements by other employees • Cheating may increase as users might work to achieve higher levels solely for their sake of rewards • Cheating the self • Cheating others	• Demotivating users [8, 9] with possible ethical implications	
	Possible over-emphasis on hedonic elements at the expenses of the utilitarian purpose	• Quality of tasks might suffer if gamified elements distract from the main purpose of the activity • Gamified solutions may distract users from the main purpose • Users might be optimising the end-result game (ex. Position in leaderboards) and not the task at hand • Distraction from health purpose	• Decreased productivity • Health Matters [9, 28]: Possible flow generating gamified solutions that could put at risk users prone to addiction or with ADD	
Flawed Rewarding System	Unsound encouraging/ punishing	• Some rewards were judged to be irrelevant or exaggerated • Some gamified solutions may encourage users to perform behaviour only when rewarded • Exaggerated punishment • Execution overuse due to wrong rewards • Incorrect reward • Unfulfilled expectations (generated by	• Hampering users' motivation, frustrating users, undermining cooperation, thus obtaining the opposite effects relative to the gamification's goals [8, 27]	18/42 (42.8%)

Areas/ functions of gamification	Categories of gamification issues	Items (limitations, unintended side effects, challenges of gamification) x category	Possible Threats	Frequency of items x Areas/ functions of gamification
		gamification solutions) • Fostering behaviour that harms third parties *		
	Overemphasis on extrinsic motivational elements rather than on intrinsic ones	• By excessively granting extrinsic rewards, the underlying intrinsic motivation can be undermined • Risks of replacing intrinsic motivation with pursuit of extrinsic rewards • Undermining intrinsic motivation		
	Weakening cooperation, teamwork	• An overemphasis of competition might lead to decreasing participation and not appeal to employee. • Lucrative gaming elements for one user can be detrimental to teamwork • Overemphasised peer pressure (competition) • Discouragement due to failure in competitions		
	Short term impact of gamification on users' motivation	• A decreased effectiveness can occur once the novelty of gamification has worn off. • Users might feel motivated and excited about the gamification elements but the interest declines over time • Results of gamification may not be long term • Motivation decreases over time		
Ethical Issues	Moral principles matters	• Monitoring and surveillance of both the performed activity and the performing employee are likely to breach privacy rights	• Generating an atmosphere of mistrust [27]	4/42 (9.5%)

Areas/ functions of gamification	Categories of gamification issues	Items (limitations, unintended side effects, challenges of gamification) x category	Possible Threats	Frequency of items x Areas/ functions of gamification
		• Taking advantage of users, infringing their autonomy • Feeling of manipulation • Privacy infringements		

Table 3.
The areas/functions of gamification with their corresponding categories of gamification issues, items x category (limitations, risks, challenges and unintended side effects of gamification), possible threats arising from gamification (with the bibliographic reference number in brackets) and frequency of items per areas/function of gamification relative to the total amount of items expressed in fractions and percentage.

Overall, the failures concerning the rewarding system are a threat at both the individual and collective level insofar as they may hamper users' motivation or lead to users' frustration [7, 27], and thus obtaining the opposite results relative to those targeted by the gamification system [9].

4.2.3 Ethical issues

This sort of critical matters usually results from the two previous areas/functions of gamification (an Inadequate Gamification Design and Development phase, and a Flawed Rewarding system). It could relate to a moderate quality of gamified solutions, in which underlying rules are not clearly defined and enable "cheating". Ethical issues might also arise from the way in which the gamification system handles users' data, defines and implements the users' role ("Privacy and autonomy infringements", "feeling of manipulation") [27, 29]. Besides, as mentioned earlier, rewards that "Foster behaviour that harms third parties" could have also ethical consequences [7]. These issues may generate a sense of mistrust and thus demotivate users, which in turn would weaken the adherence to the system [7].

The synthetic overview of the possible threats arising from areas and functions of gamification are summarised in the **Table 3**.

In short, an inadequate gamification design and development (partially due to the lack of framework to evaluate this tool) would lead to several negative consequences [26]. That is, the usability issues of the gamified solutions together with the flawed rewarding system might adversely impact the motivation of users [27], thus obtaining the opposite outcome of the gamification purpose [9]. Moreover, rewards that foster behaviours that may harm third parties would have ethical consequences [7]. Besides, the moral/legal matters [7, 27] as well as the hedonic emphasis of some gamified solutions could generate ethical and health-related issues [9], thus risking to cause mistrust, which in turn might aggravate the already weakened engagement and motivation of users due to the dysfunctional rewarding system. Then, the users' demotivation and the mistrust may threaten and jeopardise the credibility of both the gamification approach and that of the management in charge of it with the negative impact it may have on productivity, cost-effectiveness, etc. [7, 26, 27]. Finally, this credibility loss, in turn, would worsen both users' demotivation and mistrust [27].

5. Discussion

Overall, this integrative review on gamification suggests that an inadequate design and development phase together with the flawed rewarding system and the moral/legal negative issues arising from it, may be sources of threats for both organisations and individuals, and could possibly jeopardise the management and approach credibility, demotivate users, generate ethical and health issues leading to mistrust [7, 9, 25–27]. Unsound rewards and poor usability of gamified solutions are the categories of gamification issues with the highest number of reported items.

The included studies, among other matters, explored the gamification side effects in several areas (i.e., Education, Health, Business, etc.), yet many negative outcomes seem to occur across sectors. Although the reviewed literature highlights the relevance of the mentioned potential adverse impacts and threats, it is noteworthy wondering how gamification specific they are. Gamification presents similarities with previous information systems (IS) (i.e. intrinsically motivating IS, Persuasive IS, Hedonic IS) whose goals also aim at motivating and engaging users [30]. Moreover, gamification may be regarded as an attempt to improve and/or facilitate pre-existing managerial practices aiming at increasing users' engagement under the assumption that it will have a positive effect on performance [18, 31]. In line with these statements, frustrating and/or demotivating workers/users through childish tasks or over complex processes, or by over encouraging competition at the expenses of cooperation is not a particularity of gamification since the same phenomenon could be produced with other means. The same goes for ill-managed policies resulting in the risk of losing management credibility, obtaining production loss and decreased cost-effectiveness. Designing flow-generating cyber game-like activities with its potential health effects it has for those with a history of gaming addictions [9, 32] is not a distinctive trait of gamification either. Thus, considering that most gamification risks and perils can be found in already pre-existing concepts and practices, it could be stated that at least the mentioned threats may occur in a gamified approach although they do not constitute per se a feature of gamification uniqueness.

It could be posited that gamification would suffer from its design dilemma. That is, since highly stimulating tasks do not require boosting the motivation via other means, it supposes that gamification is meant to target activities which may be important and/or necessary (ex. Commercial, educational, health related tasks etc.) but less stimulating or even somewhat unpleasant [9]. It is assumed that rendering these less attractive tasks more stimulating by introducing the engaging components of games would possibly increase users' participation and thus the performance level [33].

Now, as described below, gamification could rely on gameful or playful components to fulfil its purpose [18]. Although, (video) games are structured around a set rules and competition, they do provide also to some extent with some the room for improvising and enjoying like play does. Indeed, it has been observed the massive use of video games would be explained by motives that could match the targets of certain gamified solutions (skills development, competition, socialising), but also by other reasons that could hinder the gamification purpose (designed to achieving serious goals) like evading one-self, moving into a fantasy world and relaxing [34], which probably derive from the main emotional states associated with play (joy, lightness and flow) and are correlated with opioids release as well as with the activation of ancient brain structures such as the para-fascicular and posterior thalamic nuclei [35].

Ethologically, understanding the functions of play may contribute to assessing the feasibility or the impossibility of transposing some of its engaging components to gamification (applied in serious contexts). Play would serve social purposes

(bonding, cooperation, competition) as well as individual aims associated with survival and social interests (learning physical skills, innovation, tool use), and would exercise the production and mastering of affective behaviours, as a possible waking alter ego of dreaming which processes affective states during the rapid eyes movements cycles while sleeping [35]. It is noteworthy remarking that the cholinergic system (involved in memory, emotional processing and selective attention) [36] is associated with both playing and dreaming [35]. Besides, among mammals and due to their extended childhood and adolescence, humans experience the longest playing time [35], which would imply that this innate activity with its hedonic components is quite anchored in memory and probably rather dissociated from serious contexts.

The mentioned distinctive emotional features of *play* (joy, lightness and flow) suggest that a safe environment is required for the ludic activity to occur, as observed in animal models where rodents set in a new environment adopt an exploratory behaviour to familiarise with it before being in the mood for playing [35]. A supplementary index supporting this view is that laughter, in young humans. as an innate emotional action linked with the activation of ancient brain systems, is strongly associated with play [35] and also suggests enjoying time within a secure context.

Along these lines, fear and hunger (among other states like rage, anger and separation distress) stop playing [35]. Whilst hunger is quite unlikely to happen in a gamification scenario, it might not be always the case for fear. For instance, some competition-like gamified solutions whose results are related to important personal goals (ex. Being promoted, being positively judged, etc.), could trigger fear in users, particularly in anxious ones, and render them reluctant to engage lest gamified solutions would prevent them to achieve their objectives. The same would go for anger resulting from a gamified solution perceived as unfair, or for separation distress produced by providing open access to comparative performance displays (leader boards), which could engender in poor performers the fear of being disregarded by others or of losing their jobs.

This foundation of gamification would argue in favour of a safe context as a prerequisite for gamification and raises several challenges that, if inappropriately managed, may have adverse impacts on both organisations and individuals. For instance, one challenge would be how to render the unattractive task more engaging through game elements generating joy and lightness without trivialising the gamified solution [37] and/or the entire gamification policy, with all the risky consequences this approach might have in terms of management credibility and of users' adherence to the gamified approach [7]. The fact that gamification is usually applied in serious contexts [29] makes this issue even more relevant and raises the question of whether this approach is the most suitable for this sort of settings. Moreover, when the users end up mastering the process by which they obtain the gamification rewards (points, badges, etc.) their involvement level in the gamified solution is reduced [18], which compromises the purpose of the gamification policy [9].

It is likely that the adverse impacts that gamification may have on users are of the same nature as those arising from games [9]. In this line, when playing competition-like video games, the level of dopamine (DA) released in the ventral striatum (a brain area mediating reward, cognition, reinforcement and motivation) is quite comparable to that produced by psycho-stimulant drugs [38, 39]. Enhancing the attractiveness of an activity by introducing flow-generating elements in it could also be a matter of concern. In effect, it has been observed that flow recruits the brain circuits associated with cognitive synchronisation of the attentional function together with those of the brain rewarding system and consequently places the

individual in a "here and now" mode, sometimes engendering distorted perception of place and time [40]. Moreover, excessive exposure to video game has been associated with attention deficit, impulsivity and reduced proactive cognitive control [28, 41, 42]. This grabbing of the entire attentional resources may lead the individual to focus on one particular aspect of the gamified solution at the detriment of broader and more important matters [7, 9, 27].

Besides, over-emphasising the hedonic traits of gamified solutions not only could diminish the users' awareness of the utilitarian purpose of this approach but also may put at risk certain users. Indeed, gaming cues may increase craving in those with gaming disorders [43], which would represent a perilous situation for users with a history of game addiction [9]. Examples of gamification in large organisations showed that an important proportion of users perceive the process as addicting, or they may encounter difficulties prioritising the serious purpose of gamification due to the compulsion they feel to seek rewards [29]. Physiologically, this could be the result of an over DA release at the expenses of serotonin (5HT) since both neurotransmitters share the same amino acid transporter, which leads to an unbalance in the DA-5HT interaction preventing the serotoninergic system to display its inhibitory function to moderate the over activation of the dopaminergic system [44] and consequently increases the likelihood to worsening the mentioned addictive disorder [45]. Moreover, in this sort afflictions, flow may disrupt the perception of individuals [32, 46] that could result in somewhat distorted insights into their emotional states associated with their addictive behaviours [45, 47].

The impact of gamification on this kind of disorders probably deserves much attention. It is noteworthy remarking though, that the link between experiencing flow and this sort of disorders may not be as direct as it seems. In effect, neither all addict video gamers experience flow, nor experiencing flow leads inevitably to addiction, but experiencing flow would boost the chances of becoming addict [32], hence the necessity to take care of the impact that a gamified solution might have on individuals with this type afflictions.

In short, these mentioned adverse impacts pledge for considering and assessing the possible health related consequences of gamification.

Gamified solutions based on competition would be a double edge tool whose impact would vary according to the kind of user profile. In effect, it would be suitable for performance, competitive mind and affective driven individuals [31], but it may not be appealing to users without those personal characteristics. In addition, assuming that the booming of video games based on competition could be transposed to gamification might be a misleading idea insofar as contests in flow generating activities like games are usually perceived as non-self-judgemental [48] and does not entail any responsibility, unlike competitions in gamified solutions especially in work and education environments where displaying the ranking about users' performance may be regarded as humiliating [29] and where results could give rise to criticism from hierarchy. This distinction is in line with what differentiates *play* from *a gamified solution*: playing supposes the lightness of free movements, improvisation and careless fun [35] (Semantic Mapping), whereas through gamification it is expected to obtain results that may be scrutinised by others. It is noteworthy remarking that both perils resulting from over-emphasising competition and hedonic traits of gamified solutions coincide with the critical zones detected through the semantic mapping.

The identified ethical issues (Monitoring and surveillance of users, infringing autonomy and privacy, taking advantage of users, fostering behaviours that may harm third parties, etc.) [29] may reveal various aspects of gamification. It could imply an exploitative purpose and a morally questionable influence on users' behaviour when the gamification approach is only designed to produce value for the

tool provider [49, 50]. It may also result from the speed gap between the very fast pace of gamification technical development relative to the delayed and slower progress of norms definitions required to set ethical boundaries for the design and implementation of the mentioned technical approach [29]. These reasons might not exclude each other.

The consequences of these ethical issues may create a deleterious atmosphere of mistrust among users and vis a vis the gamification provider, which in turn could feed the demotivation engendered by a flawed rewarding system, thus worsening the credibility level of the gamification system and that of the management in charge of it.

6. Conclusion

Overall, the potential threats previously mentioned are all areas of concern that could lead the gamification approach achieving, if not the opposite, diverging results to those for which it was initially designed.

Moreover, it would seem as if gamification is context and user dependent, that is, it would rather suit safe and less serious environments, short/medium term goals and users with competitive and affective characteristics [25, 31].

Perhaps, one of the main challenges of gamification is overcoming the quandary posed by the relationship between the hedonic intensity of gamified solutions and the unengaging tasks. That is, a less stimulating task will remain unengaging if the gamified solutions are not motivating enough; on the other hand, if the emphasis is mainly put on the hedonic gamified components around the task it might increase the likelihood of engendering a trivialisation of the context, a biased attention and a possible demotivation of users over time, unethical issues, unhealthy behaviours [9] and a gamification policy loss of trustworthiness. May be, a gamified solution that bridges the end of its process with the real-world matters could be a possible way forward [8, 18], as a manner to, at least, moderate the over-focus on the hedonic experience seeking loop engendered by flow which would disconnect the user from the outside world [32].

In sum, putting gamification at the service of work and serious contexts is an idea that would be tantamount to combining the useful with the pleasant, yet it involves an attempt to merge two worlds that, a priori, do not mix easily [29]. This suggests that gamification represents a demanding, laborious and somewhat troublesome conception work, to the extent that, according to estimations, gamified applications are destined to have a very high rate of failure [37].

6.1 Limitations

Several limitations for this study are to be mentioned. Due to the novelty of gamification as a research topic, there is a clear shortage of literature review on the threats that may arise from it [8, 9]. In effect, a rather reduced number of studies met the inclusion criteria and were selected in this integrative literature review. In addition, despite the careful approach adopted during the selection phase, one is not immune to having missed out on papers that meet the inclusion criteria. The same goes for the text analysis of the selected and included literature review studies in spite of the detailed checking and examining of information related to negative impacts and possible threats that could result from gamification. Besides, it cannot be excluded that other studies covered this research subject by using another wording and therefore went unnoticed. For example, studies designed to emphasise the potential benefits and added value of gamification that were excluded in this

research might also contain information about the possible adverse impact of this tool. Consequently, it should be stated that this is a non-exhaustive integrative literature review. Furthermore, since the gamification contexts (Health Care, Enterprise, etc.) and the methodologies vary between the selected studies, caution is required when comparing their results and when reaching conclusions about them. This last point argues in favour of deploying future research endeavours to define and design a united framework so as to evaluate gamification outcomes [26].

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