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Gamification: a systematic review of design frameworks

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Abstract Learner's motivation difficulties are recognized as a problem in diverse educational scenarios, reaching up to university degrees. Among other techniques that are often applied by instructors to counteract this issue, those related to the use of gaming elements seem to very promising. In this context, considering the use of game-like properties in learning scenarios, known as gamification, has received increasing interest by academia in recent years. However, its application in higher education can be challenging, due to some unwanted effects caused by the lack of proven design methodologies have been detected. Choosing the adequate formal process for gamification design has become an important success requirement. This work presents a systematic review of the gamification design frameworks discussed in the literature, providing a useful resource to educational practitioners as well as gamification designers and researchers. A total of 2314 unique works are initially recorded, based on queries in databases, libraries, journals and search engines. After applying a systematic filtering process, a definitive list of 40 works is more closely analysed. Next to review over relevant literature, an assessment of the main features found in the discussed approaches is given, while also categorizing them according to their main application field and its suitability in higher educational environments.

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Introduction

Every day, instructors face the challenge of motivating students while designing student-centred activities aimed at unique learning interests and needs (Hannafin and Land 2000). Given the motivational properties of games, the application of game-design principles (such as competition and cooperation) and elements (such as challenges, points and levels) in non-game environments has emerged as a widespread and powerful technique for shaping behaviour (Deterding et al. 2011). This is commonly known as gamification. Unlike other widely extended gaming approaches applied in learning scenarios for different purposes (such as serious games and game-based learning), gamification arises as a relevant approach for overcoming motivation and engagement difficulties (Dominguez et al. 2013), rather than focusing on pure entertainment. As the *Horizon Report—2014 Higher Education Edition* reflects, there is an emphasis on the adoption of gamification by higher education over the next 2 or 3 years for the promotion of desired behaviour (Johnson et al. 2014).

While the gamification of learning promises increased student motivation and engagement, the design and implementation of the learning experience requires a great deal of effort (Dominguez et al. 2013). The literature shows a great interest in the topic (Vargas-Enríquez et al. 2015), reporting practises which have shown varying rates of success. In higher-education environments particularly, some learning experiences have revealed limited benefits, or even had a counterproductive effect (Broer 2014). Many case studies applying gamification in an ad hoc manner, without the formal process of proven design support, have been presented in the literature. Additionally, instructors report that the costs of design and implementation processes, the time needed, and difficulties in the process are too great in relation to the expected benefits (O'Donovan et al. 2013). Hence, the need becomes clear for a formalisation to guide and streamline the processes of gamification design.

Accordingly, a wide array of gamification frameworks have been published in the literature, as shown in our previous work (Mora et al. 2015). Thus, the main goals of this paper are twofold. On the one hand, relevant state-of-the art literature on the gamification design process is reviewed and updated, while analysing existing gamification design frameworks in order to classify them and evaluate their suitability for higher-education environments. On the other hand, an analysis study is carried out, considering the features, strengths and weaknesses of each framework. These goals have been formalised into the following research questions:

- Q1: Which gamification design frameworks are available in literature?
- Q2: What is the background and scope of these gamification design frameworks?

- Q3: Which of these gamification design frameworks are suitable for learners' engagement in higher-education environments?
- Q4: What design items are taken into account in the gamification design process?

This paper is structured in the following way: second section presents background knowledge on the principles of game design; third section describes the methodology applied for the research process; fourth section undertakes a thorough review including a classification of gamification frameworks; fifth section assesses and discusses a set of the reviewed frameworks; and final section presents the conclusions of this paper.

Background

Caillois (2001) defined a game as an activity with the following characteristics: fun (the activity is chosen for its light-hearted character), separate (it is circumscribed in time and place), uncertain (the outcome of the activity is unforeseeable), non-productive (participation does not accomplish anything useful), governed by rules (the activity has rules that are different from everyday life), and fictitious (it is accompanied by the awareness of a different reality).

From this premise, we consider the process of game design as 'the action of making sense of things related to a game', similar to the definition from Schell (2008) who considers it to be 'the act of deciding what a game should be'. In that regard, Salen and Zimmerman (2003) propose a set of fundamental principles for game design, applied within an iterative process:

- Understanding design, systems, and interactivity, as well as player choice, action, and outcome.
- Including a study of rule-making and rule-breaking, complexity and emergence, game experience, game representation, and social game interaction.
- Adding the powerful connection between the rules of a game and the play that the rules engender, the pleasures games invoke, the meanings they construct, the ideologies they embody, and the stories they tell.

According to Brathwaite and Schreiber (2009), these principles are used to reflect on how to incorporate different game elements once they have been appropriately identified; identifying game atoms as the smallest parts of a game that can be isolated and studied individually, and considering a game-design process as the use of a collection of these. This idea was expanded by introducing ten ingredients considered to be relevant for a successful game design (Reeves and Read 2009): self-representations; three-dimensional environments; narrative; feedback; reputations, ranks and levels; marketplaces and economies; competition under rules; teams; communication; and time pressure.

The need to integrate all these principles and ingredients into a formal and recognised proposal in the context of game design led to the development of the

well-known Mechanics-Dynamics-Aesthetics (MDA) framework (Hunicke et al. 2004). This framework attempts to bridge the gap between game design and development, game criticism, and technical game research by providing a formal structuralist approach to understanding games. Accordingly, games can be broken down into three elements: rules, system, and fun, which easily translate into the following design components:

- Mechanics, describing the particular components of the game, at the level of data representation and algorithms.
- Dynamics, describing the run-time behaviour of the mechanics acting on player inputs and any other outputs over time.
- Aesthetics, describing the desirable emotional responses evoked in the player when interacting with the game system.

Additionally, from the perspective of the experience and going beyond structural game elements, Deterding et al. (2011) describe the necessary game-design actions for 'gamefulness' on different levels: game interface design patterns, game-design patterns and mechanics, game-design principles and heuristics, game models, and game-design methods. Calvillo-Gámez, Cairns and Cox (2010) consider a model is only a fraction of the whole as proposed in their 'Core Elements of the Gaming Experience'. They present a set of necessary but not sufficient conditions to provide a positive experience while playing, which must be considered during the design process: interface design pattern, design pattern and dynamics, design principles and heuristics, and models (such as MDA and design methods).

However, gamification, widely known as the application of game-design elements and game principles in non-game contexts (Deterding et al. 2011), is conceived as a process whose purpose is far removed from traditional game-design objectives. Consequently, the process of gamification design is somewhat different from game design, the former being used to enhance engagement in different contexts, whereas the latter is directed towards pure entertainment. Accordingly, the design process of a gameful environment differs from that of designing a conventional game. Thus, an explicit distinction between game and gamification design and its features is proposed by Marczewski (2014). While the most common starting point of game design is based on the idea of enjoyment, gamification points towards a business objective. Furthermore, the definition of metrics or game lines occurs during different stages of the design process.

Gamification, therefore, requires a specific and formal design process given that its purpose is different to that for games. Consequently, given the contrast to traditional game-design processes, it seems appropriate to carry out the analysis proposed in the present work, in order to identify and analyse the gamification design frameworks available in the literature and their applicability in higher-education environments. The next section describes the systematic review conducted in order to analyse and be able to answer the proposed research questions.

Methodology

Gamification is a topic of interest that currently receives attention in the context of diverse research areas: Education, Psychology, Game Theory and Design, Human–Computer Interaction, Digital Information Systems, Business, and Medical Science. However, design approaches vary widely depending on the area of research and application, a fact that is reflected in the diversity of publications in the literature.

Therefore, to answer the research questions proposed in "Introduction" section, a systematic review has been conducted of the works about gamification available in the literature, focusing on current scientific knowledge about gamification design within any research context. The review is based on works indexed in relevant databases such as Scopus, Web of Science (WOS), ProQuest and Google Scholar, as well as digital libraries such as ACM Digital Library, Science Direct (Elsevier), IEEE Xplore and Springer. In accordance with our scope, a complementary manual search was conducted by looking for works published in relevant journals in the research areas described. This was based on the wide range of works that can be identified from the reference lists of the key studies (see Table 1) beyond any systematic search process. Additionally, a manual search for non-academic works was conducted using the following search engines: Google, Yahoo, and Bing. We consider that relevant non-academic sources from recognised experts in the field may be brought into literature reviews occasionally. Including grey literature can broaden the scope to a wider range of relevant studies, thereby providing a more complete overview of available evidence (Mahood et al. 2014).

The publications were identified using three levels of specificity regarding the search keywords 'gamification', 'gamification design' and 'gamification design framework' in the title, abstract, metadata and full-text. The number of matches for each level in the different databases is shown in Table 2. Moreover, the table depicts a decrease in the number of matches for the 2nd and 3rd level when moving from a

Table 1 Manual search in relevant journals from diverse areas

Area	Journal
Education	Computing in Higher Education, Journal of the Learning Sciences, Computers and Education
Psychology	Computers in Human Behaviour, Behaviour and Information Technology
Game Theory and Design	Games and Culture, International Journal of Serious Games, Journal of Gaming and Virtual Worlds
Human–Computer Interaction	Computers in Human Behaviour, Interacting with computers, International Journal of Human–Computer Studies, Behaviour and Information Technology
Digital Information Systems	Computers in Human Behaviour, Interacting with computers, International Journal of Human–Computer Studies, Behaviour and Information Technology, Journal for Infonomics, Journal of Management System Information, Computing in Higher Education
Business	Business Horizons
Medical Science	Journal of Medical Internet Research

Table 2 Query results (number of matches and difference compared to the preceding level)

	Level 1 query	Level 2 query	Level 3 query
ACM DL	782	726 (−7.16%)	368 (−49.31%)
Science Direct	339	307 (−9.44%)	171 (−44.30%)
IEEE Xplore	658	598 (−9.12%)	357 (−39.39%)
Springer	1164	1047 (−10.13%)	571 (−45.46%)
Scopus	1852	1455 (−21.44%)	589 (−59.52%)
WOS	460	189 (−58.92%)	32 (−83.07%)
ProQuest	7934	2526 (−68.16%)	723 (−71.38%)
Google Scholar	13,500	11,000 (−18.52%)	7400 (−32.73%)

'gamification'

'gamification' AND 'design'

'gamification' AND 'design' AND 'framework'

less specific keyword (level 1, 'gamification') to more specific ones (level 2, 'gamification design'; level 3, 'gamification design framework'). Gamification design does not necessarily involve the use of a framework. The literature search for gamification design and frameworks was not restricted to a particular time period, even though most references were published after 2011. This study was conducted during a period ending on 1 October 2015.

Our search queries (carried out independently by two researchers before being merged) revealed a total of 2314 unique works after filtering publications that were not published in English (Criterion 1). Based on only those unequivocally addressing a process of gamification design (Criterion 2), a total of 1971 records were excluded through the manual revision of abstracts, leading to 343 potential publications being recorded. Following this, another 303 publications were excluded based on Criterion 3, which ensures that the work meets minimum requirements in order to be considered a framework (according to the American Heritage Dictionary, a framework is defined as 'a standardized set of concepts, practices and criteria to focus on a particular type of problem that serves as a reference, to confront and solve new problems of a similar nature set'). Thus, a total of 40 frameworks (hereafter referred to as 'initial candidates') are included in this review. The systematic process carried out can be visualised in Fig. 1. An additional filtering process is explained in "Assessment and discussion" section, by which a list of final candidates for a comparative purpose (homogeneity) is obtained.

A summary of the sources from which the 40 initial candidates were drawn is shown in Fig. 2. It suggests that publications from conferences and journals (in this order) are the largest contributors to this review. Nevertheless, minor works are also included since none of the other sources (such as web-sites) are disregarded in this systematic study, these constitute 7.5% of the total. The following section presents a classified description of the 40 gamification design frameworks recorded.

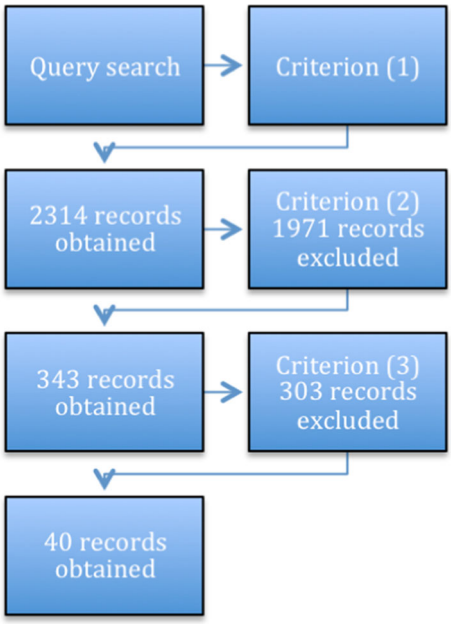

Fig. 1 Systematic filtering process

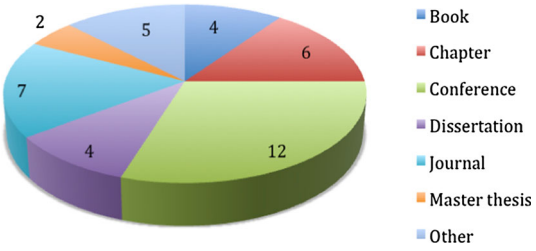

Fig. 2 Sources from initial candidates

Literature review

The frameworks obtained as initial candidates through the systematic process described in the previous section are now discussed. When observing the publication date of the initial candidates (see Fig. 3), it can be observed that the year with the highest scientific production on the research topic was 2013. It is probably no coincidence that this is the same year that Gartner (2013) positioned

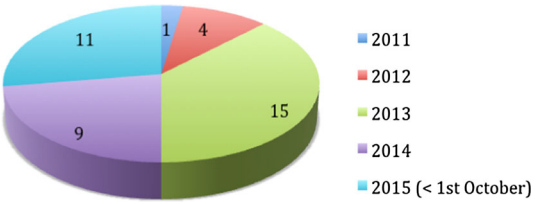

Fig. 3 Publication date from initial candidates

gamification at the *Peak of Inflated Expectations*, in its yearly report. The number of contributions decreased in 2014, when Gartner (2014) positioned gamification at the *Trough of Disillusionment* stage. However, based upon our results for the period to 1 October 2015 when this study concluded, gamification design sources for 2015 were expected to match or even exceed 2013 by the end of the year.

Concerning the main areas of application of the initial candidates, four categories can be defined: learning, business, health and generic (not specific to a concrete environment). The largest number of reviewed works focus on a business environment, while generic design frameworks (a priori, suitable for any context, even educational) can be applied to a wide range of environments, as can be seen in Fig. 4. It is noteworthy that the design frameworks presented that focus directly on learning processes only add up to 15% of all the papers considered. This can be explained by the fact that educational approaches that implement gamification are highly focused on describing specific experiences and guidelines (Kapp 2014; Tzouvara and Zaharias 2013). As far as focused design frameworks are concerned, the health sector is the least developed, and is an area of application that has received great interest from an academic point of view in recent times. The 40 reviewed frameworks presented in the initial candidate set are now presented in tables and ordered by categories and publication date.

To summarise the reviewed works, some issues related to design frameworks in a learning context are highlighted:

- Social relevance design is shared by a few frameworks (Simões et al. 2012; Wongso et al. 2015).
- In contrast to other publications, one of the frameworks is focused on researchers and software designers, making it unsuitable for application by teachers (Nah et al. 2013).
- Two frameworks explicitly recognise the use of an e-learning platform as a necessary environment where the gameful experience should be developed (Klock and da Cunha 2015; Wongso et al. 2015).
- Two frameworks explicitly stress the relevance of an iterative process (Mora et al. 2016; Wongso et al. 2015).
- The MDA framework is present implicitly and is explicitly considered in several frameworks (Klock and da Cunha 2015; Mora et al. 2016).

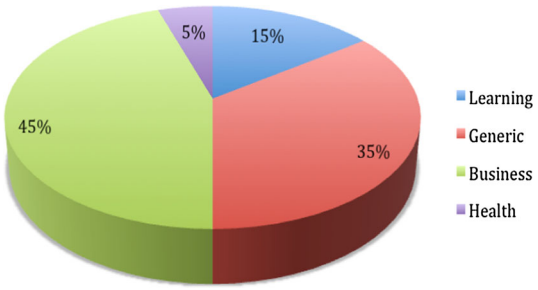

Fig. 4 Scope from initial candidates

To summarise the reviewed works, some issues related to design frameworks in a generic environment are highlighted:

- All reviewed non-theoretical generic frameworks explicitly consider iterative processes as a main design principle.
- User-centred design principles are explicitly featured in most of the frameworks, with one exception (Merino de Paz 2013).
- Two frameworks show technological relevance (Liu and Santhanam 2015; Merino de Paz 2013).
- Cross-references reveal that the MDA framework is used as an inspiration in the approach published by Fitz-Walter (2015), while the framework of Werbach and Hunter (2012) is the basis for the work presented by Merino de Paz (2013).
- A few of the frameworks rely heavily on psychological and motivational theories (Chou 2015; Francisco-Aparicio et al. 2013; Nicholson 2012).

To summarise the reviewed works, some issues related to design frameworks in a business environment are highlighted:

- Most of the presented non-theoretical business frameworks explicitly highlight iterative processes as a main design principle, with one exception (Gears and Braun 2013).
- User-centred design principles are prominently featured in many frameworks (Burke 2014; Gears and Braun 2013; Kumar 2013; Li 2014; Popa 2013; Raftopoulos 2014).
- Technology is relevant to many frameworks (Brito et al. 2015; Harms et al. 2014; Herzig 2014; Kumar 2013; Li 2014; Raftopoulos 2014; Ruhi 2015).
- The MDA game-design framework (Hunicke et al. 2004) inspires four frameworks (Harms et al. 2014; Neeli 2015; Robson et al. 2015; Ruhi 2015), while the 6D framework is the basis for two of them (Brito et al. 2015; Julius and Salo 2013).
- One framework reveals great relevance to psychological and motivational theories (Gears and Braun 2013).

Finally, Table 6 shows the frameworks addressing a health context:

To summarise, some issues related to frameworks in health environments are highlighted:

- Health specific frameworks present great relevance to prototyping and experimentation issues, as well as measurement and continuous iteration. Additionally, it is remarkable that design steps are defined with high concretion.
- Gamification design issues and elements reveal theoretic issues and diverse implementation targets, including both designers (Charles and McDonough 2014) and researchers (Rojas et al. 2014).

Having listed and described the frameworks, we carried out an evaluation, described in the next section, in order to answer the proposed research questions.

Assessment and discussion

The frameworks presented in previous sections are discussed in more detail in the following paragraphs. It is noteworthy that there is no consensus in the literature about a specific definition of the term gamification and its scope, although the most widespread definition of gamification clearly comes from Deterding et al. (2011) as the use of game-design elements in non-game contexts. Almost half of the reviewed publications (49%) conceive gamification under this definition or in a similar fashion, such as the application of game elements and theories to non-game contexts with the intention of modifying behaviours, increasing fidelity or motivating and engaging users (Merino de Paz 2013). These definitions differ from the one that describes gamification as 'the application of game-like accelerated user interface design to make electronic transactions both enjoyable and fast' (Pelling 2011). In some papers, no definition of gamification is explicitly included or cited (Raftopoulos 2014; Sakamoto et al. 2012), a necessary pre-requisite for proposing any framework for gamification design. Another point of interest is the relationship between these frameworks and technology. Several frameworks reveal technology as perceived as having an innate association with the term gamification (Burke 2014; Charles and McDonough 2014; Ruhi 2015; Versteeg 2013; Wongso et al. 2015).

However, due to the variety of research areas involved, little homogeneity can be observed in the reviewed frameworks. Accordingly, we propose three major approaches in the analysed design processes:

- User-centred: the user and their goals are the central focus of the design and development (UCD processes from the human–computer interaction scope).
- Game-centred: game designs and game artefacts are the central focus of the design and development process.
- Technology-centred: technological artefacts and modelling are the central focus of the design and development process. They are focused on a definition of architectures and systems as the basis of any gamification design and deployment.

Figure 5 shows the proportion of papers addressing each design approach proposed in the previous paragraph.

As shown, more than half of the frameworks reviewed are user-centred (this does not imply a restriction on the use of game-design principles and/or technology, but signifies that the user is the centre of the design process). At this moment, based on

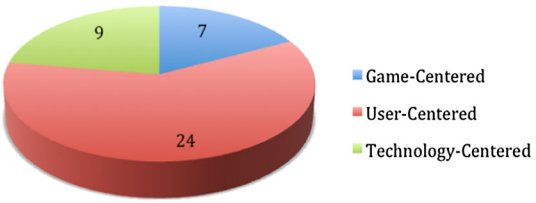

Fig. 5 Framework approaches

the literature review carried out in this research, we are able to answer the proposed research questions Q1, Q2 and Q3. Diverse frameworks for the gamification design process have been discussed in the literature, as listed and described in Tables 3, 4, 5 and 6 (Q1), and the publications are classified into three different design principles (User-centred, Game-centred, and Technology-centred) related to different perspectives in the design process (Q2). As previously discussed in "Methodology" section, gamification is a topic of interest which is being addressed from diverse research areas.

Regarding Q3, although the analysed frameworks addressing a learning environment are suitable in higher education, the application of more generic frameworks can also be a useful complement. In order to get a better answer to the last research question (Q4) about what items are taken into account in the gamification design process, a comparative study needs to be carried out. For analysis of the data, an additional inclusion criterion was applied to the initial candidates (the 40 references previously described in section four) discussed previously. This allowed us to obtain a list of 'comparable' frameworks (there is a gap between the more theoretical and the more conceptual frameworks thus precluding a comparison between them), hereafter referred to as 'final candidates'. To be included, final candidates needed to be:

- Conceptual frameworks (consisting of concepts that are placed within a logical and sequential design, a less formal structure, based on specific concepts and propositions, and derived from empirical observation and intuition).
- From academic sources (characterised by being very concise frameworks).
- Complete design frameworks (not guides for a partial or specific design process).

After applying this filtering criterion, a total of 27 out of 40 final candidates were considered for the following discussion, being distributed as shown in Fig. 6. From these final candidates, 24 relevant design principles (hereafter referred to as 'items') commonly found in frameworks of this kind have been grouped into six categories, one qualitative (concerning design principles, covering three of the items) and five quantitative (knowledge, logic, psychology, measurement and interaction, covering the remaining 21 items). This categorisation is defined to facilitate the analysis process. The possible values that it can have are:

- Explicit, the item is present in the framework description.
- Implicit, the item is not explicitly present in the framework description. It has been inferred by the authors, referring to other sources or clarified by means of contacting the authors.
- Unreferenced, the item is not present in the framework description.

Principles:

- Domain: framework application areas can be grouped into generic, business, learning and health. Business frameworks present a high-level of interest for the community (12 frameworks), but generic ones are also widespread (7).

Table 3 Summary of frameworks: learning

References	Background	Target	Gamification definition	Framework description
Simões et al. (2012)	Digital Information Systems	Educators	The use of elements from video games in non-game applications	A social gamification framework to be applied in social learning environments. It aims to assist educators with most usual game elements present in social games including game-thinking to improve students' motivation and learning outcomes
Nah, Telaprolu et al. (2013)	Digital Information Systems	Software designers and researchers	The process of game-thinking and game mechanics to engage users and solve problems	A framework which provides guidance to software designers and researchers in order to gamify educational applications. It is focused on five main principles: goal orientation, achievement, reinforcement, competition, and fun orientation
Wongso et al. (2015)	Digital Information Systems	Educators	Implementing game mechanisms and elements in non-game applications like e-learning	A framework based on social engagement which can be applied to e-learning environments and based on the *Design Science Research Methodology* (Peffers et al. 2007) It comprises five iterative phases: analysis, design, development, implementation and evaluation
Mora et al. (2016)	Human–Computer Interaction	Educators	The use of game design and game elements in non-game contexts	An iterative framework for agile gamification of the learning experience. It is based on *Lean UX* (Gothelf and Seiden 2013) and *Behaviour-Driven Development* (Chelimsky et al. 2010) principles and structured in four phases: declaration, creation, execution and learning

Table 3 continued

References	Background	Target	Gamification definition	Framework description
Kotini and Tzelepi (2015)	Human–Computer Interaction	Educators	A powerful strategy that influences and motivates groups of people	A gamification-based framework for developing activities of computational thinking which provides a student-centred design for enhancing their involvement in the learning environments. It proposes ways to introduce and set game-design elements, as appropriate, into a learning environment
Klock and da Cunha (2015)	Digital Information Systems	Educators	The use of game elements for purposes unrelated to games in order to get people stimulated and engaged to achieve a specific goal.	A conceptual framework, based on the MDA and 6D frameworks (Werbach and Hunter 2012), for engaging students, and its application in adaptive e-learning systems. By the definition of a set of dimensions, it provides information on what game elements, actors, data and behaviour should be involved in the gamification process

Learning-specific design frameworks are slightly less common (6) and, finally, health environments have the lowest presence in the literature (2).

- Development: most of them reveal iterative designs. In contrast, six of them do not refer explicitly to this issue (Gears and Braun 2013; Kappen and Nacke 2013; Klock and da Cunha 2015; Kotini and Tzelepi 2015; Nah et al. 2013; Simões et al. 2012).
- Background: two main works stand out as an inspiration for the gamification frameworks: the MDA game-design framework (Hunicke et al. 2004) inspires Fitz-Walter (2015), Kappen and Nacke (2013), Klock and da Cunha (2015), Neeli (2015), Robson et al. (2015) and Ruhi (2015), and the 6D framework is the basis for the work of three (Brito et al. 2015; Julius and Salo 2013; Klock and da Cunha 2015).

Knowledge:

- Objectives/goals: almost all of the frameworks explicitly reveal the importance of defining clear objectives at the beginning of the process. Accordingly, behavioural objectives/goals are widely considered as the core of any gamification design process. Unclear or fuzzy objectives are common reasons for failure in gamification design.

Table 4 Summary of frameworks: generic

References	Background	Target	Gamification definition	Framework description
DiTommaso (2011)	Human–Computer Interaction	Designers	The use of game design elements in non-game contexts	A framework based on the Self Determination Theory (SDT) (Ryan and Deci 2000) which includes the following steps: discovering, identifying players' profiles and motivational drivers, setting up goals and objectives, describing skills, tracking and measuring, defining lenses of interest, desired outcomes, play-testing, and polishing
Nicholson (2012)	Human–Computer Interaction	Researchers	The use of game-design elements in non-game contexts	A theoretical framework for meaningful gamification design which comprises the following issues: organismic integration theory, situational relevance, situated motivational, universal design for learning and player-generated content
Sakamoto et al. 2012	Digital Information Systems	Designers	No definition or reference has been provided	A conceptual value-based gamification framework for increasing intrinsic motivation in every-day life and based on five values: informative, empathetic, persuasive, economic and ideological
Kappen and Nacke (2013)	Human–Computer Interaction	Designers	The application of game-design elements in non-game contexts	A design framework and design analysis tool for gamification based on games design and SDT (Ryan and Deci 2000). It comprises a set of layers: effective gamification core, motivated behaviour, game experience, game-design process and perception of fun
Marache-Francisco and Brangier (2013)	Human–Computer Interaction	Designers	An informal umbrella term for the use of video game elements in non-gaming systems to improve user experience (UX) and user engagement	A design guide and a toolbox for the gamification design process based on the human–computer interaction (HCI) principles in order to identify the factors involved. Three dimensions are described: sensory-motor dimension, motivation emotion and commitment, and cognitive dimension of interaction
Francisco-Aparicio et al. (2013)	Human–Computer Interaction	Designers	The use of game design elements in non-gaming contexts	A method based on the SDT (Ryan and Deci 2000) for applying gamification as a tool to improve the participation and motivation of people in performing different tasks, considering a structure formed by game core, engine and interface

Table 4 continued

References	Background	Target	Gamification definition	Framework description
Marczewski (2013)	Digital Information Systems	General	The application of gaming metaphors to real-life tasks to influence behaviour, improve motivation and enhance engagement	A simple framework, called GAME, based on two main phases: planning tasks to be developed, including the tasks of gathering information, purpose and knowledge from the players, and the tasks related with the design by using appropriate game elements, analytics and metrics, testing, feedback, and releasing
Merino de Paz (2013)	Digital Information Systems	General	The application of game elements and theories to non-game contexts with the intention of modifying behaviours, increasing fidelity or motivating and engaging users	A guideline consisting of three phases: setting up of business goals (suitability, teaming, objectives, outcomes and player profiling), design (desired behaviours, game components and game design), and implementation and maintenance (including the development or buying, deployment, collecting data and adjusting)
Versteeg (2013)	Digital Information Systems	Designers, Software developers	A persuasive technology that can influence user behaviour	A framework for gamification design as a persuasive technology perspective and based on the moral design framework (Berdichevsky and Neuenschwander 1999). It incorporates a methodology for analysing the ethics based on: definition of moral principles and values, conceptual investigation, stakeholders' involvement, and evaluation and iteration
Manrique (2013)	Game Design	Designers	A design experience based on happiness and motivation	A model called SMA based on an iterative process for designing gameful experiences for fun and motivation. It conceives four main variables: goals, actions, players and system
Chou (2015)	Human–Computer Interaction	General	The act of making something game-like	A framework called Octalysis based on an octagon which comprises eight 'gameful' shapes: epic meaning and calling, development and accomplishment, creativity and feedback, ownership and possession, social influence and relatedness, scarcity and impatience, unpredictability and curiosity, and loss and avoidance

Table 4 continued

References	Background	Target	Gamification definition	Framework description
Fitz-Walter (2015)	Human–Computer Interaction	Designers	A design strategy where game elements are used in non-game systems to promote behaviour change and hedonistic qualities of user experience	An iterative framework for designing gamification based on the following relevant elements: user experience, motivation and gamification experience, and considering the following main steps: justifying, designing and evaluating
Liu and Santhanam (2015)	Digital Information Systems	Designers, Researchers	The application of game-based thinking to everyday tasks to make them more engaging	A framework for the design and research of gameful systems information (SI) inspired by the PAT model (Finneran and Zhang 2003), commonly used for the study of the experiences in computer environments (persons, tasks and technology artefacts including game-design elements)
Almarshedi et al. (2015)	Digital Information Systems	Designers	The use of game elements and techniques in a non-gaming context	A framework for sustainable gamification that aims to increase the sustainability of the desired impact of gameful applications based on the following three components: Flow Dimension Theory (Csikszentmihalyi 1990), drive motivation elements (Pink 2011), and SDT (Ryan and Deci 2000)

- Feasibility: only ten of the frameworks explicitly refer to this issue. Special emphasis is considered in several frameworks which consider technological (Herzig 2014), economic (Gears and Braun 2013) and ethical (Versteeg 2013) feasibility.
- Risk: weaknesses and risks are considered by several frameworks (Burke 2014; Fitz-Walter 2015; Gears and Braun 2013; Mora et al. 2016; Raftopoulos 2014; Ruhi 2015; Simões et al. 2012).
- Investment: only one of the frameworks explicitly refers to this item (Gears and Braun 2013).
- Stakeholders: the need to interact with stakeholders is explicitly considered as relevant by half of the publications. It should be noted here that none of the learning specific frameworks takes stakeholders into account.

Logic:

- Engagement cycle: the notion of 'gamification loop' was proposed to support the gamification design process (Liu et al. 2011). This item has been considered explicitly by more than half of the studied frameworks.

Table 5 Summary of frameworks: business

References	Background	Target	Gamification definition	Framework description
Werbach and Hunter (2012)	Business	General	The use of game elements and game-design techniques in non-game contexts	Commonly known as 6D, it is the most popular and referenced gamification design framework. It conceives the following steps: defining business objectives and expected behaviours, describing the players, devising the activity loops without forgetting the fun, and finally, deploying the gamification system with the appropriate tools
Kumar (2013)	Digital Information Systems	Designers, Software developers	It is the application of game-design principles and mechanics to non-game environments	A user-centred design process for designers and developers to incorporate the principles of gamification into software. It is based on eight steps: understanding the player, mission, human motivation, applying game mechanics, setting the game rules, defining engagement loops, managing-monitoring-measuring, and considering legal and ethical issues
Gears and Braun (2013)	Digital Information Systems	Designers	A process that incorporates game-design elements in non-game contexts to improve the user experience	A role-motivation-interaction framework (RMI) to facilitate the architecture of gameful interactions. It is based on a model and method of usage, taken from user-centred design (UCD). A set of elements are considered: objectives, business rules, behavioural norms, preconditions, actors and the course of these actions
Julius and Salo (2013)	Business	General	The use of game-design elements in non-game contexts	A framework for gamification in a business context focused on marketing purposes and based on the 6D framework with the addition of a new stage, called 'market research'
Popa (2013)	Digital Information Systems	Designers	No definition or reference has been provided	A UCD gamification framework for productivity software which provides a set of methods and tools to facilitate the creation of emotional experiences to the user. It places great emphasis on the definition of gamification 'personas', which encapsulates and defines the issues regarding the user's goals, emotional states and personality types

Table 5 continued

References	Background	Target	Gamification definition	Framework description
Jacobs (2013)	Digital Information Systems	General	Achieving goals using an engaging set of metrics-based interaction	A gamification framework for implementing enterprise gamification within an organisation through a goal-model design. Five phases are considered: understanding the goals and impact, defining the goals, considering user and social media, feed-back and compilation of data for analysis, and running the loop engagement
Jiménez (2013)	Business	General	The use of game-thinking and mechanics in non-game environments for troubleshooting	A business centred approach known as Gamification Model Canvas based on the Business Model Generation Canvas (Osterwalder and Pigneur 2010) and the MDA framework. It is an agile, flexible, and systematic tool that considers the following items: revenues, players, behaviours, aesthetics, dynamics, components, mechanics, platforms and costs
Herzig (2014)	Digital Information Systems	Software developers	A novel method to improve engagement, motivation, or participation in non-game contexts using game mechanics	Conceptual requirements of gamification based on literature review for the gamification development as a technology-centred design process. It considers different phases: business modelling, requirements, iterative design, provisioning, implementation, testing, deployment and monitoring
Raftopoulos (2014)	Business	Designers	No definition or reference has been provided	A conceptual model focused on sustainable gamification design (SGD) that yields a minimum viable design (MVD) for gameful enterprise applications. It includes the following stages: discovering, reframing, envisioning and creating
Burke (2014)	Business	Designers	The use of game mechanics and experience design to digitally engage and motivate people to achieve their goals	A player experience design process to build a gameful application and the task structures in a logical order, considering: business outcomes and success metrics, target audience, player goals, engagement model, play space and journey, game economy, and play, tests and iterations

Table 5 continued

References	Background	Target	Gamification definition	Framework description
Harms et al. (2014)	Digital Information Systems	Designers	The use of design elements characteristic for games in non-game contexts to produce desired psychological and behavioural outcomes	A structured design process for gamification of surveys based on the MDA framework and form design layers. It proposes four steps: aesthetics and the relationship layer; dynamics and the conversation; mechanics and the conversation and appearance; and prototyping, evaluation and iteration
Schönen (2014)	Business	Designers	The use of game mechanics and game-design elements in non-game contexts	A theoretical framework which provides guidance for using gamification in the change management context. It is based on an adaptation of the 6D framework and empirical findings. It aims to determine the best point in time at which to apply gamification in the change processes and the decision criteria for applying gamification
Li (2014)	Business	Designers	The use of game-design elements in non-game contexts	A theoretical model for gamification in the workplace in an information system context. It is based on the Technology Acceptance Model (TAM) (Davis et al. 1989) which serves as a determinant of both perceived usefulness (PU), perceived ease of use (PEOU), and the impact
Neeli (2015)	Business	Designers, Software developers	An informal umbrella term for the use of game elements in non-gaming systems to improve user experience (UX) and user engagement	A prescriptive method for designing a gamification environment for companies, to guide designers from the conceptualisation to the implementation through six phases: setting the goals and objectives, understanding challenges and motivations, analysing motivations, designing, measuring and improving, and engaging boosters
Brito et al. (2015)	Digital Information Systems	Designers	The use of game-design elements in non-game contexts	A conceptual framework to guide the design of gamification in crowdsourcing-based systems. It comprises a guideline that combines knowledge from software engineering, collaborative systems, game design and interaction design. Four main phases are proposed: gathering, analysis, modelling and execution

Table 5 continued

References	Background	Target	Gamification definition	Framework description
Ruhi (2015)	Business	Designers	Game-thinking and game-based tools used in a strategic manner to integrate with existing business processes or information systems, and these techniques are used to help drive positive employee and organisational outcome	An adaptation of the MDA framework for enterprise gamification to accomplish the connections between end-user motivations, interactive gameplay elements, technology features and functions. A set of guidelines for design and for management are also proposed
Robson et al. (2015)	Business	Designers	It is the application of game-design principles in non-gaming contexts	A framework based on mechanics, dynamics and emotions (MDE), an adaptation of the MDA framework to aid the design process considering mechanics, settings, contexts and interactions, dynamics, and emotions

Table 6 Summary of frameworks: health

References	Background	Target	Gamification definition	Framework description
Rojas, Kapralos, and Dubrowski, (2014)	Medical Science	Researchers	Employing game-design elements for non-gaming applications to make them more fun, engaging and motivating, has been growing in popularity and is seen in a large number of contexts	A framework which seeks to provide researchers with the necessary guidelines for the implementation of gamification in health services, public health, and social policy related to health. It comprises four main stages: theory and modelling, piloting, evaluation, and implementation
Charles and McDonough (2014)	Digital Information Systems	Designers	It is the application of game elements and metaphors, game-design patterns, or game technology to the design of systems that can positively influence behaviour and improve motivation and engagement of people with non-game tasks and processes	A framework for guiding the design of gameful rehabilitation systems placing emphasis on people, aesthetics, context and technology. From design to development process four dimensions are defined: people, aesthetics, technology and context

- End-game: several frameworks take this issue into account (Burke 2014; Chou 2015; Julius and Salo 2013; Mora et al. 2016; Robson et al. 2015; Werbach and Hunter 2012).
- On-boarding: this issue is more widespread than the endgame process. In addition to previous frameworks which support endgame, the onboarding process is supported by four of them (Klock and da Cunha 2015; Kumar 2013; Marczewski 2013; Ruhi 2015).
- Rules: all frameworks take them into account explicitly.

Psychology:

- Fun: for most of the frameworks, fun is a relevant issue that has to be explicitly or implicitly considered during the design process; only one of the works does not consider this aspect (Wongso et al. 2015).
- Motivation: different motivational factors and models have been proposed in the literature and it is the core of the design process in all the frameworks. Therefore, SDT (Ryan and Deci 2000), which supports the intrinsic human motivational needs, is the predominant source.
- Social: most of the frameworks studied consider social interaction either explicitly or implicitly in the design process, with one exception (Harms et al. 2014).
- Desired behaviours: all of the frameworks studied address, explicitly or implicitly, the prior description of expected behaviours in the design process.
- Profiling: identifying the players has also been studied in the literature (Tuunanen and Hamari 2012). Most of the frameworks (all except six of them) consider a good knowledge of their players to be an essential factor.
- Players' taxonomy: many of the frameworks explicitly consider Bartle's taxonomy (Bartle 1996): Chou (2015), Julius and Salo (2013), Merino de Paz (2013), Neeli (2015), and Werbach and Hunter (2012). To a lesser extent, the HEXAD Taxonomy (Marczewski 2013), based on Bartle's taxonomy is also referred to (Charles and McDonough 2014; Klock and da Cunha 2015; Marczewski 2013) and Yee's taxonomy (Yee 2007): Neeli (2015).

Measurement:

- Analytics: various authors emphasise the benefits of measurement in gamification (Conley and Donaldson 2015). Most of the frameworks in this review take

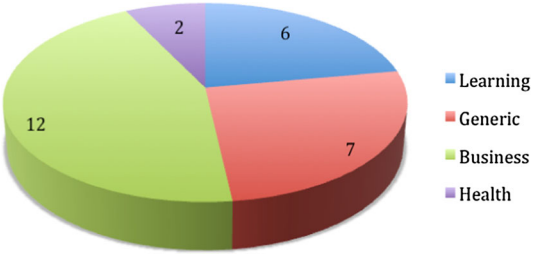

Fig. 6 Principles category

them into account, except in the case of two frameworks (Gears and Braun 2013; Kotini and Tzelepi 2015).

- Metrics: are the standards used for measurement processes commonly associated with efficiency, performance, progress or quality. A first set of measures has been proposed by Zichermann and Cunningham (2011). More than half of the frameworks explicitly refer to this issue but not all of the papers define the use of metrics.
- Ethics: regarding the appropriate use of analytics, the ethical discussion within the gamification community is still in its infancy (Shahri et al. 2014). Special relevance can be assigned to one specific framework (Versteeg 2013) and several frameworks give great importance to this issue (Fitz-Walter 2015; Kumar 2013; Marache-Francisco and Brangier 2013; Mora et al. 2016; Raftopoulos 2014). However, ethical issues are not extensively considered by most of the frameworks.

Interaction:

- Storytelling: more than half of the frameworks explicitly consider storytelling as necessary in any design process.
- User experience (UX): further research is needed to investigate the impact that gamification has, on the user experience, instead of solely focusing on motivation and behaviour change (Fitz-Walter 2015). In this way, not all frameworks refer explicitly to gamification as a user experience, although most of them are user-centred.
- Technology: there is a controversy between the gamification conceptualisation and the involvement of technology. More than half of the frameworks require the use of technology for deploying a gameful design.

Most of the analysed design principles and elements are present to some extent in the final candidates, and can be seen as relevant issues in the game-design literature (Salen and Zimmerman 2003; Schell 2008). Therefore, common game-design items are widely applied in the gamification process, as shown in Figs. 7, 8, 9, 10 and 11 where the figures show which game-design elements are being included to a greater (such as psychology and interaction items) or lesser extent (knowledge) by the researchers and practitioners. In the next section, the results are discussed taking into account the analysis conducted in this section. To summarise, Fig. 12 provides an overall comparison of the number of quantitative items (both implicit and explicit) previously analysed in relation to each framework. Additionally, all the items are presented in detail in the "Appendix". Future works should enhance the focus on elements that are referenced to a lesser extent (ethics, definition of the endgame conditions, the use of player taxonomies for personalisation and the necessary investment for deploying a gameful experience).

From the specific point of view of gamification in higher education, it can be noted that most of the specific frameworks for gamification design in higher education are described as manageable design processes by educators themselves. Even though the specifics slightly differ between the existing frameworks, they tend

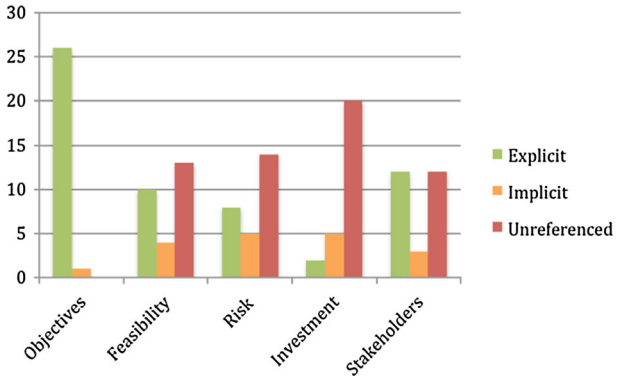

Fig. 7 Knowledge category

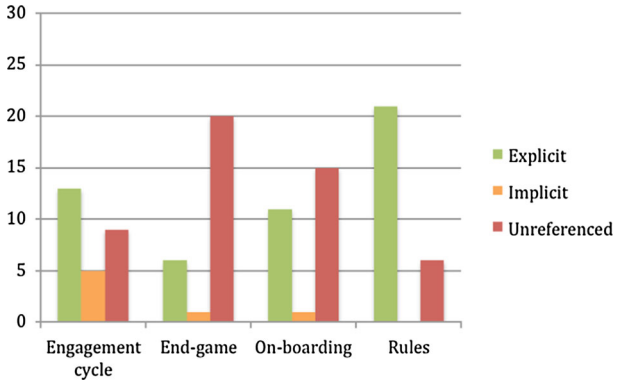

Fig. 8 Logic category

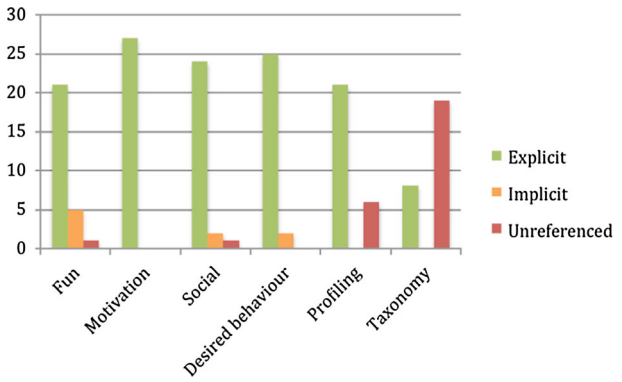

Fig. 9 Psychology category

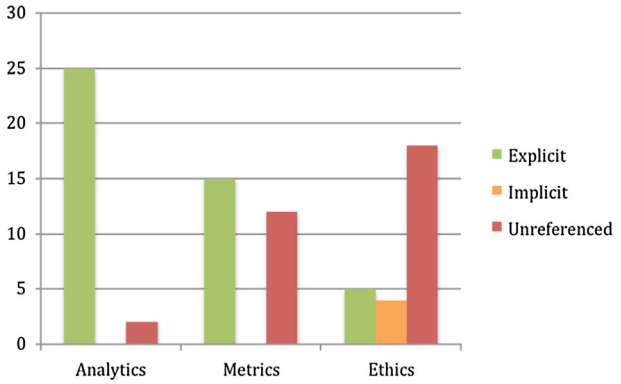

Fig. 10 Measurement category

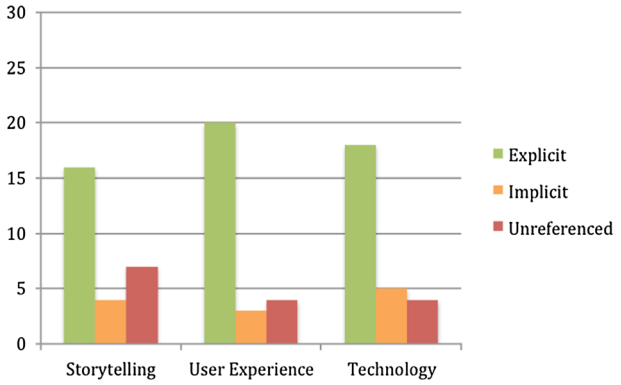

Fig. 11 Interaction category

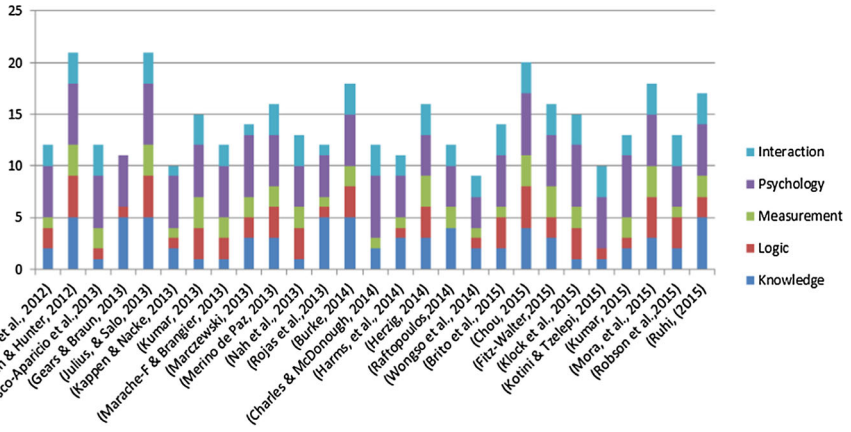

Fig. 12 Quantitative comparison of frameworks

to agree on three basic main design principles: defining the expected behaviours, identifying player types and, given the player types, deploying the appropriate game-design principles. Therefore, researchers have developed guidelines for educators ranging from fully defined formal processes to a loose list of guidelines with a few examples. The fact cannot be ignored that gamification design is a delicate process and the use of ad hoc approaches seems to be unbeneficial, as shown by the results available in the literature. Considering this background, it is remarkable that the vast majority of the reviewed publications about gameful experiences in higher education do not follow a formal processes design. In contrast to the proposed frameworks for an educational context, the predominance of formal process designs in the other reviewed areas is a useful framework for other kinds of profiles such as gamification designers, researchers and developers.

Moreover, in comparison to other areas such as business, the ratio of gamification design frameworks in education is still low. Most papers focus on experiences carried out in an ad hoc fashion, making procedures and features difficult to apply in other case studies with different researchers or educators. More effort towards personalisation and the integration of motivational and instructional design is required in these environments.

Conclusions

In this paper, a systematic literature review on gamification design has been presented. It relies on queries from databases, libraries, journals and search engines which have revealed a total of 2314 unique works. This was carried out independently by two of the researchers and finally merged. Through a systematic procedure, a final list of 40 gamification design frameworks was recorded and these are presented and described in more detail. For comparative purposes, 27 non-theoretical gamification design frameworks were thoroughly analysed according to 24 game-related items within six categories. The study has revealed a clear predominance of gamification design frameworks in a business context, with less available research concerning generic, learning and health frameworks. Moreover, it can be concluded that most of them are conceived as user-centred designs.

On a more detailed level, diverse issues such as risk, feasibility and investment are only seldom taken into account, even in a business context. The participation of the stakeholders in the design process is considered necessary in less than half of the papers, in contrast to the widespread consideration given to the definition of objectives as an early premise. From a logical perspective, while the importance given to the engagement loop item is extensive, only a few frameworks consider onboarding and endgame processes as relevant. Measuring also seems to be a critical issue for gamification and the majority of the frameworks explicitly refer to the use of analytics and the importance of data collection, while the use of metrics is less common. Regarding data usage and management, the issue of ethics is given little consideration. The psychological perspective presents a high relevance in almost all of the frameworks, with all of the studied frameworks agreeing that it is a key element that must be present in the design process. However, broad-based

consideration of issues of user typologies and their personalisation preferences is not widespread. Interaction fundamentals are also extensively referred to, emphasising gamification as a user experience in itself. The need or desirability of developing software taking into account the possibilities provided by digital environments is also extensively referenced.

Additionally, a closer relationship between the principles and elements of game design and gamification has been shown. Moreover, the results have revealed the heterogeneity of the analysed frameworks, from a highly theoretical objective through to conceptualisation, including the perception of gamification from different contexts and areas of interest. Regarding future work, the development and extension of a complete framework from a personalisation perspective (considering the principles and knowledge acquired through the current work) and its application to higher-education environments (diverse case studies) could be carried out, since most of the references available in the literature focus on ad hoc experiences instead of formal design processes.

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Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

Appendix

See Table 7.

Table 7 Summary of framework items

Framework/features	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)
Simões et al. (2012)	E	U	E	U	U	I	U	U	E	U	E	U	E	E	E	E	E	U	U	E	E
Nah et al. (2013)	E	U	U	U	U	E	U	E	E	E	E	U	E	E	E	E	U	U	E	E	I
Wongso et al. (2015)	E	E	U	U	U	E	U	U	U	U	E	U	U	E	E	I	U	U	U	E	E
Mora et al. (2016)	E	E	E	U	U	E	E	E	E	E	E	E	E	E	E	E	E	U	E	E	E
Kotini and Tzelepi (2015)	E	U	U	U	U	U	U	U	E	U	U	U	E	E	E	E	E	U	E	E	I
Klock and da Cunha 2015	I	U	U	U	U	E	U	E	E	E	E	U	E	E	E	E	E	E	E	E	E
Kappen and Nacke (2013)	E	E	U	U	U	U	U	U	E	U	E	U	E	E	E	E	E	U	U	E	U
Marache-Francisco and Brangier (2013)	E	U	U	U	U	E	U	U	E	U	E	E	I	E	E	E	E	U	E	E	U
Francisco-Aparicio et al. (2013)	E	U	U	U	U	U	U	U	E	E	E	U	E	E	E	E	E	U	E	E	E
Marczewski (2013)	E	E	U	U	E	E	U	E	U	E	E	U	E	E	E	E	E	E	U	U	E
Merino de Paz (2013)	E	U	I	U	E	E	U	E	E	E	E	U	E	E	E	E	E	E	E	I	E
Chou (2015)	E	I	I	I	U	E	E	E	E	E	E	I	E	E	E	E	E	E	E	I	I
Fitz-Walter (2015)	E	E	E	U	U	I	U	U	E	E	E	E	E	E	E	E	E	U	E	E	E
Werbach and Hunter (2012)	E	I	I	I	I	E	E	E	E	E	E	I	E	E	E	E	E	E	I	E	E
Kumar (2013)	E	U	U	U	U	E	U	E	E	E	E	E	E	E	E	E	E	U	E	I	E
Gears and Braun (2013)	E	E	E	E	E	U	U	U	E	U	U	U	I	E	E	E	U	U	U	U	U
Julius and Salo (2013)	E	I	I	I	I	E	E	E	E	E	E	I	E	E	E	E	E	E	I	E	E
Herzig (2014)	E	U	I	U	E	I	I	U	E	E	E	I	I	E	I	I	U	U	I	E	E
Raftopoulos (2014)	E	E	E	U	E	U	U	U	U	U	E	E	I	E	I	E	U	U	E	U	E
Burke (2014)	E	E	E	I	I	E	E	E	U	E	E	U	E	E	E	E	E	U	E	E	I
Harms et al. (2014)	E	E	U	U	E	U	U	U	E	U	E	U	E	E	U	E	E	U	U	E	E
Neeli (2015)	E	U	U	U	E	U	U	U	E	E	E	U	E	E	E	E	E	E	E	E	U
Brito et al. (2015)	E	U	U	U	E	E	U	I	E	U	E	U	I	E	E	E	E	U	E	E	E
Ruhi (2015)	E	I	E	I	E	U	U	E	E	E	E	U	E	E	E	E	E	U	E	E	E

Table 7 continued

Framework/features	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)
Robson et al. (2015)	E	U	U	U	E	I	E	U	E	U	E	U	E	E	E	E	U	U	I	E	I
Rojas et al. (2014)	E	E	E	E	E	I	U	U	U	U	E	U	E	E	U	E	E	U	U	U	E
Charles and McDonough (2014)	E	U	U	U	E	U	U	U	U	U	E	U	E	E	E	E	E	E	E	E	E

Items studied: Objectives (1), Feasibility (2), Risk (3), Investment (4), Stakeholders (5), Engagement cycle (6), Endgame (7), Onboarding (8), Rules (9), Metrics (10), Analytics (11), Ethics (12), Fun (13), Motivation (14), Social (15), Desired behaviours (16), Profiling (17), Taxonomy (18), Storytelling (19), User Experience (20), Technology (21). Possible values: Explicit (E), the item is present in the framework description. Implicit (I), the item is not explicitly present in the framework description. It has been inferred by the authors, referring to other sources or clarified by means of contacting the authors. Unreferenced (U), the item is not present in the framework description

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