

# Gamification Usage Ecology

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## ABSTRACT

Gamification is applied in academia and industry and is being studied in the last years. Gamification is nowadays applied to several areas, such as learning, computer science, business, marketing, tourism, among others. However, we need to understand to what extent it is studied in academic context. We present a bibliographic study on gamification research, by identifying publications trends. This paper presents the gamification related areas, result from a publication keyword analysis of the scientific publications on gamification. In this paper, we also identify the game elements, game mechanics, and game dynamics, used as part of any gamification implementation. In this study are also present the most used gamification theoretical models.

## CCS Concepts

**Information Interfaces and Presentation** → **Miscellaneous**; → **User Interfaces** → Evaluation/Methodology, User-Centered Design; **Group and Organization Interfaces** → Evaluation/Methodology; **Personal Computing** → **Games** → **Social and Behavioral Sciences** → Psychology, Sociology. **Information systems** → Miscellaneous

## Keywords

Gamification, Literature Review, Gamification Ecology, Models, Game Elements, Game Mechanics, Game Dynamics

## 1. INTRODUCTION

Gamification is a subject that has an increased interest over time, [1]. The number of references related to gamification in the Google scholar was 8,660 in 2016, while in 2011 was only 481.

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Gamification Google index reached the peak of popularity in 2014 [1]. Conceptually gamification is the use of game elements in the non-environment game, to achieve engagement of individuals in the pursuit of defined goals. In literature, the gamification concept is related to other concepts, like simulation and serious games [8].

The goal of this paper is to build an ecology of gamification, identifying gamification and other related concepts, e.g. simulation, serious games, among others, this ecology is also reached by the classification of those concepts historically, and identifying the main areas where gamification was used and its consequences.

The concept is used in literature related to other concepts. Especially, in the context of business education, management game education is prevalent [2]. Market simulation games, for example, are used to teach market process [3] in management classes context. This approach is similar to the serious game, that may be applied either in education [3] or activities like marketing [4]. More specifically, gamification is the application of game-design elements [5], game principles [6] and game mechanics [7] in contexts that are not related to games. Results show that some fields, especially marketing and education had important research.

The next section defines the gamification concept and other related concepts. Section three presents a literature review on gamification, including a bibliometric study. It also the relations between gamification and the various scientific fields. In the same section describes gamification dimensions and various integrated approaches. In the last section, conclusions are presented

## 2. GAMIFICATION VS OTHER CONCEPTS

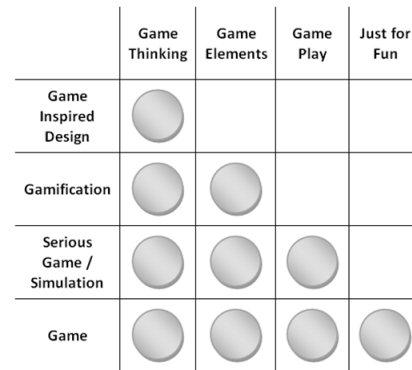
<https://doi.org/10.1145/3121113.3121205>The gamification concept was coined in 2011 by Deterding et al. [8], the concept definition is widely adopted as follows, “*Gamification is the use of game design elements in non-game contexts.*” Apart from the “gamification” term derives from the “game”, it does not necessarily imply playfulness or serious game environments. Gamification involves a certain design and use of elements, which induces individuals into a certain continuous behaviour intention. Gamification integrates distinct game elements in a way that its design attains a set of guidelines to achieve a user engagement within a certain dynamic, whereas “game” definition entails, a willingness to play. Games have goals and conflicts, they also have rules, and games are either won or lost. Games are interactive and challenging, and they give the players their intrinsic value. Games also can engage people/players. Furthermore, games are played in closed formal systems. Since these characteristics are quite a few to include them all in one definition of game, Schell [32] proposed this definition “*A game is a problem-solving activity, approached with a playful attitude*” (p. 37). Gamification then does not necessarily correspond to playfulness, so what is the difference between gamification and serious games? A Serious Game is a system developed through game technology and designed through game principles with a purpose different than just entertainment [33]. Marczewski [34] conceptualises serious games, as full games that have been developed for reasons other than pure entertainment. It includes teaching game, simulator, meaningful game, and purposeful game. Figure 1 depicts the overlaps between experience, entertainment, and multimedia, which corresponds to serious games.



**Figure 1. Serious games based on [35]**

In a teaching game, one can be taught in something using real gameplay environment, as for a simulator, is usually a virtual version of something from the real world, which allows safe practice and testing. A meaningful game uses gameplay to promote a specific message to the player. A purposeful Game uses games to create certain outcomes directly into the real world. These concepts also lead to a different term which is “gameful design”, which corresponds to a process, where “game thinking” has been used [34]. Figure 2 illustrates the main differences between these

concepts.



**Figure 2. Game thinking, broken down by design goals [34]**

Gamification uses “game thinking” and “game mechanics” in non-playful contexts to engage users in solving problems. Gamification is implemented in applications and processes to improve user engagement, return on investment, data quality, timeliness, and learning. Table 1 presents the evolution of these concepts in Google Scholar [36] and ACM Digital Library (ACM DL) [9]. We verify that gamification studies registered a considerable increase in Google Scholar (78.3%), and in ACM DL (60.6%), whereas most the related concepts decreased in both digital libraries.

**Table 1. Gamification and other concepts evolution**

	Google Scholar			ACM DL		
	2011	2016	Δ	2011	2016	Δ
Serious Games	1 480	3 250	17.04%	219	138	-8.82%
Gamification	481	8 660	78.27%	18	192	60.55%
Simulation Games	1350	1 880	6.85%	42	26	-9.15%
Game	361 000	106 000	-21.74%	4 512	3 025	-7.69%
Training Simulation	1 560	1 420	-1.86%	34	28	-3.81%
Gameful design	7	277	108.68 %	286	236	-3.77%

## 3. GAMIFICATION IN LITERATURE

### 3.1 Evolution

We performed a search in Web of Science (WoS) to grasp the evolution of scientific publications in gamification, from 2011 to 2016. Table 2 shows the crescent publication number in the past six years, registering high growth rates during this period.

**Table 2. Gamification publications evolution in WoS**

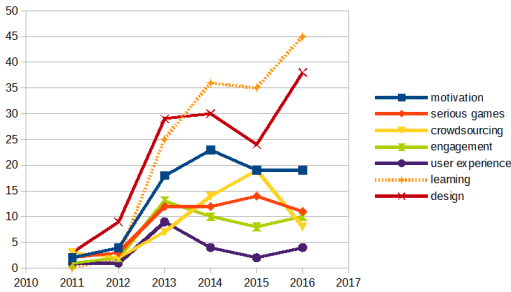
Year	Publications	Growth Rate
2011	417	---
2012	2 156	417.0 %
2013	7 510	248.3 %
2014	15 925	112.1 %
2015	31 919	100.4 %
2016	39 082	22.4 %

From these results, we can infer the crescent importance of gamification, and therefore, a natural step in our study is to

understand whether gamification is being studied with other fields and how it evolved in the past six years.

### 3.2 Related concepts

To understand possible related concepts, we selected all papers from ACM Digital Library [9] which contained the search terms “gamification” or “gamified” in the authors’ keywords filed. The search was conducted on March 10<sup>th</sup> of 2017, and the search output was 834 publications. From the keywords output, we identified the most common of the publications, per year. Afterwards, we computed the yearly frequency and registered the tendency to the most used terms. From the keywords evolution depicted in Figure 3, we can verify that gamification is studied within other scientific fields. “Gamification” term or “Gamified” is mainly related to other keywords, such as motivation, serious games, crowdsourcing, engagement, user experience, learning, and design. From the evolution of these keywords, we confirm that majority of these terms registered a crescent tendency until 2014, apart from “engagement” and “user experience”, which contradict the trend. Results also show that since 2105 all related keywords, decreased or remained, but “learning” and “design” registered an increase. This lead to a deeper analysis, there are



**Figure 3. Gamification-related keywords evolution**

more and more scientific works related to learning, and to design, but it may also indicate that new areas of research are arising. The next step in our analysis consisted of finding more areas which are studied with gamification. To have a deeper understanding of the gamification terms ecology, we conducted a qualitative study, including the primary keywords, and computing a frequency analysis of those terms, since 2011 until 2016. For this part of the study, we used the gamification related keywords extracted from ACM digital library [9]. Figure 4 depicts six tag clouds, corresponding to each year keyword group extracted. In each tag cloud of each year, are represented the most frequent terms in the studies, the bigger the word is represented, the bigger the frequency of that keyword in the correspondent year. For example, in 2011, the most frequent Keywords were: gamification, design, games, game, user, mobile, crowdsourcing, game based, technology, location, services, recognition, work, serious, among others. From this, we can infer, that in 2011, gamification studies

were mainly related to games design and development. In 2012, gamification studies, still relate to games design, but new areas arise, such as human interaction, social, user-centered studies, motivation, participation, incentive, experience, framework, among others. In 2012, we can observe that researchers are transposing gamification into other areas, rather than pure technology engineering. In 2013, education, learning, software, games, design, interaction, engagement, motivation, technology, experience, enterprise, and serious, are among the most studied keywords. Revealing that other areas related to educational, and enterprise fields are applying gamified environments. In 2014, areas of education, learning, e-learning, design, motivation, games, crowdsourcing, collaboration, behaviour, were among the most occurred. In the following years, 2015 and 2016, the tendency was similar, with an increase in studying gamification in learning and education, as well as, studies in gamification, design, and motivation.

### 3.3 SCIENTIFIC FIELDS

From the previous analysis, we verified the evolution of gamification studies and the related keywords. From the WoS [10] searches, we could understand the scientific fields where gamification is present (Table 3). Computer science, educational, engineering, and business represent more than 50% of the scientific publications. This reveals that until 2016 these were the most studied areas within gamification.

**Table 3. Gamification relation with other scientific fields**

Research Areas	% Gamification publications
Computer Science	35%
Education Educational Research	21%
Engineering	17%
Business Economics	4%
Psychology	3%
Telecommunications	3%
Social Sciences Other Topics	3%
Health Care Sciences Services	2%
Medical Informatics	2%
Information Science Library Science	2%
Public Environmental Occupational Health	1%
Science Technology Other Topics	1%
Communication	1%
Rehabilitation	1%
Robotics	1%
Operations Research Management Science	1%
Nursing	1%
Environmental Sciences Ecology	1%
Automation Control Systems	1%
<b>Total of publications</b>	<b>100%</b>

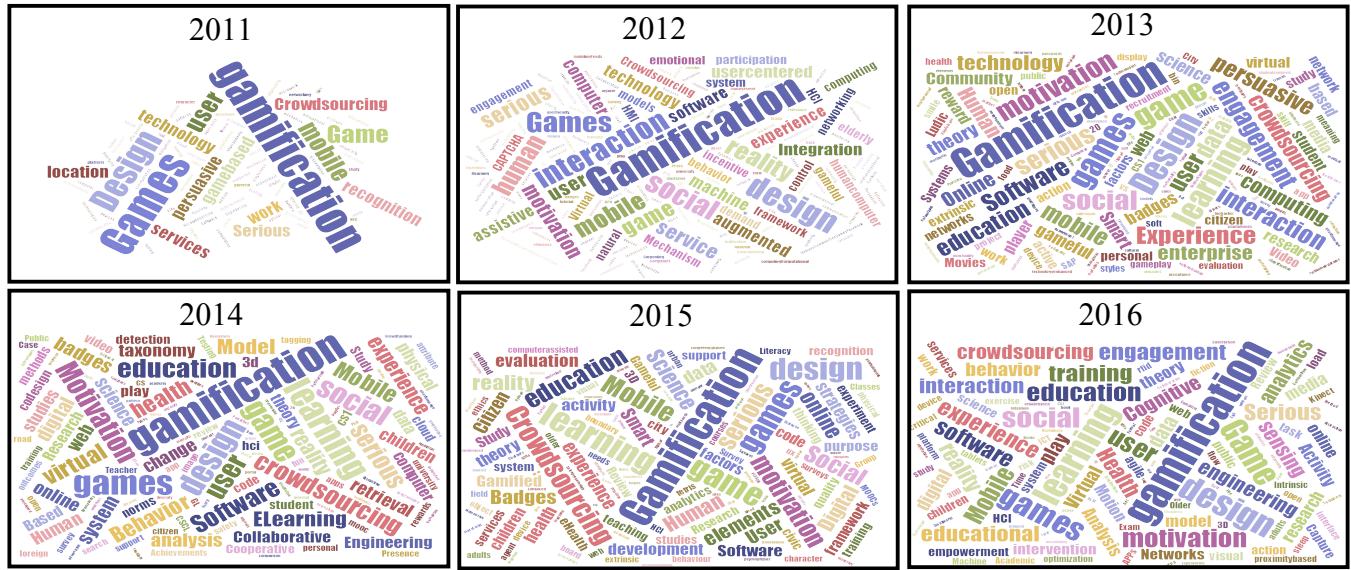


Figure 4. Evolution of Gamification Related Keywords in ACM DL

### 3.4 AUTHORS AND COUNTRIES

Deterding and his colleagues [5] are the most cited authors in gamification counting in total with 2846 citations of the paper which introduce gamification concept. We tried to create a network supported by Co/authoring information to use SNA techniques. However, we verified that we could create just many small networks, involving a reduced number of authors connected between them through co/authorsip. Figure 5 shows the geography of gamification, with a predominance of the USA, followed by Spain, Germany, Canada, and Brazil.

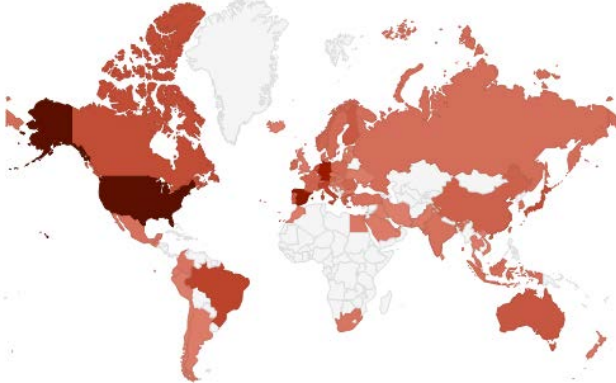


Figure 5. Public publications on gamification by country

### 3.5 DIMENSIONS & INTEGRATED APPROACHES

Concepts on gamification dimensions are studied by various authors [8, 11, 12, 13, 14, 15, 16, 17]. According to Deterding et al. [8], game elements define the “characteristics” which are present in games, as a set of “building blocks”, that may or may not be all present in a game. For example, game elements can be categorised into five levels: first game interface design patterns, second game design patterns and mechanics, third game design principles and heuristics, fourth game models, and in fifth game design methods [8]. Since gamification concept comprises “game elements” and “non-game contexts”, we decided to classify those “elements” into certain dimensions according to the literature. The way these dimensions are aggregated differ

from framework to framework, and from model to model. Table 4 presents various definitions according to literature. To operationalize these concepts, researchers and practitioners developed several approaches, among the most used we can find: Octalysis, [18], Werbach and Hunter model [12], and a recent model named Gamification Model Canvas [19]. A brief description of these approaches is presented in the next subsections.

#### 3.5.1 Octalysis

The Octalysis is a framework developed by Yu-Kai Chou. [18], the framework presents a human-focused framework, composed of eight human motivation drivers:

1. Epic Meaning and Calling
2. Development and Accomplishment
3. Empowerment of Creativity and Feedback
4. Ownership and possession
5. Social influence and relatedness
6. Scarcity and Impatience
7. Unpredictability and Curiosity
8. Loss and Avoidance

Table 4. Gamification dimensions’ definitions

Dimensions	Definitions	Authors
Game mechanics	“Commonly reoccurring parts of the design of a game that concern gameplay” (Deterding et al., 2011, p. 12)	[8, 11, 12]
	“Mechanics are already more specific elements in the way that they imply towards more specific actions” (Kuutti, 2013, p19)	
	“Mechanics are the basic processes that drive action forward and generate players engagement (Werbach and Dan, 2012, p. 79).”	

Dimensions	Definitions	Authors
Game components	<p>“Components are specific instantiations of mechanics and dynamics” (Werbach and Dan, 2012, p. 82)</p> <p>“Components are specific applications that can be seen and used in the interface of the game” (Kuutti, 2013, p. 19)</p> <p>“Game components act as stimuli and are often directly perceivable from the consumer perspective.” (Gatautis et al., 2016, p.92)</p>	[12- 13]
Game elements	<p>“Game elements are the pieces that a game designer assembles in creating an engagement experience.” (Werbach and Dan, 2012, p. 131)</p> <p>“They are what allow you to create something gamelike that is not, itself, a game.” (Werbach and D. Hunter, 2015)</p>	[12, 14]
Game principles	<p>“Evaluative guidelines to approach a design problem or analyse a given design solution” (Deterding et al., 2011, p. 12)</p> <p>“Principles are basic assumptions that have been accepted as true” (Crumlish and Malone, 2009, p. 10 )</p>	[8, 15]
Game dynamics	<p>“Dynamics describes the run-time behaviour of the mechanics acting on player inputs and each other's outputs over time.” (Hunicke et al., 2004)</p> <p>“Dynamics are the big-picture aspect of the gamified system that you have to consider and manage but which can never directly enter into the game” (Werbach and Dan, 2012, p. 82)</p> <p>“Dynamics are the highest level of abstraction of game elements. They are themes around which the game revolves.” (Kuutti, 2013, p. 18)</p>	[11, 12, 16]
Game aesthetics	<p>“Aesthetics describes the desirable emotional responses evoked in the player when she interacts with the game system.” (Hunicke et al., 2004)</p>	[16]

The Octalysis framework [21], represents each of the eight drivers indicate examples of several gamification dimensions, like components, elements, among others.

The author Yu-Kai Chou [21] provides a dynamic tool to experiment Octalysis at <http://www.yukaichou.com/octalysis-tool/>. Several studies referred Octalysis. We searched in the Google Scholar, and we found 194 references. By observing data from table 5 allow to identify an increase of interest by the Octalysis framework.

**Table 5. References to Octalysis in Google Scholar**

Year	References
2013	8
2014	26
2015	54
2016	80

### 3.5.2 Gamification Toolkit (Kevin Werbach) 6 steps

The D6 design framework [12] consists the following steps:

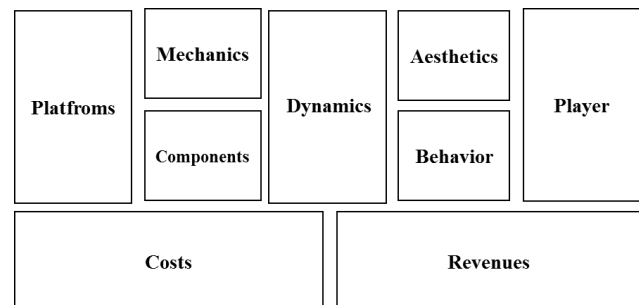
1. Define business objectives
2. Delineate target behaviours
3. Describe players
4. Devise activity loops
5. Do not forget the fun
6. Deploy the appropriate tools

Werbach also introduced a framework for gamification elements named the Pyramid of gamification elements. This framework explains the overall experience of the game based on three levels. [12] dynamics, mechanics and components. This approach is quite popular in the literature if it is subject of a course from the Wharton School, University of Pennsylvania and distributed through the Coursera. [22]. Figure 7 represents the pyramid of gamification elements based on the hierarchy proposed by Werbach and Hunter [12]. According to these authors, the three elements should be defined in different levels, defining the design principles (Dynamics) is crucial to choose the adequate actions structures (Mechanics) to select the suitable interface level displays (Components).

### 3.5.3 Gamification Model Canvas

The gamification model canvas is inspired in the business model canvas [23] and the MDA Framework [16]. MDA Framework is a methodology uses a decomposition of three key elements: Mechanics, Dynamics, and Aesthetics. [16]

The Business Model Canvas by Alex Osterwalder [24] inspired the authors of Game Model Canvas how to represent the model. It also helped them to integrate the business perspective, and other contexts, to conceptualise and design solutions. Gamification Model Canvas entails nine sections that break down the key elements in designing gamification projects: dynamics, aesthetics, behaviour, players, revenues, mechanics, components, platforms, and costs. The canvas is organised into two groups, the left side which represents the designer and efficiency, and the right side, representing player and value.



**Figure 8. Gamification Model Canvas [19]**

On the left side, platforms describe the technology where game mechanisms are to be implemented. Costs designate the main costs/investment of the project development, for example identifying and classification to serve as a base for budgeting. Mechanics define the rules of the game, for instance suggesting that if the user watches a video, he/she gets extra points, or do a quiz and unlocking the next level.



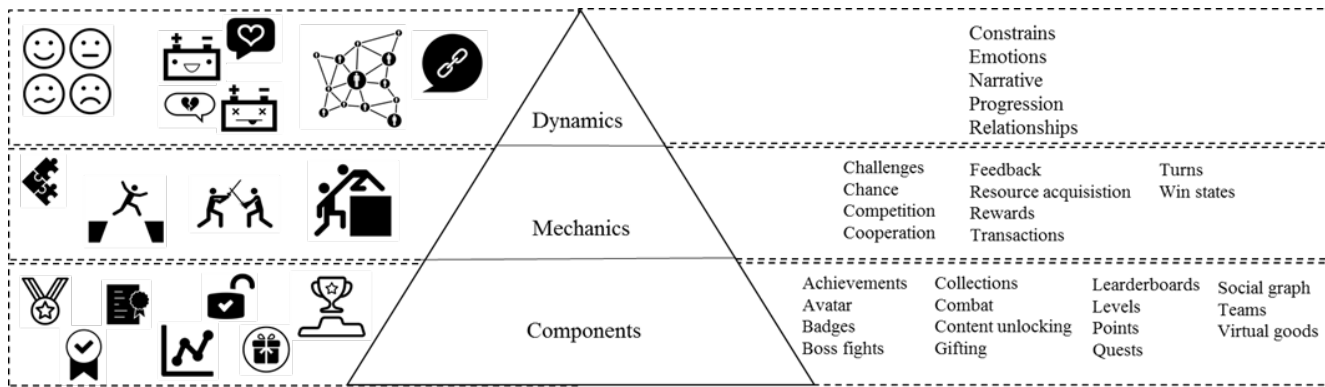


Figure 7. Pyramid of Gamification Elements

As for the components, they create game dynamics, and they describe the elements or characteristics, to create mechanics, or to give feedback to users. Components can be, for example, points, badges, leaderboard, progression bar, and achievements among others. This concept was borrowed from MDA [16]. In the middle, are described the dynamics, which comprises the run-time behaviour of the mechanics acting on the player over time, such as status, scarcity, identity, productivity, to name just a few dynamics. This concept is the nearest to motivation. This concept was also borrowed from MDA [16]. On the right side, the player and value side, the aesthetics define the desirable emotional responses induced in users, when interacting with the game. Examples of aesthetics are narrative, challenge, discovery, fantasy, sensation, fellowship, among others. This concept is the adjoining to fun, a concept borrowed from MDA [16]. Behaviours characterise the necessary actions which users should accomplish to get returns from the project, for example, watch a video, complete a quiz, read content, recommend someone/something, participate in forums. Players describe who and what are the characteristics of users, and what are the wants and needs of users. Revenues describe the expected economic or social returns of implementing gamification, and how success will be measured.

A study [37] mention that, when designing a gamified system/environment, the model should balance the rewarding mechanisms regarding promoting an equilibrium between intrinsic and extrinsic motivations. Because “*In general, tangible rewards had a significant negative effect on intrinsic motivation for interesting tasks*” (p.653) [38]. Although badges, gifting, point or even avatars, are in the most cases digital rewards, they can be regarded in this context as tangible rewards, since users can have direct benefits and profit from the expected behaviour. Therefore they lead to extrinsic motivations [39, 40, 41, 42, 43, 44]. Figure 9 characterise user types according to intrinsic and extrinsic motivations. On the one hand, users that act on intrinsic motivations can be philanthropists, they pursue a sense purpose from a system, usually answering questions on social media. Achievers: search for improvement and mastery, by learning more about the systems, to be considered the best than others. Socializers, establish interactions with other by engaging in social networks.

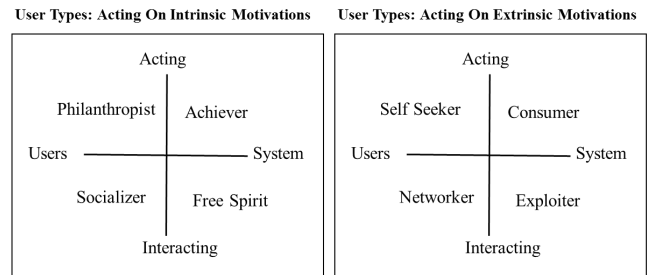


Figure 9. User types vs. motivation types [34]

Free spirit users aim for autonomy, exploration and creativity, for example by customising their system environment, sometimes using avatars. On the other hand, users motivated by extrinsic rewards can be self-seekers, for instance, they usually expect rewards from acting on others, like participating in forums by answering people’s questions, just for points. Consumers, however, expect to be rewarded with little interaction, by adopting loyalty schemes, or easy competitions. Networkers’ goals are related to the connections with others to increase their degree on their profile. Exploiters are motivated to gain reward from using a system for prizes, discovering gaps that help them win [34]. Figure 10 illustrates the user types according to with the correspondent motivation types. The most used and referred models in gamification [17] are Octalysis, [18], Werbach and Hunter model [12], and a recent model named Gamification Model Canvas [19], cited by [20] among others. The following table shows citations to the book of Werbach and Hunter model [12], where they explain D6 design framework, the book of Kevin Chou [18] and the blog post from Sergio Jiménez [19].

Table 6. Summary of Citations to Gamification Frameworks

Year	[12]	[18]	[19]
2012	3	---	---
2013	76	---	---
2014	148	---	2
2015	254	6	1
2016	194	34	4
2017	60	3	3

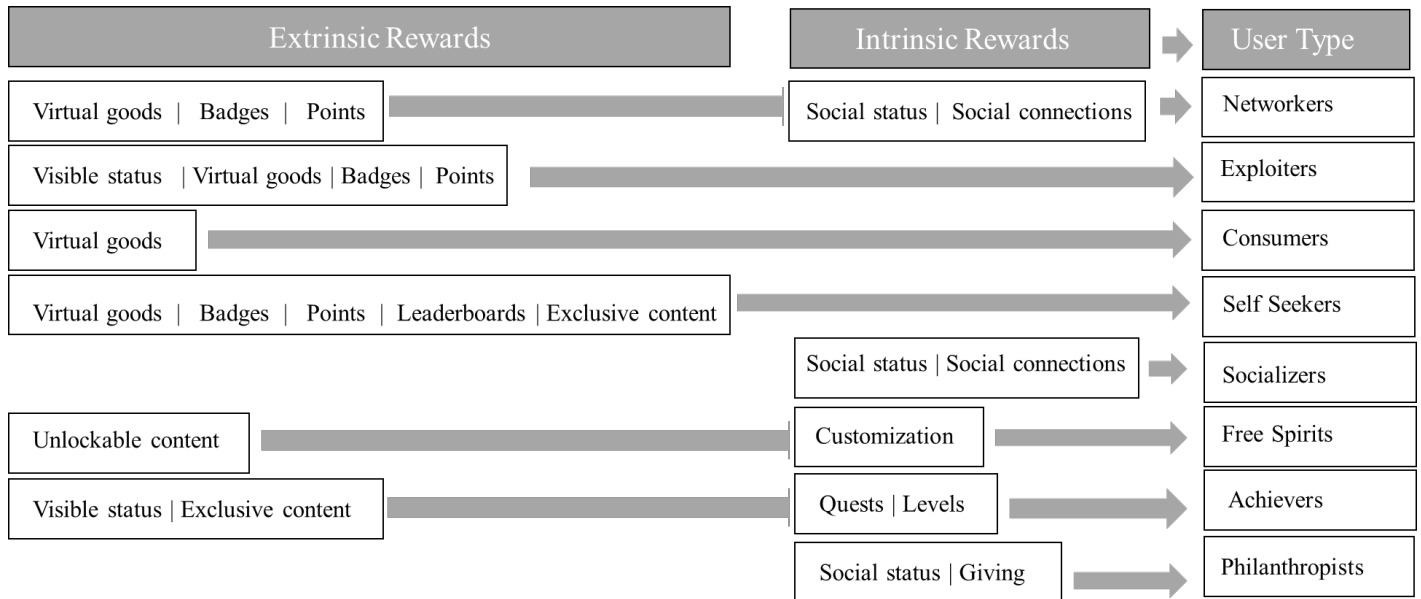


Figure 10. User types per reward types

#### 4. CONCLUSIONS

Gamification is widely employed and disseminated in the corporate context. The study reports that this concept is also becoming relevant in academia. The concept is being studied in many perspectives and by several scientific fields. Nevertheless; education is the most relevant and representative field. It is also the field where the concept of gamification has more significant increase. We also identified some approaches that have the purpose of operationalizing gamification concept. Those approaches are also subject to rising interest. Gamification increases users' engagement in several information systems and organisational processes and can be applied to increase motivation, through the implementation of game mechanics, and game components.

#### 5. REFERENCES

- [1] "Google Trends," Google Trends. [Online]. Available: <https://g.co/trends/Z9QE>. [Accessed: 14-Jan-2017].
- [2] C. Costa, & M. Aparicio, 1999. "Utilização do Jogo de Simulação de Gestão Sim7 como Instrumento Pedagógico: Um Estudo Exploratório". 7, pp. 75--86. Revista Portuguesa de Marketing.
- [3] C.Sousa and C. J. Costa. 2011. Market Game: simulation game for business classes. In *Proceedings of the 2011 Workshop on Open Source and Design of Communication* (OSDOC '11). ACM, New York, NY, USA, 83-84. DOI=<http://dx.doi.org/10.1145/2016716.2016737>
- [4] L. F. Rodrigues, C. J. Costa, & A. Oliveira. 2013. The adoption of gamification in e-banking. In *Proceedings of the 2013 International Conference on Information Systems and Design of Communication* (ISDOC '13). ACM, New York, NY, USA, 47-55. DOI=<http://dx.doi.org/10.1145/2503859.250386>
- [5] S. Deterding, M. Sicart, L. Nacke, K. O'Hara, and D. Dixon, "Gamification. using game-design elements in non-gaming contexts," in *CHI'11 Extended Abstracts on Human Factors in Computing Systems*, 2011, pp. 2425–2428.
- [6] K. Slegers, S. Ruelens, J. Vissers, and P. Duysburgh, 2015 "Using Game Principles in UX Research: A Board Game for Eliciting Future User Needs," in *Proceedings of the 33rd Annual ACM Conference on Human Factors in Computing Systems*, New York, NY, USA, , pp. 1225–1228.
- [7] I. Bunchball, 2010 "Gamification 101: An introduction to the use of game dynamics to influence behavior," White Pap.,
- [8] S. Deterding, D. Dixon, R. Khaled, and L. Nacke, 2011 "From Game Design Elements to Gamefulness: Defining 'Gamification,'" in *Proceedings of the 15th International Academic MindTrek Conference: Envisioning Future Media Environments*, New York, NY, USA, , pp. 9–15.
- [9] ACM, "ACM Digital Library," 2017. [Online]. Available: <http://dl.acm.org>
- [10] WoS, 2017 "Web of Science - Please Sign In to Access Web of Science,". [Online]. Available: <https://login.webofknowledge.com>
- [11] J. Kuutti, 2013 "Designing gamification," University of Oulu, Oulu Business School.
- [12] K. Werbach and D. Hunter, 2012. *For the Win: How Game Thinking Can Revolutionize Your Business*. Wharton Digital Press.,
- [13] R. Gatautis, E. Vitkauskaitė, A. Gadeikiene, and Z. Piligrimiene, 2016 "Gamification as a Mean of Driving

- Online Consumer Behaviour: SOR Model Perspective,” *Engineering Economics*, vol. 27, no. 1, pp. 90–97,.
- [14] K. Werbach and D. Hunter, 2015 *The Gamification Toolkit: Dynamics, Mechanics, and Components for the Win*. Wharton Digital Press,.
- [15] C. Crumlish and E. Malone, 2009 *Designing Social Interfaces: Principles, Patterns, and Practices for Improving the User Experience*. O’Reilly Media, Inc.,.
- [16] R. Hunicke, M. LeBlanc, and R. Zubek, 2004 “MDA: A formal approach to game design and game research,” presented at the Proceedings of the AAAI Workshop on Challenges in Game AI, , vol. 4.
- [17] C. Li, 2014 “Evaluation of a Theoretical Model for Gamification in Workplace IS context,” 06-Oct-. [Online]. Available: <https://open.library.ubc.ca/cIRcle/collections/42591/items/1.0075830>.
- [18] Y. Chou, 2015 *Actionable gamification: Beyond points, badges, and leaderboards*. Octalysis Media Fremont, CA, USA,.
- [19] S. Jiménez, 2017 “Gamification model canvas,” *Gamasutra2013* Retrieved July, Retrieved March 14, , from [http://www.gamasutra.com/blogs/SergioJimenez/20131106/204134/Gamification\\_Model\\_Canvas.php](http://www.gamasutra.com/blogs/SergioJimenez/20131106/204134/Gamification_Model_Canvas.php).
- [20] A. Mora, D. Riera, C. Gonzalez, and J. Arnedo-Moreno, 2015 “A literature review of gamification design frameworks,” presented at the Games and Virtual Worlds for Serious Applications (VS-Games), 2015 7th International Conference on, , pp. 1–8.
- [21] “Octalysis: 2015 Complete Gamification Framework - Yu-kai Chou,” Yu-kai Chou: Gamification & Behavioral Design, 01-Mar-. [Online] Available: <http://yukaichou.com/gamification-examples/octalysis-complete-gamification-framework/>
- [22] K. Werback, 2017 “Gamification - University of Pennsylvania,” Coursera. [Online]. Available: <https://www.coursera.org/learn/gamification>.
- [23] .A. Osterwalder and Y. Pigneur, 2003, “Modeling Value Propositions in e-Business,” in *Proceedings of the 5th International Conference on Electronic Commerce*, New York, NY, USA, , pp. 429–436.
- [24] A. Osterwalder, 2004 “The Business Model Ontology: A Proposition in a Design Science,” Ph. D. Thesis, Université de Lausanne, Lausanne,.
- [25] A. Bujari, M. Ciman, O. Gaggi, and C. E. Palazzi, 2017 “Using Gamification to Discover Cultural Heritage Locations from Geo-tagged Photos,” *Personal Ubiquitous Comput.*, vol. 21, no. 2, pp. 235–252, Apr..
- [26] B. Morschheuser, A. Maedche, and D. Walter, 2017 “Designing Cooperative Gamification: Conceptualization and Prototypical Implementation,” in *Proceedings of the 2017 ACM Conference on Computer Supported Cooperative Work and Social Computing*, New York, NY, USA, 2017, pp. 2410–2421.
- [27] S. Khandelwal, S. K. Sripada, and Y. R. Reddy, 2017 “Impact of Gamification on Code review process: An Experimental Study,” , pp. 122–126.
- [28] D. Bianchini, D. Fogli, and D. Ragazzi, 2016 “Promoting Citizen Participation through Gamification,” , pp. 1–4
- [29] J. L. Jurado, A. Fernandez, and C. A. Collazos 2015, “Applying Gamification in the Context of Knowledge Management,” in *Proceedings of the 15th International Conference on Knowledge Technologies and Data-driven Business*, New York, NY, USA, , p. 43:1–43:4.
- [30] C. Helf, P. Zwickl, H. Hlavacs, and P. Reichl, 2015 “mHealth Stakeholder Integration: A Gamification-based Framework-approach Towards Behavioural Change,” in *Proceedings of the 13th International Conference on Advances in Mobile Computing and Multimedia*, New York, NY, USA, , pp. 268–274.
- [31] E. G. R. Flores, M. S. R. Montoya, and J. Mena, 2016 “Challenge-based gamification and its impact in teaching mathematical modeling,” , pp. 771–776.
- [32] J. Schell, 2008 *The Art of Game Design: A Book of Lenses*. San Francisco, CA, USA: Morgan Kaufmann Publishers Inc.,.
- [33] O. G. Pañella, 2012 “Game Design and e-Health: Serious Games put to the test,” *Advancing Cancer Education and Healthy Living in Our Communities: Putting Visions and Innovations Into Action. Selected Papers from the St. Jude Cure4Kids® Global Summit 2011*, vol. 172, p. 71,.
- [34] A. Marczewski, 2013 “What’s the difference between Gamification and Serious Games,” Andrzej’s Blog,.
- [35] F. Laamarti, M. Eid, and A. E. Saddik, 2014 “An overview of serious games,” *International Journal of Computer Games Technology*, vol. 2014, p. 11,.
- [36] Google, “Google Scholar,” 2017. [Online]. Available: <http://scholar.google.com>.
- [37] C. Maican, R. Lixandroi, and C. Constantin, 2016 “Interactivia.ro – A study of a gamification framework using zero-cost tools,” *Computers in Human Behavior*, vol. 61, pp. 186–197, Aug..
- [38] E. L. Deci, R. Koestner, and R. M. Ryan, 1999 “A meta-analytic review of experiments examining the effects of extrinsic rewards on intrinsic motivation,,”.
- [39] M. Aparicio,.,and C. J. Costa, 2015. Data visualization. *Communication design quarterly review*, 3(1), 7-11. DOI=<http://dx.doi.org/10.1145/2721882.2721883>
- [40] L. F Rodrigues, C. J Costa, and A Oliveira, 2017. How does the web game design influence the behavior of e-banking users?. *Computers in Human Behavior*, 74, 163-174. <https://doi.org/10.1016/j.chb.2017.04.034>
- [41] L. F. Rodrigues, A. Oliveira, and C. J. Costa. 2016. Playing seriously – How gamification and social cues influence bank customers to use gamified e-business applications. *Computers in Human Behavior* 63 (October 2016), 392–407. DOI: <https://doi.org/10.1016/j.chb.2016.05.063>
- [42] L. F. Rodrigues, C. J. Costa, and A. Oliveira. 2016. Gamification: A framework for designing software in e-banking. *Computers in Human Behavior* 62 (September 2016), 620–634. DOI: <https://doi.org/10.1016/j.chb.2016.04.035>
- [43] L. F. Rodrigues, C. J. Costa, and A. Oliveira. 2014. Gamification: The Using of User Discussion Groups in the Software Development in e-Banking. In *Proceedings of the*



International Conference on Information Systems and Design of Communication. ISDOC '14. New York, NY, USA: ACM, 27–34. DOI: <https://doi.org/10.1145/2618168.2618173>

- [44] C. J. Costa, and M. Aparicio 2006. Computer Game—Discussing Development Process. In Proceedings of IRIS (Vol. 29).