



Literature mapping about gamification in the teaching and learning processes

Mapeo de la literatura acerca de la gamificación en los procesos de enseñanza y aprendizaje

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ABSTRACT:

Gamification refers to the incorporation of typical game elements in contexts that are not games, with an objective to motivate the individual to perform certain tasks. For this reason, numerous academics are putting their efforts into designing gamified strategies for the classroom. This paper maps trends and patterns related to gamification as a strategy in teaching and learning processes. For this purpose, a systematic literature review was conducted, based on the content analysis of 99 documents. The results highlight engagement, motivation, and performance as the principal benefits from adopting gamified tools in the classroom. This research is made up of Quantitative and conceptual work: the most used collection techniques are questionnaires, and the gamified elements focused on are the point scoring system, badges, and leaderboard. These previous reasons motivate a growing trend for the use of gamification both in face-to-face modality and virtual learning platforms, as well as opening new lines of research related to the long-term impact of these strategies and their relation to lifelong learning.

Keywords: Gamification, learning, teaching, systematic review

RESUMEN:

La gamificación hace referencia a la incorporación de elementos propios del juego en contextos que no son juegos y tiene como objetivo motivar al individuo a realizar determinadas tareas. Este artículo pretende mapear tendencias y patrones en cuanto a la gamificación como estrategia en los procesos de enseñanza y aprendizaje, realizando un análisis del contenido de 99 documentos. Los resultados señalan al compromiso, motivación y rendimiento como los principales beneficios de las herramientas gamificadas usadas en las aulas.

Palabras clave: Gamificación, aprendizaje, enseñanza, revisión sistemática

1. Introduction

Education is a mechanism that allows students to acquire knowledge and to develop skills, being a fundamental factor in the development of human beings and society. However, not all people learn in the same way or at the same rate; with the appearance of emerging technologies, such as gamification, innovative pedagogical practices have developed, promoting flexibility and active learning. Gamification refers to "the use of game design elements in non-game contexts"

(Deterding, Khaled, Dixon, & Nacke, 2011); this strategy is used, primarily, to motivate to perform tasks that *a priori* can appear little fun.

According to the model proposed by Werbach & Hunter, (2012) gamification is made up of 3 fundamental parts: dynamics, mechanics, and components. Components are the resources used to design the activity, like avatars, points, badges, levels and leaderboard. The mechanics refer to the operating rules and can be types of collection, cooperation, competition, challenges, rewards or feedback. Dynamics, or the way the mechanics launch, alludes to the contexts where gamification develops, including the narrative, progression and social interaction.

In the last few years, gamification has become a growing focus of interest for researchers in education, because its implementation in teaching and learning scenarios can help both teachers and students to reach their short, medium and long term objectives. Nevertheless, in some occasions the generated benefits are not unanimous and depend on the incorporated elements, because each element or their combinations have specific psychological results in the students.

From the above, this paper seeks to accomplish a systematic mapping of patterns and current trends in the research of gamification and its elements, with the aim of providing some suggestions to implement this strategy in Education and future research about its impact.

2. Methodology

In this study, a systematic bibliography review is done focused on the advances and trends in the motivational didactic tools based on gamification used in the teaching and learning processes. For this, a search equation is proposed with the keywords that represent the major aspects for this research (see Figure 1) and the use of the multidisciplinary research databases ISI Web of Science and Scopus because of the high impact of their publications and their international recognition (Aghaei Chadegani et al., 2013).

Therefore, in the structure of the equation (as shown in Figure 1), the term gamif* is found with the aim of finding papers related with gamification, in this case the asterisk (*) is used to include the different variations of the term (gamification, gamified, gamify). Likewise, the terms motivat*, didactic* and tools (motivation, motivate, motivational/ didactics, didactical), referring to the motivational didactic tools, and the words learn* and teach* (learning, learned/ teaching, teaches), alluding to the teaching and learning processes. At the same time, added as a requisite, the documents need to have terms like: trend*, tendency* or advance* (trends, trending, trendy/ tendency, tendencies/ advance, advanced, advancement) to focus the search on the advancements and tendencies of gamified tools.

Figure 1
Search equations

Web of Science: TS=((gamif*) AND (motivat* OR didactic* OR tool OR tools) AND (learn* AND teach*) OR (trend* OR tendenc* OR advance*))

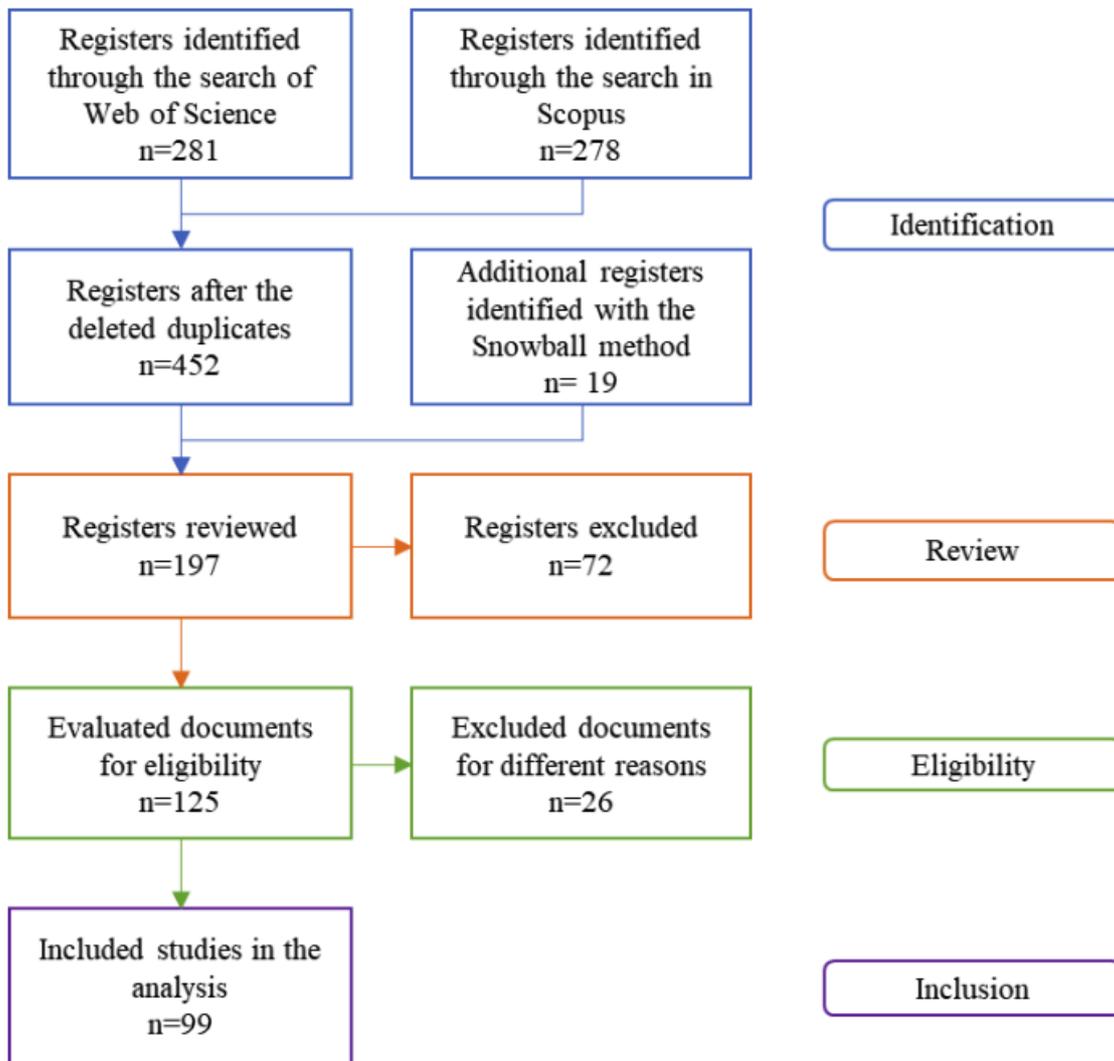
Scopus: TITLE-ABS-KEY ((gamif*) AND (motivat* OR didactic* OR tool ORtools) AND (learn* AND teach*)) AND ALL (trend* OR tendenc* OR advance*)

Source: Authors

This search is done for all the integrated databases in Web of Science (WoS- Web of Science Core Collection, KCI – Korean Journal Database, RSCI-Russian Science Citation Index and SciELO), with all the available years (1980-2019 for Web of Science and 1976-2019 for Scopus), without language restriction, type of document or subject; resulting in a total of 452 entries that include articles, conference proceedings and book chapters.

Additionally, to complement the consolidation of the information, a search is done based on the snowball method (n=19). From the total entries identified, only the ones with major affinity to the topic are reviewed, taking into account title, abstract, and keywords of every document (n=197). Afterwards, the more pertinent documents are evaluated considering that the present review is framed within the DIDACTIC project (Platform of motivational didactic, based on gamification, as a support for the programs of virtual formation) (n=125). In this phase, articles are dismissed if they have restricted access or use the term "gamification" to describe other domains. Finally, the studies most relevant for this research are selected (n=99) (see Figure 2).

Figure 2
PRISMA Flowchart of the bibliographic review



Source: Authors

The 99 selected documents are analyzed in terms of applied methodology, studied gamification elements, the results obtained, and a combination of gamification with other technologies. The data were interpreted and compared with the findings of other studies found in the literature.

3. Results

This section presents the advances and trends in methodological approach, data collection tools, studied elements and results of the research of gamification in the teaching and learning processes, considering the analysis of the 99 selected documents.

3.1. Research methodology

The predominant methodology is quantitative (40.40%). Mainly descriptive statistics (average, variance, deviation) and non-parametric tests (Mann-Whitney, Kruskal-Wallis, Wilcoxon, among other) are used to compare results before and after interactive tests. Likewise, regressive models (partial least squares, ordinary least squares, logistic regression, etc.) are employed to determine whether the elements of gamification, or gamification itself, have any relation with variables like motivation, engagement, performance, among others. Moreover, there is a high number of studies that use the conceptual methodological approach (27.27%) or qualitative methods (23.23%). Within the latter, and just like in the findings made by Bozkurt & Durak (2018), the qualitative/descriptive studies stand out (see Table 1).

Table 1
Methodological research approaches

Methodology	%	Type	n
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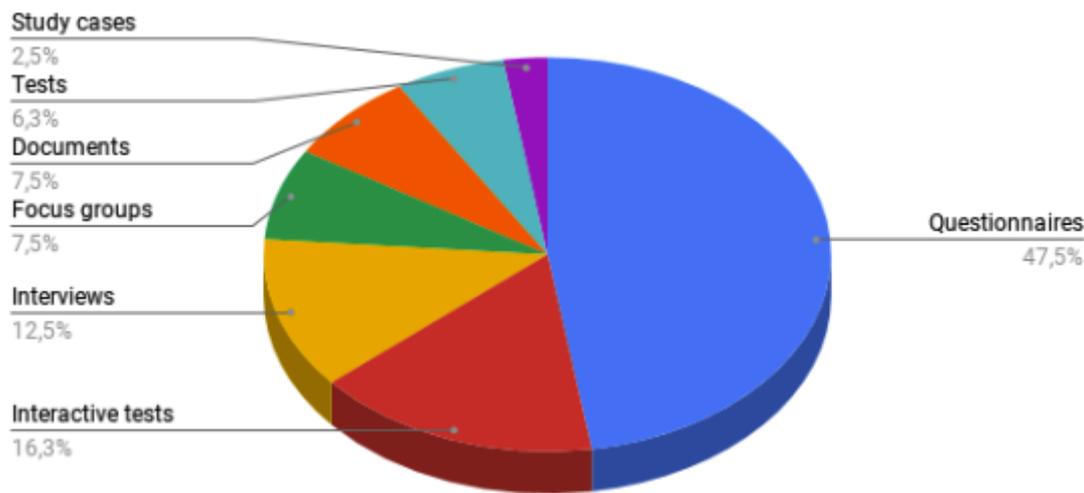
Quantitative	40.40%	Descriptive statistics	15
		Non-parametric tests	11
		Regression	10
		Parametric tests	8
		Analysis of variance and covariance	7
		Factorials	1
Conceptual	27.27%	Literature review	27
Qualitative	23.23%	Descriptive	12
		Axial coding	5
		Phenomenological design	2
		Narrative design	1
		Open coding	1
Mixed	9.09	Sequential exploratory	3
		Convergent parallel	2
		Sequential explanatory	2
		Multiphase	2

Source: Authors

3.2. Data collection instruments

From the total of documents analyzed, $n=27$ correspond to literature reviews and $n=72$ to studies; the latter employ different data collection techniques according to their subject of investigation (see Figure 3). The predominant instrument is the questionnaire (47.5%), composed of a series of questions that can be answered using a Likert scale. Other methods of data compilation that presents high frequency of use are the interactive tests (16.3%), from which derived data is extracted from the implementation of gamified tools, like time of use, number of points, etc.; and the open-question interviews (12.5%). A study can use more than one data compilation technique in order to triangulate the information and obtain more reliable data.

Figure 3
Data collection instruments



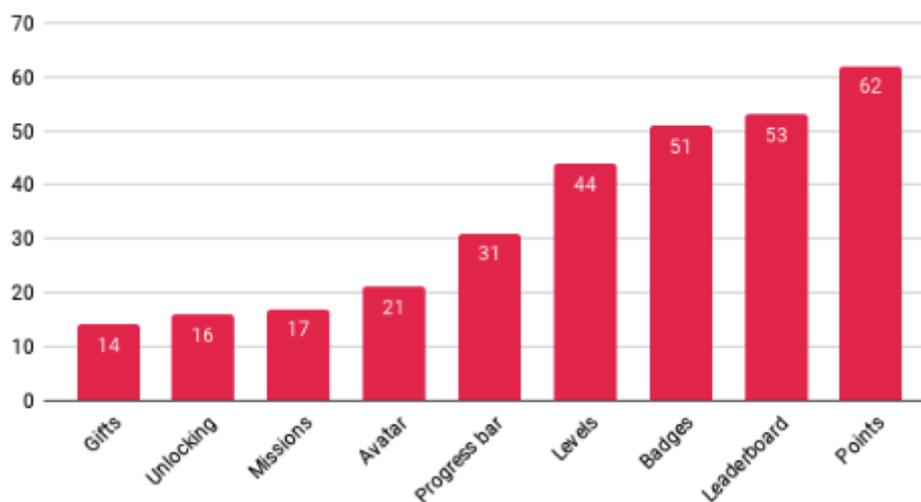
Source: Authors

3.3. Elements of gamification

From the total of chosen documents (n=99), 75% corresponds to research that study the effects of the elements of gamification. Between these, the most studied are components (n=73), followed by mechanics (n=65) and dynamics (n=52).

In relation to components, there is predominantly points inclusion (n=62), leaderboards (n=53), and badges (n=51) (see Figure 4); similar findings present in other systematic reviews (Mincov Tenório, Fernandes Reinaldo, Góis, Lopes, & Junior, 2017; Subhash & Cudney, 2018). The game points, together with levels, increase the extrinsic motivation, so they effectively improve the participation and performance (Li, Grossman, & Fitzmaurice, 2012; Mekler, Brühlmann, Tuch, & Opwis, 2017). Similarly, the visualization of the advance of the player through a progress bar improves their participation, mainly in virtual learning environments (Meinel & Schweiger, 2016; Olsson, Mozelius, & Collin, 2015). Likewise, it was detected that badges have positive effects over motivation (Sailer, Hense, Mayr, & Mandl, 2017), but they do not influence performance (Kyewski & Krämer, 2018). On the contrary, leaderboards can damage motivation when they only promote the explicit competition, so a careful implementation is recommended (Aldemir, Celik, & Kaplan, 2018; Hanus & Fox, 2015; Mincov Tenório et al., 2017).

Figure 4
Components used in the documents analyzed

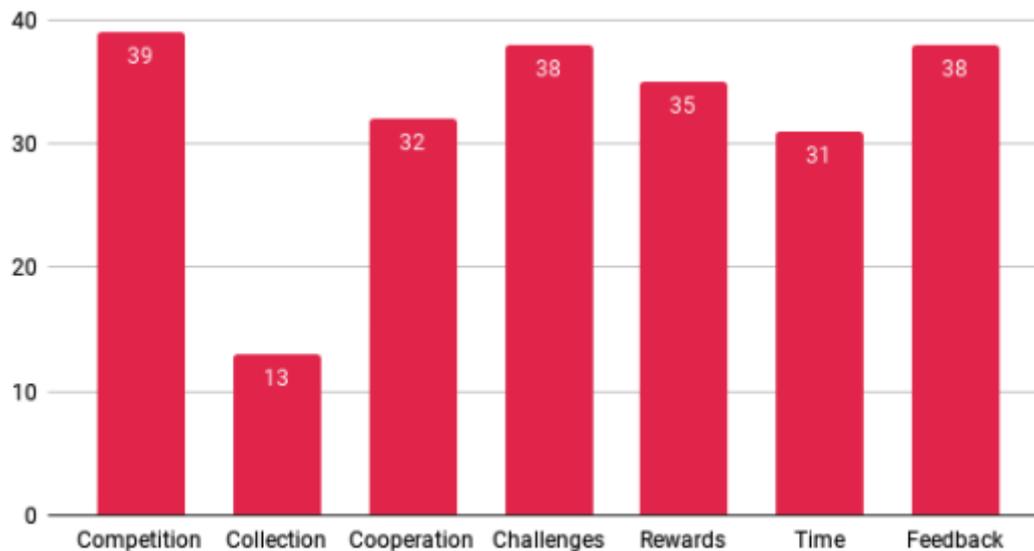


Source: Authors

Moreover, the least studied mechanic is the collection (n=13) or accumulation of objects (see Figure 5). As for the effects, challenges (n=38) contribute to improving commitment, but the literature suggests that they be designed according to the students' skills, because otherwise they can lead to harmful results in the learning process (Doney, 2019; Rojas-López, Rincón-Flores, Mena, García-Peñalvo, & Ramírez-Montoya, 2019). Also, the literature recommends

complementing the competition mechanics (n=39) with that of cooperation (n=32), since together they increase the motivation and participation of the students, but separately they can lead to negative effects in the satisfaction and enjoyment of the game (Doney, 2019; Sepehr & Head, 2013). Likewise, it is advised to include immediate feedback (n=38), because this element allows the students to determine their progress in the course and increases their desire to continue (Alabbasi, 2018; Doney, 2019; Sepehr & Head, 2013).

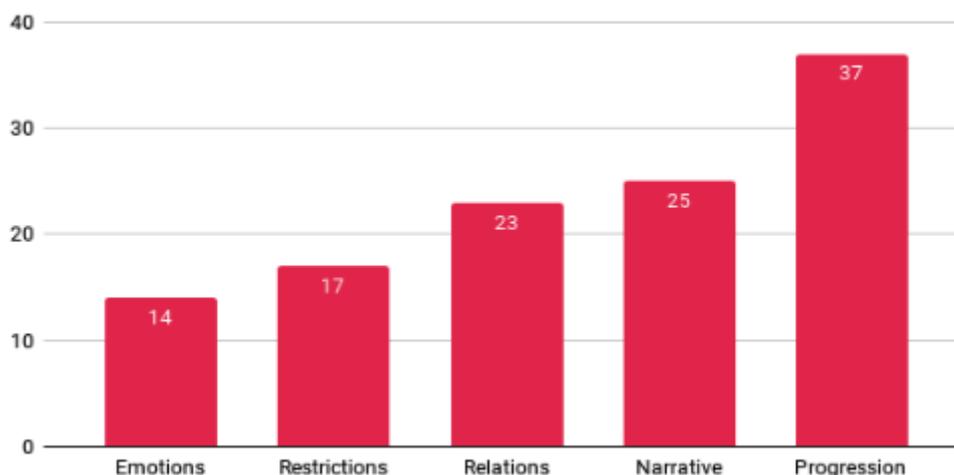
Figure 5
Mechanics used in the documents analyzed



Source: Authors

As for the dynamics, the progression (n=37), since it gives the users the sensation of development and growth, and the narrative (n=25) provides the sensation of immersion and helps students comprehend the different contents (Canals & Minguell, 2018) (see Fig. 6).

Figure 6
Dynamics used in the documents analyzed



Source: Authors

3.4. Results of the gamified experiences

In 90% of studies analyzed, the gamified tools present positive results (see Table 2). The engagement of the users is significant (Alabbasi, 2018; Pascuas, Vargas, & Muñoz, 2017; Rojas-López et al., 2019), especially within the virtual educational modality, since gamification can increase the use of the virtual learning environment (VLE) (Regalado, Aranha, & da Silva, 2016) and improve the sense of belonging with the online community, increasing the interaction between students (Alabbasi, 2018).

Another advantage of using gamified techniques is the increase of completion rates of the educational programs (Huang & Hew, 2018; Li et al., 2012; Romero-Rodriguez, Ramirez-Montoya,

& Gonzalez, 2019), given that the learning alternative strategies, like gamification, encourage student involvement in their learning, and ownership of the course's completion (Gonzalez, Gomez, & Echeverri, 2017). There can be even a fewer desertion rate when gamified tools involve social media, because gamified tools involving social media also increase participation (Almeida & Simoes, 2019; Borrás-Gene, Martiñez-Nuñez, & Fidalgo-Blanco, 2016; Cavalcanti, Filatro, & Presada, 2018; De-Marcos, Domínguez, Saenz-De-Navarrete, & Pagés, 2014). Additionally, gamification can help motivate students to achieve their learning goals (Bicen & Kocakoyun, 2018; Loos & Crosby, 2017; Meinel & Schweiger, 2016). Nevertheless, in some cases motivation decreases slightly when using gamified tools because the novelty of the incorporated tools disappears over time (Mese & Ozgur Dursun, 2019; Van Roy & Zaman, 2018); to combat this, researchers recommend increasing the level of difficulty sequentially and incorporating surprise elements.

Similarly, gamification has the potential to improve academic performance because it provides a variety of learning opportunities through incorporating different elements in the game (Bonora, Martelli, & Marchi, 2019; Filippou, Cheong, & Cheong, 2018; Melo-Solarte & Díaz, 2018). It increases the capacity for remembrance (Fotaris, Mastoras, Leinfellner, & Rosunally, 2016), it improves attention and motivates students to increase their efforts to comprehend concepts and content (Alabbasi, 2018). Moreover, gamified systems have the potential to develop higher order thinking skills (Bonora et al., 2019) like citizenship competencies, because they help drive desired behaviors in terms of moral development and active commitment to the community (Romero-Rodríguez, Torres-Toukoumidis, & Aguaded, 2016). However, when teachers do not assume an active role in the teaching process, gamification does not have any effect overall performance (Aji & Napitupulu, 2018; Orhan Göksün & Gürsoy, 2019).

Table 2
Results of the gamified experiences

Variable	Results	
	Positive	Negative
Motivation	(Bicen & Kocakoyun, 2018; Borrás-Gene et al., 2016; Gasca-Hurtado, Gomez, & Zepeda, 2018; Goshevski, Veljanoska, & Hatziapostolou, 2017; Hanus & Fox, 2015; Loos & Crosby, 2017; Meinel & Schweiger, 2016; Pascuas et al., 2017; Pérez - López & Rivera García, 2017; Romero-Rodríguez et al., 2019; Sánchez-Mena & Martí-Parreño, 2017; Taspinar, Schmidt, & Schuhbauer, 2016; Yildirim, 2017)	(Aji & Napitupulu, 2018; Mese & Ozgur Dursun, 2019; Orhan Göksün & Gürsoy, 2019; Van Roy & Zaman, 2018)
Engagement	(Alabbasi, 2018; Biel & García Jiménez, 2016; Bouchrika, Harrati, Wanick, & Wills, 2019; Filippou et al., 2018; Gasca-Hurtado et al., 2018; Li et al., 2012; Noran, 2016; Pascuas et al., 2017; Rojas-López et al., 2019)	
Performance	(Alabbasi, 2018; Brian Chen, Kathy Huang, Gribbins, & Swan, 2018; De-Marcos et al., 2014; Filippou et al., 2018; Fotaris et al., 2016; Gonzalez et al., 2017; Melo-Solarte & Díaz, 2018)	(Aji & Napitupulu, 2018; Orhan Göksün & Gürsoy, 2019)
Participation	(Cavalcanti et al., 2018; De-Marcos et al., 2014; Hasan, Nat, & Vanduhe, 2019; Loos & Crosby, 2017; Pascuas et al., 2017; Romero-Rodríguez et al., 2019)	(Brian Chen et al., 2018)
Completion	(Borrás-Gene et al., 2016; Gonzalez et al., 2017; Huang & Hew, 2018; Li et al., 2012; Melo-Solarte & Díaz, 2018; Romero-Rodríguez et al., 2019)	
Enjoyment	(Alabbasi, 2018; Filippou et al., 2018; Hanus & Fox,	

	2015; Sánchez-Mena & Martí-Parreño, 2017)	
Interaction	(Alabbasi, 2018)	

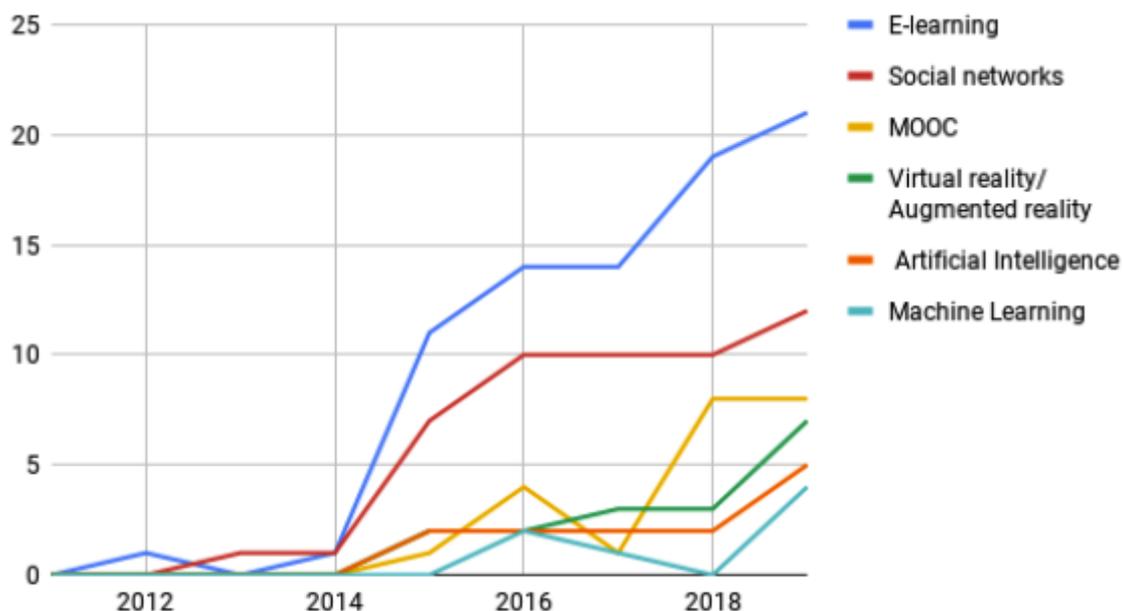
3.5. Combination of gamification with other technological advances

With the advances in information and communications technology (ICT), four paradigms in Education have emerged: the paradigm 1.0 corresponds to the traditional model in which evaluation is made orally or written. Paradigm 2.0 includes projects that use open technologies like Arduino and OpenCV; in paradigm 3.0, social media play a key role in the creation of environments outside the limits of the course. Finally, education 4.0 the learning models adapt and customize themselves according to the profile of each student in virtual learning environments with interactive components, where gamification and artificial intelligence play a significant role (Almeida & Simoes, 2019).

Virtual learning environments (VLE) and massive open online courses (MOOC) are technologies that many educational institutions are incorporating in their development policy and academic prospectus. However, given the restrictions in the teacher student interaction, there can be high desertion rates (Gonzalez et al., 2017; Melo-Solarte & Díaz, 2018; Romero-Rodriguez et al., 2019). Therefore the strategies to motivate students are of great importance and in the last few years researchers are exploring gamification techniques focused on this goal (Regalado et al., 2016). For the studies analyzed, as shown in Figure 7, since the year 2014 there has been an increasing trend of gamification incorporated into e-learning platforms.

Also, the inclusion of the social media in the educational environment has positive results because of instant feedback of most of them (Borras-Gene et al., 2016; De-Marcos et al., 2014; Dombrowski, Dazert, & Volkenstein, 2019). Therefore, in the context of this research, since r 2014 there has been growth in the inclusion of social media in gamification application (see Figure 7). Likewise, the combination of virtual and augmented reality (VR/AR) with gamified tools strengthens the teaching and learning processes (Fraga et al., 2019). One example is the good results from the training prototype for the cardiopulmonary resuscitation (VR-CPR), designed through virtual scenes in 3D with gamification elements like points, levels and feedback (Almoussa et al., 2019).

Figura 7
Gamification trends



Source: Authors

Recent advancements in artificial intelligence (AI) provide their integration with gamification. such is the case of Duolingo, an app that combines language learning with gamification and interactive chatbots that communicate with the user (Fadhil & Villafiorita, 2017). In a similar way, by combining previous technologies with machine learning, they can identify actions, patterns, errors

and other characteristics of the student behavior with the aim of providing personalized suggestions (Di Pietro & Distefano, 2019; Urh, Vukovic, Jereb, & Pintar, 2015). For the context of this study, the combination of gamification both VR/AR and machine learning and artificial intelligence present a slight increase for the current year (2019), possibly because these technologies are very recent and in the last years there has been a growth in research about these topics (see Figure 7).

4. Conclusions and discussion

According to the findings of this work, within the methodological approaches used by the research in gamification, the highlights are quantitative (40.4%) and conceptual (27.27%). Also, the data collection techniques used most are questionnaires (47.5%), interactive tests (16.3%) and interviews (12.5%). Moreover, the most studied elements of gamification are components (n=73), points (n=62), leaderboards (n=53) and badges (n=51).

The results indicate that gamification is a motivational didactic tool that, when designed and used correctly, can improve teaching and learning processes. It has the potential to increase motivation, engagement, and participation, it can facilitate cognitive activity, support individualized learning, decrease student desertion, and promote the development of different skills.

During its design phase, it is important to keep in mind that gamification must be motivating but not addictive (Schulz, Isabwe, & Reichert, 2016) and must include some elements like leaderboards, challenges, competition, and cooperation because in some occasions there can generate negative results. On the contrary, there is a suggestion to include gamified elements that generally can produce positive results in the users, like narrative, points, levels, badges, progress bars and feedback.

With the emergence of the education 4.0, in the last few years there has been a rise in the use of gamification with virtual learning environments, social media, virtual and augmented reality, machine learning, and artificial intelligence. These technological advances play a key role in the transformation of educational practice towards an approach oriented to adaptation and personalization of learning according to each student's profile. In this way, gamification becomes a strategy with high potential for lifelong learning, since it allows people to improve knowledge acquisition and continuous skill development, facilitating their development comprehensively.

Related to the studies analyzed, some of them present limitations related to a small sample size (Fotaris et al., 2016; Sepehr & Head, 2013; Yildirim, 2017) and the short follow-up periods (Bernik, Radošević, & Bubaš, 2017; Signori, Guimaraes, Severo, & Rotta, 2018; Yildirim, 2017), key factors to provide a significant statistical analysis. Because of this, for future research it is recommended to pay attention to these variables. Likewise, analyzing the negative results derived from the implementation of gamified systems is suggested, since current research lacks a critique able to examine unintended consequences (Rapp, Hopfgartner, Hamari, Linehan, & Cena, 2019).

Finally, even though this work presents an exhaustive literature review, it has some limitations, because the analysis peer review publications found in Web of Science and Scopus databases were the only ones considered. Therefore, for similar studies including grey literature from university surveys, consulting like Gartner or dissertations is recommended. Also, it is pertinent to consider search engines like Google Scholar or databases like PubMed, Science Direct and JSTOR to improve the scope of the investigation.

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