Tailored gamification: A review of literature

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ABSTRACT

Gamification is increasingly becoming a pertinent aspect of any UI and UX design. However, a canonical dearth in research and application of gamification has been related to the role of individual differences in susceptibility to gamification and its varied designs. To address this gap, this study reviews the extant corpus of research on tailored gamification (42 studies). The findings of the review indicate that most studies on the field are mostly focused on user modeling for a future personalization, adaptation, or recommendation of game elements. This user model usually contains the users' preferences of play (i.e., player types), and is mostly applied in educational settings. The main contributions of this paper are a standardized terminology of the game elements used in tailored gamification, the discussion on the most suitable game elements for each users' characteristic, and a research agenda including dynamic modeling, exploring multiple characteristics simultaneously, and understanding the effects of other aspects of the interaction on user experience.

1. Introduction

Gamification refers to transforming activities, systems, services, products, or organizational structures to afford gameful experiences (Hamari, 2019). Beyond how the system has been designed, individual differences, the context of use and aspects of the task can play an important role in the formation of the resultant experience (Hamari et al., 2018; Hassenzahl and Tractinsky, 2006). Therefore, it would be beneficial for designers, researchers and users to better understand how e.g. contextual factors, individual traits, personality, interests, demographic factors may moderate and impact the experience individuals have when interacting with gamified systems (Attali and Arieli-Attali, 2015; Bittner and Shipper, 2014; Conaway and Garay, 2014; Gil et al., 2015; Pedro et al., 2015). Thus, tailoring the game elements according to the users' profile is a way to improve their experience while interacting with a gamified system, and has been noted as a current trend in gamification research (Koivisto and Hamari, 2019; Rapp et al., 2019).

In this sense, tailoring corresponds to any combination of information or change of strategy to reach individual needs and preferences according to one's profile (Kreuter et al., 2013). Some concepts

(e.g., personalization, adaptation, and recommendation) can be reintroduced in gamified scenarios to promote this tailoring effect. Personalization is a method where "the content is tailored by the system to individual tastes" (Sundar and Marathe, 2010), while adaptation is a way to "tailor interaction to different users in the same context" (Brusilovsky and Maybury, 2002). Thus, both adaptive and personalized systems modify some of their aspects to fulfill the specific user's needs with the most suitable solution (Garcia-Barrios et al., 2005). The "user model" is the basis for those changes, since it stores explicitly and implicitly captured data (e.g., goals, needs, preferences, and intentions) (Jrad et al., 2007). However, while personalization is a type of adaptation that responds solely to the user model (Garcia-Barrios et al., 2005), adaptation techniques also consider other models, such as the domain, task, and discourse ones (Maybury, 1998). Recommendation technique also reuses this user model, given that "recommendations are usually personalized, different users [...] benefit from diverse, tailored suggestions" (Ricci et al., 2015).

Based on these definitions, this paper aims to describe the state-of-the-art of the tailored gamification through a systematic literature review. We investigate methods, users' characteristics, application

contexts, as well as the most suitable game elements for each user profile according to extant corpus. For this, the paper is structured as follows: Section 2 briefly presents the related systematic works about tailored gamification, while introducing our major contributions. Section 3 describes the systematic protocol and process, including the research questions, keywords, search engines, selection criteria, and extracted data. Section 4 discusses the quantitative and qualitative data and answers the research questions, while Section 5 suggests a research agenda. Lastly, Section 6 states the limitations and final remarks of this study.

2. Related works

Several publications focusing on developing user preference models, classifying game elements, or understanding the effects of different tailoring approaches began to appear in recent years (Tondello, 2019). It is widely accepted that there is a dearth of understanding of the role of individual differences in the susceptibility of the effects of gamification (Koivisto and Hamari, 2019), review studies approaching this emergent topic to understand the literature better were expected.

For instance, Böckle et al. (2017) reviewed gamification literature to answer *"What are the main objectives, elements, and challenges of current research regarding the development of adaptive gamification approaches?"*. The 43 works included aimed to change the state of the user (i.e., improving behavior and goals), support participation and learning, or create meaning by adapting feedback and points based mostly on usage data (e.g., performance or behavior) and user profile (e.g., player types or personality traits). However, understanding the effect of game elements on different individuals remains mostly undiscussed, which makes it a current research challenge (Böckle et al., 2017). Based on that, this study majorly contributes to the literature by addressing the suitable game elements for the specific characteristics of the user profile.

A more recent literature review conducted by Hallifax et al. (2019a) aimed to answer *"What are the current kinds of contributions to the field?"*, *"What do the current contributions base their adaptation on, and what is the effect of this adaptation on the gamified system?"*, and *"What is the impact of the adaptive gamification, and how is this impact measured?"*. The 20 studies included proposed real-world adaptation studies, recommendations, or theoretical architectures based on usage data and user profile, similar to those reported by Böckle et al. (2017). Also, Hallifax et al. (2019a) reported that studies lasting less than two weeks were more likely to have positive effects than more extended experiments, which described mitigated results. Since the scope of this study was related to the educational area, the results are highly context-dependent. Thus, our contribution focuses on exploring these tailoring methods and outcomes regardless of the application context, given it is a challenge for any domain (Cursino et al., 2018; Hakak et al., 2019; Larson, 2020; Noorbehbahani et al., 2019).

3. Methodology

A systematic literature review is a method that analyzes the literature available of a specific phenomenon of interest, focusing on providing a background for new studies, identifying gaps for further investigation, and summarizing evidence concerning a technology (Kitchenham and Charters, 2007). While tailoring gamification is an emerging trend aiming to improve user experience by considering one's profile, researchers have not yet appropriately identified and summarized the employed approaches and most suitable game elements to do that. Following the guidelines previously described by Kitchenham et al. (2009), this study aims to achieve it through a defined, reproducible protocol describing: **(1)** research questions, **(2)** keywords, **(3)** search engines, and **(4)** selection criteria.

3.1. Research questions

Four main research questions (RQ) will be answered to describe the state-of-the-art of tailored gamification:

RQ1: What methods have been mainly used to make tailored game elements in gamified systems based on the characteristics of the user profile?
- **RQ1.1:** Which algorithms or techniques are used to provide tailored gamification?
- **RQ1.2:** Which game elements are used in tailored gamification?
- **RQ1.3:** How is tailored gamification evaluated?
- **RQ1.4:** What aspects of gamification do these evaluations assess?
- **RQ2:** In what contexts is the users' profile considered for the tailored gamification process?
- **RQ3:** What users' profile characteristics are considered?
- **RQ4:** What are the most suitable game elements for each specific characteristic?

3.2. Keywords

One of the most used processes to define the search keywords is PICO, which identifies the population (P), the intervention (I), the comparison (C), and the expected outcomes (O), based on the research questions (Kitchenham and Charters, 2007). In this scenario, we have:

- **Population (P):** studies that describe or apply *gamification* tailored to characteristics of the user profile in computational systems;
- **Intervention (I):** methods used to make *tailored* game elements in gamified systems (e.g., *adapted, personalized, recommended*);
- **Comparison (C):** not applicable, since the purpose of this study is to describe the state-of-the-art;
- **Outcomes (O):** most used algorithms, techniques, characteristics of the user profile, and game elements.

A set of keywords representing the expected search results was defined based on this PICO. Thus, the search string comprises two major sets of keywords:

- **Gamification:** covers the collection of keywords related to gamification (e.g., gamified, gamify, gamifying);
- **Tailoring:** covers the collection of keywords about tailor-made methods (e.g., tailoring, tailored, adaptation, adaptive, user model, user modeling, personalization, personalisation, recommend, recommender system, recommendation).

Thus, the search string defined is: "**gamif* AND (adapt* OR model OR personali* OR recommend* OR tailor*)**" - where * is a wildcard.

3.3. Search engines

The search engines were defined based on the related studies (Böckle et al., 2017; Hallifax et al., 2019a) and other systematic mapping and reviews about gamification, such as Dicheva et al. (2015); Pedreira et al. (2015); de Sousa Borges et al. (2014) and Alahäivälä and Oinas-Kukkonen (2016). All of these studies used *ACM Digital Library* and *IEEE Xplore*, and four out of them used *Science Direct, Scopus*, and *Springer Link*. Thus, these five search engines were also used in this study.

3.4. Selection criteria

After searching for the keywords in the search engines, all 3400 studies returned in September 2018 were screened according to the selection criteria (SC) to make the results more accurate.

- **SC1:** Studies published in 2013 or later (last five years);
- **SC2:** Studies written in English;
- **SC3:** Full studies (with six or more pages);
- **SC4:** Primary studies (i.e., not surveys, meta-analysis, systematic mappings or reviews);
- **SC5:** Studies available for download;
- **SC6:** Non-duplicate studies (i.e., with the same Digital Object Identifier - DOI);
- **SC7:** Studies whose central theme is gamification;
- **SC8:** Studies that explore any tailor-made methods;
- **SC9:** Studies that propose or analyze the tailor-made game elements in gamified systems.

Once applied in the returned studies, only 34 of them met the selection criteria, as shown in Table 1. These studies (Akasaki et al., 2016; AL-Smadi, 2015; Auvinen et al., 2015; Barata et al., 2016; Berg and Petersen, 2013; Borges et al., 2016; Busch et al., 2016; Butler, 2014; Challco et al., 2014; Denden et al., 2017a; 2017b; Fernandes and Junior, 2016; Ferro et al., 2013; Fuß et al., 2014; Harteveld and Sutherland, 2017; Herbert et al., 2014; Holmes et al., 2015; Lavoué et al., 2018; Monterrat et al., 2015a; 2015b; Orji et al., 2017; 2014; Oyibo et al., 2017a; 2017c; Paiva et al., 2015; Roosta et al., 2016; Taspinar et al., 2016; Tondello et al., 2017a; 2017b; 2016; Utomo and Santoso, 2015; Čudanov et al., 2014; Xu and Tang, 2015) have gone through the backward snowballing process, which uses the reference list of each one to identify additional work (Wohlin, 2014). From the 1720 references of the selected studies, eight other works met the selection criteria and were also included in the systematic review analysis (Codish and Ravid, 2014; 2017; Hakulinen and Auvinen, 2014; Jia et al., 2016; Monterrat et al., 2014; 2017; Orji, 2014; Oyibo et al., 2017b).

After generating association rules using the *apriori* algorithm (Borgelt and Kruse, 2002) based on the titles, abstracts, and keywords of the 42 selected works, it is possible to affirm that studies that contained gamification-related words also included tailoring-related terms (*confidence coefficient = 1, support coefficient = 0.6*). This result indicates that both the keywords and the selection criteria were correctly defined and applied.

3.5. Data to be extracted

Besides extracting the tailoring methods (RQ1), algorithms and techniques (RQ1.1), game elements (RQ1.2), evaluation methodology (RQ1.3), outcomes (RQ1.4), application contexts (RQ2), users' characteristics (RQ3) and the suitable game elements (RQ4), other quantitative data were also collected: publication year, type of publication venue (e.g., conference, journal) and author's affiliation country.
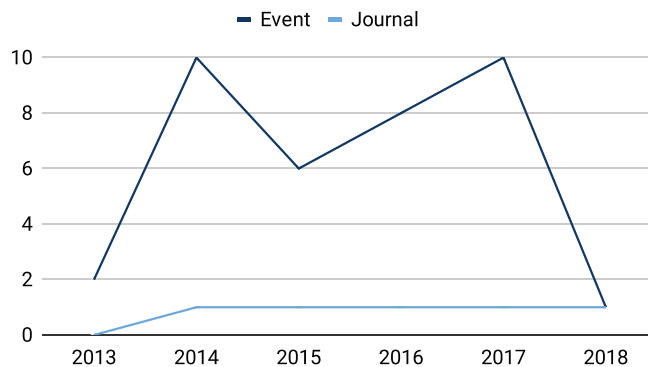

Fig. 1. Publication years and Publication venue types.

4. Results and discussion

The interest of the researchers about tailored gamification has been growing over the last years, with a substantial increase in the number of studies between 2015 and 2017, as Fig. 1 illustrates. The publication decreas in 2018 cannot be considered a trend since this search was conducted before the end of the year. The subject is mostly published in events (e.g., conferences, symposiums, workshops), which can be related to the longer revision time of journals and the low maturity of the topic (due to its novelty).

According to the authors' affiliation countries, Canadian and French studies were the most published ones, as shown in Fig. 2, and many international collaborations happened. Austrian, Canadian, and British universities wrote collaboratively one of these studies (Tondello et al., 2016) (each country had 0.3 paper – for calculation purposes). Another four studies also shared the authorship between two countries, namely: Austrian and Canadian (Busch et al., 2016), Canadian and French (Monterrat et al., 2015a), Canadian and Spanish (Tondello et al., 2017a), and Brazilian and Japanese (Borges et al., 2016) (0.5 paper each). All the other 37 studies had no international collaboration.

4.1. Tailoring methods (RQ1)

Most of the studies (67%) focused on predicting and modeling the user profile and the correspondent game elements, as shown in Table 2. While user modeling is a very significant step towards tailored gamification, this result indicates that researchers are still discussing *what* instead of *how* to customize. Little has yet been explored about concrete implementations of gamification tailoring methods (i.e., personalization, adaptation, and recommendation strategies, according to what each study described), implying a high possibility to expand and improve this topic.

Table 1
Conduction of the Search.

Criteria	Search engines					
	ACM Digital Library	IEEE Xplore	Scopus	Science Direct	SpringerLink	Total
Search: September, 2018	172	271	1368	84	1505	3400
SC1: Published in 2013 or later	170	269	1359	84	1496	3378
SC2: Written in English	168	262	1317	83	1485	3315
SC3: Full studies	100	160	1124	79	1367	2830
SC4: Primary studies	96	154	923	76	1279	2528
SC5: Available for download	90	146	297	66	1276	1875
SC6: Non-duplicate studies	89	144	219	66	1188	1706
SC7: Gamification	73	113	175	38	372	771
SC8: Tailoring methods	26	29	50	3	84	192
SC9: Tailored gamification	10	8	8	1	7	**34**
Snowballing			8			**42**

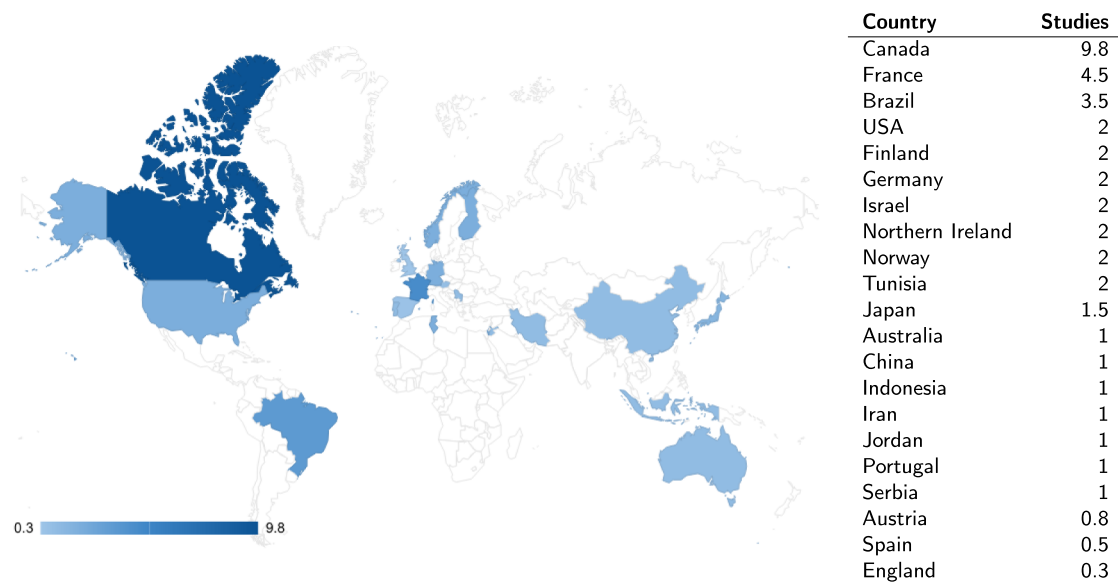| Country	Studies
Canada	9.8
France	4.5
Brazil	3.5
USA	2
Finland	2
Germany	2
Israel	2
Northern Ireland	2
Norway	2
Tunisia	2
Japan	1.5
Australia	1
China	1
Indonesia	1
Iran	1
Jordan	1
Portugal	1
Serbia	1
Austria	0.8
Spain	0.5
England	0.3

Fig. 2. Countries of the authors' affiliations.

4.1.1. Algorithms and techniques (RQ1.1)

The most used algorithms and techniques for tailored gamification are exposed in Table 3. Given that studies were mainly related to user modeling, the most used algorithms and techniques were evidently from the **statistics** domain, aiming to correlate and test the most appropriate game elements to each user profile dimension. The central tendencies (e.g., mean, median), hypothesis tests (e.g., t-test, Wilcoxon rank-sum test, Chi-squared test), deviation and dispersion (e.g., standard deviation, standard error), reliability (e.g., Cronbach's alpha, McDonalds's omega, Cohen's-kappa coefficient), linear regression (Partial Least Squares, logistic regression), analysis of variance (e.g., One-way analysis of variance, Kruskal-Wallis test), and correlations (e.g., Spearman's rho, Pearson's r) were the most employed techniques within statistics area, while bayesian statistics (Barata et al., 2016) and frequentist inference (Lavoué et al., 2018) also appeared once. However, solutions are also emerging from other domains, such as **information sciences** (e.g., manual classification, decision tree, framework (Čudanov et al., 2014), and ontology (Challco et al., 2014)), **research** (e.g., literature review and qualitative analysis), **adaptation** (e.g., adaptation rules, and user profiling (Monterrat et al., 2017)), **recommendation** (e.g., recommender systems (Tondello et al., 2017b; Xu and Tang, 2015)), **data mining** (e.g., clustering (Hakulinen and Auvinen, 2014; Herbert et al., 2014), causal data mining (Xu and Tang, 2015), and Receiver Operating Characteristic (Barata et al., 2016)), **artificial intelligence** (e.g., pedagogical agent (Utomo and Santoso, 2015)), **machine learning** (e.g., correlation-based feature selection, expectation-maximization, k-nearest neighbors and sequential minimal optimization (Barata et al., 2016)), **human-computer interaction** (e.g., design of motivational affordances (Harteveld and Sutherland, 2017)), and **linear algebra** (e.g., matrix multiplication (Monterrat et al., 2017)).

4.1.2. Game elements (RQ1.2)

Gamification employs several game elements to get a meaningful response from users (Zichermann and Cunningham, 2011), regardless of the application context. However, the literature uses different terminologies to define a common game element, since some works employ definitions of distinct abstraction levels (e.g., progression and level could address the same element, depending on the work). While this is a well-known issue for the overall gamification subject (Hallifax et al., 2019b), the following game elements emerged from the included studies, which was standardized based on the authors' description or image of each game element defined:

- **Anarchy:** creates an environment without any restrictions or penalties (Butler, 2014), allowing anarchic gameplay (Tondello et al., 2016);
- **Anonymity:** is the opportunity to share the data (e.g., performance, opinions) in the system without naming the user (Tondello et al., 2016);
- **Badge:** is a visual representation of the user's achievements. It is usually described as "badges" (Akasaki et al., 2016; Barata et al., 2016; Butler, 2014; Challco et al., 2014; Codish and Ravid, 2014; Denden et al., 2017a; 2017b; Ferro et al., 2013; Hakulinen and Auvinen, 2014; Herbert et al., 2014; Jia et al., 2016; Paiva et al., 2015; Roosta et al., 2016; Tondello et al., 2017a; 2016; Utomo and Santoso, 2015; Čudanov et al., 2014) or "achievements" (Auvinen et al., 2015; Berg and Petersen, 2013; Borges et al., 2016; Fernandes and Junior, 2016; Fuß et al., 2014);
- **Challenge:** can be a variety of situations to deal with or figure them out (Butler, 2014), boss battles (Holmes et al., 2015), or any other kind of action that requires effort from the user to be completed. Authors usually describe this game element as challenge (AL-Smadi,

Table 2
Tailored gamification methods.

Tailoring method	Studies	Total
User modeling	Akasaki et al. (2016); AL-Smadi (2015); Auvinen et al. (2015); Barata et al. (2016); Berg and Petersen (2013); Borges et al. (2016); Busch et al. (2016); Butler (2014); Codish and Ravid (2014, 2017); Denden et al. (2017a,b); Fernandes and Junior (2016); Fuß et al. (2014); Hakulinen and Auvinen (2014); Harteveld and Sutherland (2017); Herbert et al. (2014); Holmes et al. (2015); Jia et al. (2016); Orji (2014); Orji et al. (2017); Oyibo et al. (2017a, 2017b, 2017c); Taspinar et al. (2016); Tondello et al. (2017a, 2016); Čudanov et al. (2014)	**28** (67%)
Personalization	Challco et al. (2014); Ferro et al. (2013); Orji et al. (2018, 2014); Paiva et al. (2015); Roosta et al. (2016); Utomo and Santoso (2015)	**7** (16%)
Adaptation	Lavoué et al. (2018); Monterrat et al. (2015a, 2014, 2015b, 2017)	**5** (12%)
Recommendation	Tondello et al. (2017b); Xu and Tang (2015)	**2** (4%)

Table 3
Algorithms and techniques used by each tailoring method.

Studies		Statistics										Inf. S.		Research		Ad.
		Central tendency	Hypothesis test	Deviation and Dispersion	Reliability	Linear regression	Analysis of variance	Correlation	Factor Analysis	Structural Equation Models	Principal Component Analysis	Manual classification	Decision tree	Literature review	Qualitative analysis	Adaptation rules
User modeling	Berg and Petersen (2013)	•										•				
	Butler (2014)													•		
	Codish and Ravid (2014)	•	•	•		•	•	•								
	Fuß et al. (2014)	•	•	•	•		•	•			•					
	Hakulinen and Auvinen (2014)	•								•						
	Herbert et al. (2014)	•	•	•	•		•		•				•			
	Orji (2014)	•	•	•	•		•		•							
	AL-Smadi (2015)	•														
	Auvinen et al. (2015)	•	•	•				•						•		
	Holmes et al. (2015)	•										•				
	Akasaki et al. (2016)	•														
	Barata et al. (2016)	•	•	•	•	•	•						•			
	Borges et al. (2016)	•		•	•	•									•	
	Busch et al. (2016)	•			•	•										
	Fernandes and Junior (2016)	•														
	Jia et al. (2016)	•	•	•	•	•		•								
	Taspinar et al. (2016)	•		•	•			•	•						•	
	Tondello et al. (2016)	•	•	•	•	•	•			•						
	Codish and Ravid (2017)				•								•			
	Denden et al. (2017a)	•	•	•	•			•	•							
	Denden et al. (2017b)	•	•	•	•	•	•									
	Orji et al. (2017)	•	•			•	•	•	•	•						
	Oyibo et al. (2017a)	•	•	•	•		•									
	Oyibo et al. (2017b)	•	•	•	•		•									
	Oyibo et al. (2017c)	•	•	•	•											
	Tondello et al. (2017a)	•		•		•		•	•	•						
Personaliz.	Ferro et al. (2013)	•	•	•	•			•	•	•		•		•		
	Orji et al. (2014)	•	•	•	•	•		•	•	•	•					
	Roosta et al. (2016)		•		•	•		•								
	Orji et al. (2018)	•		•	•	•	•	•	•	•						
Adaptation	Monterrat et al. (2014)	•	•	•		•		•								
	Monterrat et al. (2015a)							•								•
	Monterrat et al. (2015b)															
	Monterrat et al. (2017)															•
	Lavoué et al. (2018)	•	•	•		•										•

2015; Barata et al., 2016; Berg and Petersen, 2013; Butler, 2014; Harteveld and Sutherland, 2017; Jia et al., 2016; Monterrat et al., 2014; 2015b; Taspinar et al., 2016; Tondello et al., 2017a; 2016), quest (Borges et al., 2016; Challco et al., 2014; Fernandes and Junior, 2016; Ferro et al., 2013; Herbert et al., 2014), or task (Fuß et al., 2014);

- **Choice:** lets the user have the autonomy to determinate his/her verdict among many possibilities (Harteveld and Sutherland, 2017). This game element includes non-linear gameplay (Tondello et al., 2016), high-level closures (Holmes et al., 2015), numerous open-ended or branching decisions to make and multiple paths to choose (AL-Smadi, 2015; Butler, 2014), and anchor juxtaposition (i.e., the user must decide between paying for more time or making more efforts to achieve the same result) (Tondello et al., 2017a);
- **Collection:** creates the sense of ownership in the system through picking-up (Holmes et al., 2015), trading (Tondello et al., 2017a; 2016), and management collectibles and resources within an inventory (Akasaki et al., 2016; AL-Smadi, 2015; Butler, 2014; Ferro et al., 2013; Fuß et al., 2014; Monterrat et al., 2014; 2015b);
- **Competition:** allows social comparison (AL-Smadi, 2015; Berg and Petersen, 2013; Busch et al., 2016; Holmes et al., 2015; Orji, 2014; Orji et al., 2017; 2018; 2014; Oyibo et al., 2017a; 2017b; 2017c; Tondello et al., 2017a; 2016) between users and promotes a possibility to prove themselves better than others. This competition encompasses personal conflicts (Berg and Petersen, 2013; Monterrat et al., 2014; 2015b), duels (Fuß et al., 2014), and contests (Butler, 2014);
- **Consequence:** facilitates the user observation of the cause-and-effect linkage of his/her behavior (Busch et al., 2016; Orji, 2014; Orji et al., 2017; 2018; 2014). This element also encompasses the set of boundaries (Monterrat et al., 2014; 2015b) or rules (Butler, 2014) and the punishment for not following it (Orji et al., 2017; 2018);
- **Customization:** enables the self-expression of the users through the creation and decoration of their virtual space (AL-Smadi, 2015; Berg and Petersen, 2013; Monterrat et al., 2014; 2015b), their avatar (Borges et al., 2016; Butler, 2014; Denden et al., 2017a; 2017b; Jia et al., 2016; Tondello et al., 2017a) or their character (Harteveld and Sutherland, 2017; Holmes et al., 2015; Monterrat et al., 2014; 2015b), and the personalization (Busch et al., 2016; Challco et al., 2014; Fernandes and Junior, 2016; Ferro et al., 2013; Fuß et al., 2014; Herbert et al., 2014; Orji, 2014; Orji et al., 2017; 2018; 2014; Tondello et al., 2016) of some aspects of the system's interface;
- **Easter egg:** is a surprising response of the system to a specific action of the user (Tondello et al., 2017a; 2016). This element can appear as a gift of surprise (Čudanov et al., 2014), an unforeseen event (Butler, 2014), or a secret lesson (Fuß et al., 2014);
- **Emotion:** involves all aesthetics (Monterrat et al., 2014; 2015b) that create positive perceptions (e.g., enjoyment (Butler, 2014), playfulness (Codish and Ravid, 2014)) on users and influence their actions (Harteveld and Sutherland, 2017);
- **Exploration:** gives the user the possibility to investigate and discover areas and features of the system, through exploratory tasks (AL-Smadi, 2015; Butler, 2014; Tondello et al., 2016), imperfect information (Holmes et al., 2015), and mystery boxes (Tondello et al., 2017a);
- **Feedback:** returns relevant information to users. While some authors directly described it as "feedback" (Berg and Petersen, 2013; Denden et al., 2017a; 2017b; Harteveld and Sutherland, 2017; Jia et al., 2016; Orji et al., 2018; Roosta et al., 2016; Taspinar et al., 2016), others employed feedback to provide a way for users self-monitor themselves (Busch et al., 2016; Orji, 2014; Orji et al., 2017; 2018; 2014) or a game state overview (AL-Smadi, 2015; Holmes et al., 2015);
- **Gifting:** allows the user to give or share resources with others (AL-Smadi, 2015), encouraging altruism and satisfaction (Challco et al., 2014; Herbert et al., 2014; Tondello et al., 2017a);

- **Guild:** includes the team feeling (i.e., being part of a group) and the caretaking between users. Other than being directly called "guild" or "team" (Tondello et al., 2017a; 2016), it can appear as co-operation (Busch et al., 2016; Fuß et al., 2014; Orji, 2014; Orji et al., 2017; 2018; 2014), collaboration (AL-Smadi, 2015; Berg and Petersen, 2013; Taspinar et al., 2016), and support (Butler, 2014; Fuß et al., 2014) of the guildmates. In most of the applications, the system creates roles for guild administrators to look after other users (Tondello et al., 2017a);
- **Honor system:** creates a reputation score where other users or even the system calculates a number that indicates the user reliability (Borges et al., 2016);
- **Leaderboard:** orders the users according to some criteria (e.g., points, levels, badges), contextualizing the other game elements to enable user comparison (Borges et al., 2016; Challco et al., 2014; Codish and Ravid, 2014; 2017; Denden et al., 2017a; 2017b; Ferro et al., 2013; Herbert et al., 2014; Jia et al., 2016; Lavoué et al., 2018; Monterrat et al., 2015a; 2017; Roosta et al., 2016; Tondello et al., 2017a; 2016). This element can also appear in the literature as a ranking (Akasaki et al., 2016; Fernandes and Junior, 2016; Taspinar et al., 2016);
- **Learning:** allows the user to gain and master new skills (Butler, 2014; Fuß et al., 2014; Holmes et al., 2015; Monterrat et al., 2017), by imitating other users (i.e., social learning) (Berg and Petersen, 2013; Oyibo et al., 2017a; 2017b; 2017c; Tondello et al., 2017a; 2016) or through visual representation (e.g., knowledge maps (Borges et al., 2016), skill trees (Barata et al., 2016));
- **Level:** supports users to track their progression through the system's purpose over time, aiding the visualization (e.g., progress bar (Borges et al., 2016; Codish and Ravid, 2014; 2017; Denden et al., 2017a; 2017b; Fernandes and Junior, 2016; Ferro et al., 2013; Herbert et al., 2014; Holmes et al., 2015; Jia et al., 2016; Roosta et al., 2016; Taspinar et al., 2016; Tondello et al., 2017a; 2016), stars (Lavoué et al., 2018; Monterrat et al., 2017) or flags along a path (Monterrat et al., 2015a)) of a continuously and gradually growing towards a specific goal (Butler, 2014; Fuß et al., 2014);
- **Lottery:** is an element of randomness (i.e., a chance) within the system, such as offering a "free lunch" (Tondello et al., 2017a);
- **Meaning:** allows the user to auto-identify with the system through a common purpose (Holmes et al., 2015). Some examples of meaningful choice are explicit objectives to pursue (Berg and Petersen, 2013; Butler, 2014; Jia et al., 2016; Monterrat et al., 2014; 2015b; Taspinar et al., 2016), goal setting and suggestion (Orji et al., 2017; 2018), and actions tied to something more significant than the user himself or herself (e.g., humanity hero) (Tondello et al., 2017a);
- **Narrative:** includes plots that connect the other game elements. Besides a linear or unfolding sequence of events (i.e., story) (Akasaki et al., 2016; Butler, 2014; Monterrat et al., 2014; 2015b; Tondello et al., 2017a), they can encompass different themes (Tondello et al., 2017a) and contexts that make sense to the users (Butler, 2014), plot-twists (Butler, 2014), dramatic art (Monterrat et al., 2014; 2015b), and life-like agents (Utomo and Santoso, 2015);
- **Point:** is numerical feedback provided when the user does a specific action (Borges et al., 2016; Challco et al., 2014; Codish and Ravid, 2014; 2017; Denden et al., 2017a; 2017b; Fernandes and Junior, 2016; Ferro et al., 2013; Herbert et al., 2014; Jia et al., 2016; Taspinar et al., 2016; Tondello et al., 2017a; 2016). It is also called "experience point" since it indicates that the user's progress (and knowledge) is continuously growing (Barata et al., 2016; Fuß et al., 2014);
- **Prize:** is any reward that the user wins for his/her action (Busch et al., 2016; Codish and Ravid, 2014; Jia et al., 2016; Orji, 2014; Orji et al., 2017; 2018; 2014; Oyibo et al., 2017a; 2017b; 2017c; Tondello et al., 2016). Some examples of this game element are bonuses (Fernandes and Junior, 2016; Ferro et al., 2013), combos (Fernandes and Junior, 2016; Ferro et al., 2013), win states (AL-
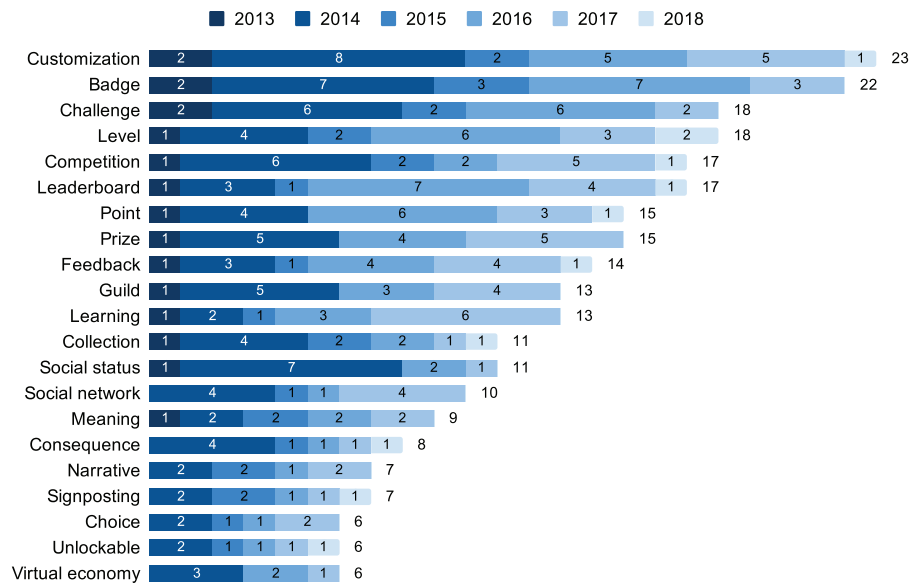
Fig. 3. Most used game elements in the studies.

Smadi, 2015; Fuß et al., 2014), and boosters (Tondello et al., 2017a);

- **Reward schedule:** applies reinforcements consistently to condition and strengthens the user's behavior in anticipation of new rewards. While other authors defined it as "reward schedule" (Fernandes and Junior, 2016; Ferro et al., 2013), Butler (2014) introduced it as "infrequent but long sessions should be rewarding";

- **Signposting:** is any guidance that the system provides to the users to help, suggest, or warn them about a path to be (or not) followed (AL-Smadi, 2015; Busch et al., 2016). It appeared as a suggestion (Busch et al., 2016; Utomo and Santoso, 2015), a tip (Lavoué et al., 2018; Monterrat et al., 2015a), a greeting message (AL-Smadi, 2015), a glowing choice (i.e., highlighting an item) (Tondello et al., 2017a), or even as an intuitive play (Butler, 2014);

- **Single-player:** allows the user to play alone, no requirements of social interaction with others (Butler, 2014);

- **Social discovery:** supports the user to find or be found by other people with the same interests or status by checking the public profile (Fuß et al., 2014; Tondello et al., 2017a; 2016);

- **Social network:** enables the connection between users (Challco et al., 2014; Herbert et al., 2014; Tondello et al., 2017a; 2016) through communication channels (Holmes et al., 2015) that support the human-human interaction (Harteveld and Sutherland, 2017) (e.g., likes (AL-Smadi, 2015), chat (Denden et al., 2017a; 2017b), voice, and face-to-face (Butler, 2014)). This communication can also appear as multi-player games (Butler, 2014; Holmes et al., 2015);

- **Social pressure:** permits users to influence or be influenced by others (Harteveld and Sutherland, 2017), through public comments (AL-Smadi, 2015) or creating fear of becoming "the loser" in the team (e.g., allowing others to know how many time you have spent on a specific level) (Tondello et al., 2017a);

- **Social status:** allows the user to brag about himself/herself through the system. Other than "social status" (Challco et al., 2014; Ferro et al., 2013; Fuß et al., 2014; Herbert et al., 2014; Tondello et al., 2017a), some types of implementation are praises (Busch et al., 2016; Orji, 2014; Orji et al., 2014), certificates (Tondello et al., 2017a; 2016), public ranks and titles (Butler, 2014), and the possibility to show off (AL-Smadi, 2015);

- **Strategy:** requires the user to elaborate a plan of action to maximize opportunities or minimizing losses and damages (Butler, 2014). It can also be activities in which users review the action plan (AL-Smadi, 2015) and notice a perceived chance to succeed

(Holmes et al., 2015);

- **Time pressure:** involves a specific constraint that demands the user to complete a particular task in a determined time. This game element encompasses timers (Butler, 2014; Lavoué et al., 2018; Monterrat et al., 2015a), and deadlines (Butler, 2014; Monterrat et al., 2015a), countdowns (Taspinar et al., 2016; Utomo and Santoso, 2015) and task reminders (Utomo and Santoso, 2015);

- **Unlockable:** is an exclusive content conditioned to an action of the user to be available, such as new contents (Herbert et al., 2014; Lavoué et al., 2018; Tondello et al., 2017a; 2016) and features (Challco et al., 2014; Holmes et al., 2015);

- **Virtual economy:** creates a currency (Borges et al., 2016) to allow users to purchase (AL-Smadi, 2015) features and virtual goods (Borges et al., 2016; Challco et al., 2014; Herbert et al., 2014), and using the term "virtual economy" is also common (Tondello et al., 2017a; 2016);

- **Voting:** allows the user to give his/her opinion within a subject, including any rating and voting mechanism (AL-Smadi, 2015; Tondello et al., 2017a; 2016).

Based on this terminology, the majority of the studies applied *customization* (55%) and *badges* (52%) in user modeling, personalization, adaptation, or recommendation processes. Other relevant game elements also used were: challenges and levels (43%), and competition and leaderboards (40%). The two recommendation studies (Tondello et al., 2017b; Xu and Tang, 2015) were the only ones that did not specify the game elements considered. All game elements used in more than 14% of the studies are represented in Fig. 3. Contrary to the forecast from the early years of gamification, the PBL triad (Points, Badges, and Leaderboards) is no longer the dominant set of applied game elements, at least in the tailoring context. Instead, researchers have been searching for the effects of a wide range of game elements in the user experience.

4.1.3. Evaluation methodology (RQ1.3) and outcomes (RQ1.4)

A total of 9 studies did not perform any empirical evaluation, mainly focusing on proposing game elements based on literature review (Denden et al., 2017b; Ferro et al., 2013; Monterrat et al., 2015b) or design principles (AL-Smadi, 2015; Fernandes and Junior, 2016; Harteveld and Sutherland, 2017; Orji et al., 2017; Tondello et al., 2017b; Čudanov et al., 2014). The other 33 studies applied a total of 54 evaluative methods, with a peak of using four methods simultaneously

Table 4
Evaluation methods and outcomes.

Studies	Methods								
	Survey	Questionnaire	System usage	Storyboard	Experiment	Interview	Personas	Prototyping	User observation
(Berg and Petersen, 2013)	•	•			•	•			
(Butler, 2014)	•								
(Challco et al., 2014)	•	•	•		•				
(Codish and Ravid, 2014)	•								
(Fuß et al., 2014)	•			•					
(Hakulinen and Auvinen, 2014)	•								
(Herbert et al., 2014)	•			•					
(Monterrat et al., 2014)	•	•	•						
(Orji, 2014)			•						
(Orji et al., 2014)	•		•						
(Auvinen et al., 2015)		•			•				
(Holmes et al., 2015)		•						•	
(Monterrat et al., 2015a)		•							
(Paiva et al., 2015)				•					
(Utomo and Santoso, 2015)									
(Xu and Tang, 2015)			•						•
(Akasaki et al., 2016)		•	•						
(Barata et al., 2016)	•	•							
(Borges et al., 2016)	•						•		
(Busch et al., 2016)	•		•						
(Jia et al., 2016)									
(Roosta et al., 2016)	•	•							•
(Taspinar et al., 2016)		•							
(Tondello et al., 2016)	•	•		•	•				
(Codish and Ravid, 2017)									
(Denden et al., 2017a)									
(Monterrat et al., 2017)	•	•		•				•	
(Oyibo et al., 2017a)	•						•		
(Oyibo et al., 2017b)	•	•							
(Oyibo et al., 2017c)									
(Tondello et al., 2017a)			•	•		•			
(Lavoué et al., 2018)	•								
(Orji et al., 2018)	•								
Total	15	15	7	5	4	2	2	2	2

Studies	Outcomes								
	Motivation	Persuasion	Interaction	Enjoyment	Performance	Perception	Playfulness	Attitude	Effectiveness
(Berg and Petersen, 2013)	•								
(Butler, 2014)	•								
(Challco et al., 2014)	•		•	•					
(Codish and Ravid, 2014)		•		•			•		
(Fuß et al., 2014)		•							
(Hakulinen and Auvinen, 2014)				•					
(Herbert et al., 2014)					•				
(Monterrat et al., 2014)									
(Orji, 2014)									
(Orji et al., 2014)		•							
(Auvinen et al., 2015)			•	•					
(Holmes et al., 2015)	•		•				•		

Table 4 (*continued*)

Studies	Outcomes								
	Motivation	Persuasion	Interaction	Enjoyment	Performance	Perception	Playfulness	Attitude	Effectiveness
(Monterrat et al., 2015a)						•			
(Paiva et al., 2015)									•
(Utomo and Santoso, 2015)	•							•	
(Xu and Tang, 2015)	•								
(Akasaki et al., 2016)	•			•					
(Barata et al., 2016)	•								
(Borges et al., 2016)	•	•							
(Busch et al., 2016)							•		
(Jia et al., 2016)							•		
(Roosta et al., 2016)	•			•					
(Taspinar et al., 2016)	•		•			•			
(Tondello et al., 2016)			•			•			
(Codish and Ravid, 2017)	•		•		•				
(Denden et al., 2017a)	•		•	•					
(Monterrat et al., 2017)		•							
(Oyibo et al., 2017a)		•	•		•				
(Oyibo et al., 2017b)		•							
(Oyibo et al., 2017c)		•			•				
(Tondello et al., 2017a)	•	•							
(Lavoué et al., 2018)				•					
(Orji et al., 2018)		•							
Total	12	9	5	4	3	3	2	1	1

(Berg and Petersen, 2013). The most common methods for evaluating tailored gamification were surveys and questionnaires (45% each), as shown in Table 4. While a survey is a systematic method for gathering information, which involves the design, data collection through questionnaires, processing, and analysis (Groves et al., 2011), a questionnaire is an instrument based on a set of questions, devised for a survey or statistical study (Stevenson, 2010). The most prominent samples were obtained through surveys ($n = 6134$, giving almost 323 participants for each survey), storyboards ($n = 3351$, an average of 838 participants for each study), and questionnaires ($n = 1760$, a proportion of 110 participants per study). Since all storyboard evaluations also employed surveys, more than half of the participants of using this technique derived from surveys. It further suggests that surveys and questionnaires were the most used in the literature (both in studies quantity and sample sizes), which is likely related to the facility to achieve more significant samples with these methods.

The selected studies evaluated fourteen different gamification outcomes, mostly concentrating on motivation (36%) and persuasion (27%). The main difference between these two concepts is that, while motivation is "the general desire or willingness to do something", persuasion is "a process designed to change the attitude or behaviour of a person or group from their current view to a view that the persuader wants them to hold" (Franklin, 2011). In other words, most studies are evaluating how effective gamification is to encourage (i.e., motivate) and convince (i.e., persuade) people. The sums of the sample sizes reported by the original studies are also the greatest ones for persuasion ($n = 4569$) and motivation ($n = 1247$), demonstrating the predominance of these two evaluative aspects in both quantity and size. Also, six studies covered more than one outcome (Akasaki et al., 2016; Auvinen et al., 2015; Butler, 2014; Codish and Ravid, 2014; Holmes et al., 2015; Orji, 2014).

4.2. Application contexts (RQ2)

Of the 42 papers, almost 60% of them applied the tailored gamification in the educational context, as shown in Table 5. Another ten studies did not focus on a specific context, claiming to be easily applied to any. Other contexts, such as health, academia (i.e., publishing papers), ecology, government, and services, also appeared. Researchers from the educational area mainly use Moodle (20% - Barata et al. (2016); Codish and Ravid (2017); Denden et al. (2017a,b); Utomo and Santoso (2015)) and Projet Voltaire (12% - Lavoué et al. (2018); Monterrat et al. (2015a, 2017)) as the virtual learning environment to implement the tailored gamification. Meanwhile, some authors are proposing conceptual frameworks (12% - Borges et al. (2016); Monterrat et al. (2014, 2015b)) and research models (8% - Codish and Ravid (2014); Ferro et al. (2013)). In the educational context, the most used game elements were badges, leaderboards, levels, challenges, customization, and points, which means that the PBL triad is still popular in this area, but other game elements also appeared.

Generic context is the only one in which the results are not from any concrete, implemented gamification. Instead, all of the results came from questionnaires (Busch et al. (2016); Jia et al. (2016); Orji et al. (2017); Oyibo et al. (2017a,b)), research models (Orji (2014); Oyibo et al. (2017c); Tondello et al. (2017a)), and conceptual frameworks (Butler (2014); Tondello et al. (2017b)). Also, the most explored game elements in the generic context were distinct from the educational one: competition, prizes, customization, guilds, and learning. This comparison could lead us to two different conclusions: either *i*) researchers are randomly naming correlated game elements (e.g., competition and leaderboards) due to the lack of proper terminology, or *ii*) each context is going to the opposite path of the other, by using more general or specific abstraction levels for the game elements.

In the health context, two out of three studies obtained their results through questionnaires (Orji et al., 2018; 2014), while one study

Table 5
Contexts of tailored gamification applications.

Context	Studies	Total
Education	AL-Smadi (2015); Auvinen et al. (2015); Barata et al. (2016); Berg and Petersen (2013); Borges et al. (2016); Challco et al. (2014); Codish and Ravid (2014, 2017); Denden et al. (2017a,b); Ferro et al. (2013); Fuß et al. (2014); Hakulinen and Auvinen (2014); Harteveld and Sutherland (2017); Herbert et al. (2014); Lavoué et al. (2018); Monterrat et al. (2015a, 2014, 2015b, 2017); Paiva et al. (2015); Roosta et al. (2016); Taspinar et al. (2016); Tondello et al. (2016); Utomo and Santoso (2015)	**25** (59.5%)
Generic	Busch et al. (2016); Butler (2014); Jia et al. (2016); Orji (2014); Orji et al. (2017); Oyibo et al. (2017a, 2017b, 2017c); Tondello et al. (2017a,b)	**10** (23.8%)
Health	Holmes et al. (2015); Orji et al. (2018, 2014)	**3** (7.1%)
Academia	Čudanov et al. (2014)	**1** (2.4%)
Ecology	Xu and Tang (2015)	**1** (2.4%)
Government	Fernandes and Junior (2016)	**1** (2.4%)
Services	Akasaki et al. (2016)	**1** (2.4%)

applied the tailored game elements in many interactive rehabilitation systems (Holmes et al., 2015). All three studies explored competition, customization, and feedback, while two of them applied consequences, guilds, meaning, and prizes. Although the health context is still little explored, we can observe that some game elements employed in the generic context also appear in this one.

4.3. Users' Characteristics (RQ3) and suitable game elements (RQ4)

The player type, which classifies users according to their game preferences and play styles, was studied by 45% of the works, followed by gender (14%) and personality traits (12%). While most of the studies covered only one characteristic at the time, others also simultaneously analyzed gamification effects in two (behavior and performance by Utomo and Santoso (2015), behavior and gender by Denden et al. (2017b), age and gender by Oyibo et al. (2017b)), three (age, culture and gender in Oyibo et al. (2017a)), and even four (age, gender, player typology and personality traits in Tondello et al. (2017a)) different characteristics. Thus, a reasonable part of the studies examining gender or culture were also covering other characteristics, and no study analyzed performance exclusively. Also, studies investigating player typology, personality traits, and motivation used more than one theory, represented in Fig. 4. While the results of these studies rely on the adopted methodological approaches, the game elements suggested by the authors for each characteristic are detailed below.

4.3.1. Player typologies

Among the studies exploring the effects of the game elements for each player type, most of them employed the **typology proposed by** Bartle. This typology defines four different player types based on a two-dimensional interplay of play styles: world versus player, and action versus iteration. These player types are *achievers* (acting upon the world), *explorers* (interacting with the world), *killers* (acting upon other players), and *socializers* (interacting with other players). In other words, achievers enjoy reaching personal goals, explorers prefer knowing all tricks and locations available in the game, killers need to impose themselves on the others to feel fulfilled, and socializers like to talk and interact with other players within the game. Each user is a composition of player types, and one or some of them are usually predominant. The system's usage and questionnaires are techniques that can be applied to identify the player types.

Seven studies correlated 28 different game elements with Bartle typology. Three studies suggested challenges and levels for **achievers**; collections for **explorers**; badges, leaderboards, and levels for **killers**; and guilds for *socializers*, as shown in Table 6. Other game elements appeared twice for achievers (badges, customization, and leaderboards), explorers (badges, challenges, customization, exploration, feedback, guilds, and points), killers (challenges, points, prizes, social pressure and status), and socializers (customization, and social network). At least one study from the literature supports that badges, challenges, customization, emotions, feedback, levels, and meaning are game elements appreciated by all of these player types. However, there is a divergence in the number of game elements to each player type: literature suggested 18 different game elements to achievers, 20 to explorers, 16 to killers, and 13 to socializers. Several relevant points remain unclear since the studies do not usually describe the distribution of user's characteristics from their sample, such as: Are socializers less likely to appreciate the game elements, or were the game elements explored by the studies just not employing the more favorable ones to this player type? Given each user is a composition of different player types, what is the impact of the less predominant player types in each user's preferences for the game elements mentioned above? Based on this composition, should we exclusively look at the more predominant one, or is there a "cutoff score" for the player type percentages that we should consider?
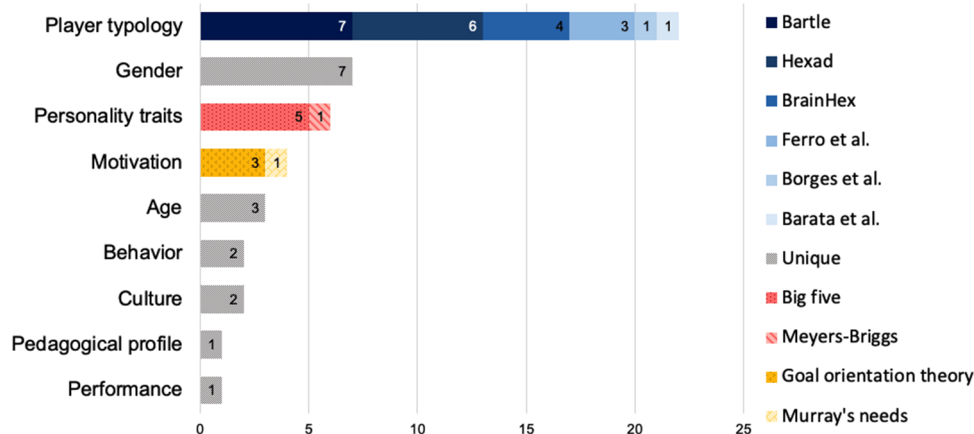

Fig. 4. Users' characteristics considered to tailor the game elements.

Table 6
Suggested game elements for each player type of Bartle typology.

Game element	Achiever	Explorer	Killer	Socializer
Badge	2 (Akasaki et al., 2016; Fernandes and Junior, 2016)	2 (Akasaki et al., 2016; Fuß et al., 2014)	3 (Akasaki et al., 2016; Fernandes and Junior, 2016; Čudanov et al., 2014)	1 (Čudanov et al., 2014)
Challenge	3 (Fuß et al., 2014; Harteveld and Sutherland, 2017; Taspinar et al., 2016)	2 (Fernandes and Junior, 2016; Taspinar et al., 2016)	2 (AL-Smadi, 2015; Taspinar et al., 2016)	1 (Fernandes and Junior, 2016)
Choice	1 (AL-Smadi, 2015)	1 (Harteveld and Sutherland, 2017)		
Collection	1 (Akasaki et al., 2016)	3 (Akasaki et al., 2016; AL-Smadi, 2015; Fuß et al., 2014)	1 (Akasaki et al., 2016)	
Competition				
Customization	2 (AL-Smadi, 2015; Fuß et al., 2014)	2 (Fuß et al., 2014; Harteveld and Sutherland, 2017)	2 (AL-Smadi, 2015; Fuß et al., 2014)	2 (Fernandes and Junior, 2016; Fuß et al., 2014)
Easter egg	1 (Čudanov et al., 2014)	1 (Fuß et al., 2014)	1 (Fuß et al., 2014)	
Emotion	1 (Harteveld and Sutherland, 2017)	1 (Harteveld and Sutherland, 2017)	1 (Harteveld and Sutherland, 2017)	1 (Harteveld and Sutherland, 2017)
Exploration	1 (Akasaki et al., 2016)	2 (Akasaki et al., 2016; AL-Smadi, 2015)	1 (Akasaki et al., 2016)	
Feedback	2 (Harteveld and Sutherland, 2017; Taspinar et al., 2016)	2 (AL-Smadi, 2015; Taspinar et al., 2016)	1 (Taspinar et al., 2016)	1 (Taspinar et al., 2016)
Gifting				1 (AL-Smadi, 2015)
Guild	1 (Taspinar et al., 2016)	2 (AL-Smadi, 2015; Taspinar et al., 2016)		3 (Fuß et al., 2014; AL-Smadi, 2015; Taspinar et al., 2016)
Leaderboard	2 (Akasaki et al., 2016; Taspinar et al., 2016)	1 (Akasaki et al., 2016)	3 (Akasaki et al., 2016; Fernandes and Junior, 2016; Taspinar et al., 2016)	
Learning		1 (Fuß et al., 2014)		
Level	3 (Fernandes and Junior, 2016; Fuß et al., 2014; Taspinar et al., 2016)	1 (Fuß et al., 2014)	3 (Fernandes and Junior, 2016; Fuß et al., 2014; Taspinar et al., 2016)	1 (Fuß et al., 2014)
Meaning	1 (Taspinar et al., 2016)	1 (Taspinar et al., 2016)	1 (Taspinar et al., 2016)	1 (Taspinar et al., 2016)
Point	1 (Taspinar et al., 2016)	2 (Fuß et al., 2014; Taspinar et al., 2016)	2 (Fernandes and Junior, 2016; Taspinar et al., 2016)	
Prize	1 (Fernandes and Junior, 2016)	1 (Fuß et al., 2014)	2 (AL-Smadi, 2015; Fernandes and Junior, 2016)	
Reward schedule	1 (Fernandes and Junior, 2016)	1 (Fernandes and Junior, 2016)		
Signposting				1 (AL-Smadi, 2015)
Social discovery				1 (Fuß et al., 2014)
Social network				2 (AL-Smadi, 2015; Harteveld and Sutherland, 2017)
Social pressure			2 (AL-Smadi, 2015; Harteveld and Sutherland, 2017)	
Social status			2 (AL-Smadi, 2015; Fuß et al., 2014)	1 (Fuß et al., 2014)
Strategy		1 (AL-Smadi, 2015)		
Time pressure	1 (Taspinar et al., 2016)	1 (Taspinar et al., 2016)	1 (Taspinar et al., 2016)	
Virtual economy	1 (AL-Smadi, 2015)			
Voting		1 (AL-Smadi, 2015)		

Six studies employed the **Hexad typology** (Marczewski, 2015). The hexad typology describes six player types according to their motivations in gamified systems: achievers, disruptors, free spirits, philanthropists, players, and socializers. *Achievers* are intrinsically motivated by competence and mastery, always trying to learn new things and overcoming challenges. *Disruptors* are motivated by changes, either negative (e.g., chasing others or discovering system crashes to spoil others' experiences) or positive ones (e.g., influencing others or adjusting the system flaws encountered). *Free Spirits* are intrinsically motivated by autonomy and self-expression, enjoying exploring the system with no restrictions and building new things. *Philanthropists* are intrinsically motivated by meaning and purpose, being altruistic and helping other players without expecting a reward for it. *Players* are those extrinsically motivated by rewards, appreciating every tangible or intangible benefit that the system may give them for their behavior. *Socializers* are intrinsically motivated by relationships, enjoying to interact with other users, and create social connections. Also, just like Bartle typology, these player types are not mutually exclusive, and a questionnaire aids in identifying the player type composition for each user.

As shown in Table 7, there is a strong evidence in the literature that **achievers** enjoy challenges and levels; **free spirits** relish unlockables and customization; **players** like leaderboards and social status; and **socializers** appreciate social networks and competition. Half of the Hexad studies also suggest learning, social status, and unlockables to achievers; customization to **disruptors**; exploration to free spirits; gifting to **philanthropists**; badges, collections, competition, points, prizes, unlockables, and virtual economy to players; and social status to socializers. Challenges, customization, learning, and levels were game elements suggested, in greater or lesser quantity, for all Hexad player types.

There is also a divergence in the number of different game elements explored for Hexad player types. Of the 32 distinct game elements proposed for the Hexad typology, the literature suggested 25, 22 and 20 different game elements for achievers, players, and socializers (respectively), while the studies that analyzed philanthropists, free spirits and disruptors only proposed 18, 16 and 11 game elements. Still, when observing the total of game elements proposed by each player type, we have: 44 for players, 38 for achievers, 32 for socializers, 23 for free spirits, 22 for philanthropists, and 21 for disruptors. The average illustrates that free spirits had a centralized use of a more limited set game elements, while the few elements studied for disruptors and philanthropists were also little used. Similar to Bartle, it is not clear if disruptors and philanthropists are less likely to enjoy the game elements or not, neither the influence of player types' percentage in these and future results.

The **BrainHex typology** relates the game motivation to the neurobiological reactions of the human body, defining seven different player types: achievers, conquerors, daredevils, masterminds, seekers, survivors, and socializers (Nacke et al., 2011; 2014). *Achievers* are those motivated by overcoming challenging long-term goals and completing collections since the satisfaction of success generates a fixation to achieve new goals, supported by dopamine. *Conquerors* are those motivated by victories and the defeat of challenging enemies, since they channel their anger to boost achievement, releasing norepinephrine and testosterone into the body. *Daredevils* are players motivated by the thrill of pursuit and risk-taking, releasing epinephrine (adrenaline) in the body, which enhances the pleasure of conquest. *Masterminds* are players motivated by the difficulty of solving problems and the strategy that these solutions require, stimulating the production of dopamine, which makes the achievement of goals intrinsically rewarding. *Seekers* are those motivated by discovering new things or finding familiar things, since their body produces endomorphin when visualizing images with richly interpretable patterns, triggering their center of pleasure. *Survivors* are players motivated by terror and the intensity of the associated experience, releasing adrenaline into their body, which drives the

effects of dopamine when they hit their target. *Socializers* are players motivated by interacting and trusting others since the primary neural source activated is oxytocin, a neurotransmitter associated to trust. These player types are not mutually exclusive, being discovered through a questionnaire.

Of the four studies suggesting game elements for BrainHex player types, three of them proposed the use of levels to **achievers** and leaderboards to **conquerors**, while two recommended time pressure to achievers and **daredevils**, and signposting to **socializers**, as shown in Table 8. No game element was suggested for all player types. In addition to exploring a smaller amount of game elements, these studies were mostly examining different ones, given the large number of unitary representations of game elements for each type of player. Achievers and conquerors had the biggest number of game elements suggested (i.e., seven), and survivors were the player type less explored by BrainHex studies. Again, we cannot affirm if the game elements preferred by survivors were just less explored or if this player type is less likely to enjoy gamification.

Three other studies used the **typology proposed by** Ferro et al., which is a correlation between many player typology proposals (Bartle, 1996; Bateman and Boon, 2005; Caillois, 2001; Fritz, 2004; Fullerton et al., 2008; Koster, 2004; Nacke et al., 2011; Yee, 2006) and personality traits studies (Berecz, 2008; Cattell, 2001; Crowne, 2007; Ryan and Deci, 2000).Based on this correlation, the authors proposed five different player types: creative, dominant, humanist, inquisitive, and objectivist. *Creative* individuals like to create and develop things by using skills obtained through experimentation. They enjoy having a structured path, but with the possibility to treat it as a guide rather than a directive. *Dominant* users exhibit a strong need to be visible, whether through sociability, assertiveness, or aggressiveness. These individuals prefer mechanics that are self-serving and personally related to their participation. *Humanists* are more inclined to be social and involve themselves in tasks that rely on social engagement. They like to work with others to solve problems collaboratively rather than on their own. *Inquisitive* users enjoy to explore and investigate new things. They are more inclined to engage with open worlds, be in control, and embark on quests to locate particular items. *Objectivist* is someone who seeks to achieve and build upon their knowledge by demonstrating their ability and intelligence. They are not necessarily as selfish as those who fall into the Dominant category, but their focus is on their selves before others. All three studies suggested collections and customization to **creative** users, as Table 9 illustrates. Two studies also indicated the preference of competition, customization, and leaderboards from **dominant** users; consequences, emotions, and narrative from **inquisitive** ones; and challenges, levels, and meaning from **objectivist** ones, while **humanist** users were the less examined Ferro et al. player type. No game element was suggested for all player types proposed by Ferro et al.. However, it is unclear how these three studies were able to identify the player type of each user (e.g., questionnaire, interaction data). Another interesting point is that while both Ferro et al. (2013) and Monterrat et al. (2014, 2015b) were related educational contexts, some divergences appeared. For instance, challenges were suggested to creative, humanist, and inquisitive players by one study (Ferro et al., 2013), and objective players by the others (Monterrat et al., 2014; 2015b). These divergences might indicate that one single user's characteristic may not be enough in promoting this tailoring effect.

The work of Barata et al. **proposed four student profiles** based on their performance and gaming preferences, namely: achiever, regular, halfhearted, and underachiever. *Achievers* were those focused on reaching achievable goals and acquiring all possible points, excelling in every aspect of the course, and being the most participative ones. *Regular* students were those with performance above the average and equilibrium between achievements and traditional evaluation components. *Halfhearted* students were those who neglected some aspects of the course and performed below the average. *Underachievers* were those with the lowest performance, apparently making just the necessary

Table 7
Suggested game elements for each player type of Hexad typology.

Game element	Achiever	Disruptor	Free spirit	Philanthropist	Player	Socializer
Anarchy						
Anonymity		1 (Tondello et al., 2016)	1 (Tondello et al., 2016)			
Badge	1 (Tondello et al., 2016)	2 (Tondello et al., 2017a; 2016)	1 (Tondello et al., 2016)		1 (Tondello et al., 2016) 3 (Challco et al., 2014; Herbert et al., 2014; Tondello et al., 2017a)	1 (Tondello et al., 2016)
Challenge	5 (Challco et al., 2014; Herbert et al., 2014; Holmes et al., 2015; Tondello et al., 2017a; 2016)		2 (Tondello et al., 2017a; 2016)	1 (Tondello et al., 2017a)	2 (Tondello et al., 2017a; 2016)	1 (Tondello et al., 2017a; 2016)
Choice	1 (Holmes et al., 2015)	1 (Tondello et al., 2017a)	1 (Tondello et al., 2016)			1 (Tondello et al., 2016)
Collection	1 (Tondello et al., 2017a)	1 (Tondello et al., 2017a)		2 (Holmes et al., 2015; Tondello et al., 2017a)	3 (Holmes et al., 2015; Tondello et al., 2017a; 2016)	
Competition	1 (Tondello et al., 2017a)	2 (Orji et al., 2018; Tondello et al., 2017a)			3 (Orji et al., 2018; Tondello et al., 2017a; 2016)	4 (Holmes et al., 2015; Orji et al., 2018; Tondello et al., 2017a; 2016)
Consequence					1 (Orji et al., 2018)	1 (Orji et al., 2018)
Customization	1 (Tondello et al., 2017a)	3 (Holmes et al., 2015; Orji et al., 2018; Tondello et al., 2016)	4 (Challco et al., 2014; Herbert et al., 2014; Orji et al., 2018; Tondello et al., 2016)	1 (Tondello et al., 2017a)	1 (Holmes et al., 2015)	2 (Orji et al., 2018; Tondello et al., 2017a)
Easter egg	1 (Tondello et al., 2017a)	1 (Tondello et al., 2017a)	2 (Tondello et al., 2017a; 2016)	1 (Tondello et al., 2017a)		
Exploration	1 (Tondello et al., 2017a)	1 (Tondello et al., 2017a)	3 (Holmes et al., 2015; Tondello et al., 2017a; 2016)	1 (Tondello et al., 2017a)		1 (Orji et al., 2018)
Feedback			1 (Holmes et al., 2015)			1 (Tondello et al., 2017a)
Gifting	1 (Tondello et al., 2017a)	1 (Tondello et al., 2017a)		3 (Challco et al., 2014; Herbert et al., 2014; Tondello et al., 2017a)	1 (Tondello et al., 2017a)	1 (Tondello et al., 2017a)
Guild	1 (Tondello et al., 2017a)			1 (Tondello et al., 2017a)	1 (Orji et al., 2018)	2 (Orji et al., 2018; Tondello et al., 2016)
Leaderboard	1 (Tondello et al., 2017a)				4 (Challco et al., 2014; Herbert et al., 2014; Tondello et al., 2017a; 2016)	1 (Tondello et al., 2017a)
Learning	3 (Holmes et al., 2015; Tondello et al., 2017a; 2016)	1 (Tondello et al., 2017a)	2 (Tondello et al., 2017a; 2016)	1 (Tondello et al., 2016)	2 (Tondello et al., 2017a; 2016)	1 (Tondello et al., 2016)
Level	4 (Herbert et al., 2014; Holmes et al., 2015; Tondello et al., 2017a; 2016)	1 (Tondello et al., 2016)	1 (Tondello et al., 2017a)	1 (Tondello et al., 2017a)	2 (Herbert et al., 2014; Tondello et al., 2017a)	1 (Tondello et al., 2017a)
Lottery	1 (Tondello et al., 2017a)	1 (Tondello et al., 2017a)			1 (Tondello et al., 2017a)	1 (Tondello et al., 2017a)
Meaning	1 (Tondello et al., 2017a)	1 (Tondello et al., 2017a)		2 (Holmes et al., 2015; Tondello et al., 2017a)	1 (Tondello et al., 2017a)	1 (Orji et al., 2018)
Narrative	1 (Tondello et al., 2017a)	1 (Tondello et al., 2017a)	1 (Tondello et al., 2017a)	1 (Tondello et al., 2017a)	3 (Challco et al., 2014; Herbert et al., 2014; Tondello et al., 2016)	
Point	1 (Tondello et al., 2017a)	1 (Tondello et al., 2017a)				
Prize	1 (Tondello et al., 2017a)	1 (Tondello et al., 2017a)			3 (Orji et al., 2018; Tondello et al., 2017a; 2016)	2 (Orji et al., 2018; Tondello et al., 2017a)
Signposting						1 (Tondello et al., 2017a)
Social discovery	1 (Tondello et al., 2017a)			1 (Tondello et al., 2017a)	1 (Tondello et al., 2016)	2 (Tondello et al., 2017a; 2016)
Social network	1 (Tondello et al., 2017a)			1 (Tondello et al., 2017a)	2 (Herbert et al., 2014; Tondello et al., 2017a)	5 (Challco et al., 2014; Herbert et al., 2014; Holmes et al., 2015; Tondello et al., 2017a; 2016)
Social pressure						
Social status	1 (Tondello et al., 2017a) 3 (Herbert et al., 2014; Tondello et al., 2017a; 2016)			1 (Tondello et al., 2017a) 1 (Herbert et al., 2014)	4 (Challco et al., 2014; Herbert et al., 2014; Tondello et al., 2017a; 2016)	3 (Challco et al., 2014; Herbert et al., 2014; Tondello et al., 2017a)
Strategy				1 (Holmes et al., 2015)		

Table 7 (*continued*)

Game element	Achiever	Disruptor	Free spirit	Philanthropist	Player	Socializer	Survivor
Unlockable	3 (Challco et al., 2014; Herbert et al., 2014; Tondello et al., 2017a)	1 (Tondello et al., 2017a)	5 (Challco et al., 2014; Herbert et al., 2014; Holmes et al., 2015; Tondello et al., 2017a; 2016)	1 (Tondello et al., 2017a)	3 (Challco et al., 2014; Herbert et al., 2014; Tondello et al., 2017a)		
Virtual economy	1 (Tondello et al., 2017a)				3 (Challco et al., 2014; Herbert et al., 2014; Tondello et al., 2016)		
Voting	1 (Tondello et al., 2017a)	2 (Tondello et al., 2017a; 2016)		1 (Tondello et al., 2017a)	1 (Tondello et al., 2017a)	1 (Tondello et al., 2017a)	

Table 8

Suggested game elements by each player type of BrainHex typology.

Game element	Achiever	Conqueror	Daredevil	Mastermind	Seeker	Socializer	Survivor
Competition		1 (Orji et al., 2014)		1 (Orji et al., 2014)	1 (Orji et al., 2014)	1 (Orji et al., 2014)	1 (Orji et al., 2014)
Consequence		1 (Orji et al., 2014)		1 (Orji et al., 2014)			
Customization		1 (Orji et al., 2014)	1 (Orji et al., 2014)	1 (Orji et al., 2014)	1 (Orji et al., 2014)		
Feedback	1 (Orji et al., 2014)	1 (Orji et al., 2014)		1 (Orji et al., 2014)			1 (Orji et al., 2014)
Guild	1 (Orji et al., 2014)					1 (Orji et al., 2014)	
Leaderboard	1 (Monterrat et al., 2015a)	3 (Lavoué et al., 2018; Monterrat et al., 2015a; 2017)	1 (Monterrat et al., 2017)				
Learning		1 (Monterrat et al., 2015a)		1 (Monterrat et al., 2017)		1 (Monterrat et al., 2017)	
Level	3 (Lavoué et al., 2018; Monterrat et al., 2015a; 2017)	1 (Monterrat et al., 2015a)			1 (Monterrat et al., 2015a)		
Prize	1 (Orji et al., 2014)						
Signposting					1 (Monterrat et al., 2015a)	2 (Lavoué et al., 2018; Monterrat et al., 2015a)	
Social status		1 (Monterrat et al., 2015a)			1 (Orji et al., 2014)		
Time pressure	2 (Lavoué et al., 2018; Monterrat et al., 2015a)	2 (Lavoué et al., 2018; Monterrat et al., 2015a)	2 (Lavoué et al., 2018; Monterrat et al., 2015a)				
Unlockable	1 (Lavoué et al., 2018)				1 (Lavoué et al., 2018)		

minimum effort to pass the course. Since it is still the only study about this typology, Barata et al. (2016) suggest the use of challenges, points, and badges to attract **achievers, regular** and **halfhearted** students, while further proposing learning to achievers. No game elements were suggested to **underachievers**. Similar to other typologies, we are still unaware if these students were performing just the necessary to pass the course because they are not motivated enough by the explored game elements or if they are not driven by any game element at all.

The work of Borges et al. **created five player roles** based on three player typologies (Bateman and Boon, 2005; Ferro et al., 2013; Yee, 2006): achievers, conquerors, creators, explorers, and humanists. *Achievers* are players that enjoy winning and accumulating all available rewards (defined as goal-oriented). *Conquerors* are those who appreciate testing their skills and competing against others (people-oriented). *Creators* are players who like customizing the system (system-oriented). *Explorers* enjoy inspecting the system by discovering its ins-and-outs (also system-oriented). **Humanists** are those that enjoy socializing, sharing learning, and relationship building (also people-oriented). The authors suggested badges, challenges, honor system, leaderboards, levels, points, and virtual economy to **achievers**; and customization, learning, and levels to **creators**. Besides being the only study about this typology, no game elements were proposed to **conquerors, explorers** and **humanists**. Like the typology by Ferro et al., the methods to identify the player types of each user are not explicitly defined.

4.3.2. Gender

The second most investigated characteristic was gender, explored by seven studies. One study also examined the femininity/masculinity dimension of gender identity (Busch et al., 2016), which refers to "the degree to which persons see themselves as masculine or feminine given what it means to be a man or woman in society" (Stets and Burke, 2000). Inside this dimension, femininity aspects include being "affectionate", "gentle", and "sensitive to the needs of others", while masculinity includes "acting as a leader", "making decisions easily", and "willing to take risks" (Stets and Burke, 2000).

Three out of these seven studies suggested badges, customization, leaderboards, and levels to **women**, and competition to **men**. Two studies also recommend guilds, points, and social status to women; and customization, guilds, and prizes to men, as shown in Table 10. The study of Busch et al. (2016) also advised the use of competition, consequences, customization, feedback, prizes, signposting, and social status to **femininity**. At the same time, no game elements were suggested to the **masculinity** dimension of gender identity. Given that only one study analyzed gender and the femininity/masculinity dimension of gender identity together, little is known about how much one may influence in the other (or even the impact of any other gender identity dimension over these two characteristics).

4.3.3. Personality traits

The third most explored characteristic were personality traits, where five out of six studies based their findings on a taxonomy called **Big Five** (also known as the five-factor model or the OCEAN model). This model defines five fundamental factors to describe most personality traits: agreeableness, conscientiousness, extroversion, neuroticism, and openness to experience (Roccas et al., 2002). *Agreeableness* encompasses individual propensity to social harmony; *Conscientiousness* measures the personal reliability based on aspects like organization and responsibility; *Extroversion* indicates the comfort level of an individual with relationships; *Neuroticism* represents the tendency of experiencing negative emotions (e.g., sadness, anxiety, anger); and *Openness to experience* focus on the individuals' range of interests with any novelty (Rizvi and Fatima, 2015). For each factor, an individual can have different polarities. In essence, an altruistic person (i.e., high agreeableness) could also have depression feelings (e.g., high neuroticism) in a chaotic life (i.e., low conscientiousness). In contrast, another person can

Table 9
Suggested game elements by each player type of Ferro et al. typology.

Game element	Creative	Dominant	Humanist	Inquisitive	Objectivist
Badge	1 (Ferro et al., 2013)	1 (Ferro et al., 2013)			1 (Ferro et al., 2013)
Challenge	1 (Ferro et al., 2013)		1 (Ferro et al., 2013)	1 (Ferro et al., 2013)	2 (Monterrat et al., 2014; 2015b)
Collection	3 (Ferro et al., 2013; Monterrat et al., 2014; 2015b)	2 (Monterrat et al., 2014; 2015b)			
Competition					
Consequence				2 (Monterrat et al., 2014; 2015b)	
Customization	3 (Ferro et al., 2013; Monterrat et al., 2014; 2015b)	2 (Monterrat et al., 2014; 2015b)	1 (Ferro et al., 2013)		
Emotion				2 (Monterrat et al., 2014; 2015b)	
Leaderboard		1 (Ferro et al., 2013)			
Level		2 (Ferro et al., 2013; Monterrat et al., 2014)			2 (Ferro et al., 2013; Monterrat et al., 2014; 2015b)
Meaning					2 (Monterrat et al., 2014; 2015b)
Narrative		2 (Monterrat et al., 2014; 2015b)			
Point		1 (Ferro et al., 2013)			1 (Ferro et al., 2013)
Prize		1 (Ferro et al., 2013)		1 (Ferro et al., 2013)	1 (Ferro et al., 2013)
Reward schedule					1 (Ferro et al., 2013)
Social status		1 (Ferro et al., 2013)			

Table 10

Suggested game elements by gender.

Game element	Gender		Gender identity	
	Women	Men	Femininity	Masculinity
Badge	3 (Codish and Ravid, 2017; Denden et al., 2017b; Tondello et al., 2017a)			
Challenge	1 (Tondello et al., 2017a)			
Choice	1 (Tondello et al., 2017a)			
Collection	1 (Tondello et al., 2017a)	1 (Tondello et al., 2017a)		
Competition		3 (Busch et al., 2016; Oyibo et al., 2017a; 2017b)	1 (Busch et al., 2016)	
Consequence	1 (Orji, 2014)		1 (Busch et al., 2016)	
Customization	3 (Denden et al., 2017b; Orji, 2014; Tondello et al., 2017a)	2 (Denden et al., 2017b; Tondello et al., 2017a)	1 (Busch et al., 2016)	
Feedback	1 (Denden et al., 2017b)	1 (Denden et al., 2017b)	1 (Busch et al., 2016)	
Gifting		1 (Tondello et al., 2017a)		
Guild	2 (Busch et al., 2016; Orji, 2014)	2 (Busch et al., 2016; Tondello et al., 2017a)		
Leaderboard	3 (Codish and Ravid, 2017; Denden et al., 2017b; Tondello et al., 2017a)	1 (Codish and Ravid, 2017)		
Learning		1 (Tondello et al., 2017a)		
Level	3 (Codish and Ravid, 2017; Denden et al., 2017b; Tondello et al., 2017a)	1 (Denden et al., 2017b)		
Lottery	1 (Tondello et al., 2017a)			
Meaning		1 (Tondello et al., 2017a)		
Point	2 (Codish and Ravid, 2017; Tondello et al., 2017a)	1 (Codish and Ravid, 2017)		
Prize	1 (Tondello et al., 2017a)	2 (Oyibo et al., 2017a; 2017b)	1 (Busch et al., 2016)	
Signposting	1 (Tondello et al., 2017a)		1 (Busch et al., 2016)	
Social discovery		1 (Tondello et al., 2017a)		
Social network		1 (Tondello et al., 2017a)		
Social status	2 (Orji, 2014; Tondello et al., 2017a)		1 (Busch et al., 2016)	
Virtual economy	1 (Tondello et al., 2017a)			
Voting	1 (Tondello et al., 2017a)	1 (Tondello et al., 2017a)		

be creative (i.e., high openness to experience) but also very shy (i.e., low extroversion). Each user has to complete a questionnaire to identify the polarity of each factor.

Three studies suggested the use of customization and leaderboards to individuals with **high extroversion**, and two of them recommended badges, competition, feedback, levels, meaning, points, and social networks to extroverted people; badges, levels, and prizes for people with **high neuroticism**; and customization to individuals with **high openness to experience**. As Table 11 illustrates, some of the polarities have not been explored by the literature, like low agreeableness, conscientiousness, and neuroticism. By far, the most investigated factor was extroversion, with a total of 32 game elements suggestions, which represents 49% of all suggestions to Big Five taxonomy.

The other study that analyzed the effects of personality traits on the game elements used the **Myers-Briggs Type Indicator (MBTI)**, which is a questionnaire grounded on Jung personality theory that describes the individual's experience according to four preferences: world, information, decision-making, and attitude (Myers et al., 1998). Like the Big Five factors, these four preference factors also have polarities. *World preference* corresponds to where an individual lives most in: either inner (introverted) or outer (extroverted) – equivalent to the Extroversion factor on the previous personality traits taxonomy. *Information preference* refers to the depth of information desire: sensing personalities focus on essential data and real facts, while intuition focuses on identifying patterns and adding meaning to it – related to Openness to Experience factor. *Decision-making preference* identifies how an individual makes choices: if he/she puts more weight on objective principles and facts (i.e., thinking) or on personal concerns and people involved (i.e., feeling) – similar to the Agreeableness factor. *Attitude preference* reports the way a person deals with the outside world: preferring making decisions (i.e., judging) or staying open to new options (i.e., perceiving) – linked to the Conscientiousness factor. Although there is no equivalent to Neuroticism from the Big Five personality traits in this taxonomy, each individual is again a combination of polarities for all four factors, which are also identified through a questionnaire.

Based on this only study (Butler, 2014), the suggested game elements for the world preference factor are choices, customization, narrative, signposting, and social networks to **extroverts**; and consequences, meaning, and single-player for **introverts**. For the information preference factor, the indicated game elements are challenges, collection, learning, levels, and meaning for **sensing** polarity; and choices, exploration, fixed rewards, and narrative for **intuitive** individuals. For the decision-making preference factor, the authors suggested challenges, guilds, and strategy for **feeling** polarity; while using badges, competition, levels, and social status for **thinking** polarity. For attitude preference, the authors suggested choices, collection, levels, strategy, and time pressure for **judging** polarity; and anarchy, challenges, consequences, customization, easter eggs, and emotions for **perceiving** polarity.

Compared to Big Five, both taxonomies considered employing customization, signposting, and social networks to extroverts. None of the game elements proposed to the Information preference factor was also indicated for Openness to experience. Individuals with high agreeableness or feeling polarity would both appreciate challenges and guilds. While levels were suggested to high conscientiousness and judging individuals, the indication of consequences and customization to perceiving polarity contradicts the Big Five analysis. Unlike in the case of the Big Five model, all polarities of the four factors from MBTI had at least three game element suggestions, while being suggested by only one study.

4.3.4. Motivation

Four studies analyzed how user motivation correlates to game element preferences. Three of them focused on the **Goal Orientation Theory**, explored by Nicholls (1984) and Elliot (1999). This theory defines how individuals interpret and experience achievement settings, divided into two interrelated dimensions: mastery/performance goals, and approach/avoidance motivation valence. Mastery goals focus on developing competence (i.e., task mastery), whereas performance goals focus on demonstrating it (i.e., bragging about it to others). Approach motivation is related to a "behavior [that] is instigated or directed by a

Table 11
Suggested game elements by each personality trait of Big Five taxonomy.

Game element	Agreeableness High	Agreeableness Low	Conscientiousness High	Conscientiousness Low	Extraversion High	Extraversion Low	Neuroticism High	Neuroticism Low	Openness High	Openness Low
Badge					2 (Codish and Ravid, 2014; Denden et al., 2017a)	1 (Denden et al., 2017a)	2 (Jia et al., 2016; Tondello et al., 2017a)			
Challenge	1 (Jia et al., 2016)						1 (Tondello et al., 2017a)		1 (Tondello et al., 2017a)	
Collection										
Competition	1 (Orji et al., 2017)		1 (Orji et al., 2017)		2 (Orji et al., 2017; Tondello et al., 2017a)					1 (Orji et al., 2017)
Consequence	1 (Orji et al., 2017)				1 (Orji et al., 2017)					1 (Orji et al., 2017)
Customization	1 (Orji et al., 2017)		1 (Orji et al., 2017)		3 (Denden et al., 2017a; Orji et al., 2017; Tondello et al., 2017a)	1 (Denden et al., 2017a)			2 (Orji et al., 2017; Tondello et al., 2017a)	1 (Jia et al., 2016)
Feedback	1 (Orji et al., 2017)		1 (Orji et al., 2017)		2 (Denden et al., 2017a; Orji et al., 2017)	1 (Denden et al., 2017a)				1 (Orji et al., 2017)
Guild	1 (Orji et al., 2017)				1 (Orji et al., 2017)					1 (Orji et al., 2017)
Leaderboard					3 (Denden et al., 2017a; Jia et al., 2016; Tondello et al., 2017a)					
Level			1 (Jia et al., 2016)		2 (Denden et al., 2017a; Jia et al., 2016)		2 (Jia et al., 2016; Tondello et al., 2017a)			
Lottery					1 (Tondello et al., 2017a)					
Meaning			1 (Orji et al., 2017)		2 (Orji et al., 2017; Tondello et al., 2017a)					
Point					2 (Denden et al., 2017a; Jia et al., 2016)		1 (Jia et al., 2016)		1 (Tondello et al., 2017a)	
Prize	1 (Orji et al., 2017)				1 (Orji et al., 2017)		2 (Jia et al., 2016; Tondello et al., 2017a)		1 (Tondello et al., 2017a)	1 (Orji et al., 2017)
Signposting					1 (Tondello et al., 2017a)					
Social network					2 (Denden et al., 2017a; Tondello et al., 2017a)	1 (Denden et al., 2017a)				
Social pressure					1 (Tondello et al., 2017a)					
Social status					1 (Tondello et al., 2017a)		1 (Tondello et al., 2017a)			
Virtual economy									1 (Tondello et al., 2017a)	
Voting					1 (Tondello et al., 2017a)					

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Table 12
Suggested game elements by each goal orientation type.

Game element	Mastery		Performance	
	Approach	Avoidance	Approach	Avoidance
Badge	2 (Auvinen et al., 2015; Hakulinen and Auvinen, 2014)	1 (Roosta et al., 2016)	3 (Auvinen et al., 2015; Hakulinen and Auvinen, 2014; Roosta et al., 2016)	
Feedback	1 (Roosta et al., 2016)			
Leaderboard			1 (Roosta et al., 2016)	1 (Roosta et al., 2016)

positive or desirable event or possibility" Elliot, while negative or undesirable events and possibilities direct the avoidance motivation behaviors. Thus, this theory presents four combinations for these dimensions: *Mastery-Approach*, where users tend to improve skills; *Mastery-avoidance*, where users avoid facing incompetence; *Performance-approach*, where users tend to demonstrate their skills to others; and *Performance-avoidance*, where users avoid demonstrating incompetence. A questionnaire aids in identifying the goal orientation of each individual.

The literature explored only three game elements: badges, feedback, and leaderboards, but only one of these elements was investigated by more than one study. All of the works suggested badges to users in the **performance-approach** spectrum and two of these studies also indicate the use of badges to **mastery-approach** users, as shown in Table 12. Badges are suggested to almost every combination except performance-avoidance, whose preference relies on leaderboards according to one single study.

The other study analyzed the Murray**'s secondary psychological needs**. Besides the primary needs (e.g., food, water, air), Murray grouped secondary needs by domains: affection, ambition, information, materialism, and power, these being related to the eight suggested game elements. *Affection* is related to the desire to love and be loved; *Ambition* is associated with the need for achievement and recognition; *Information* aims to gain knowledge and share it with others; *Materialism* relates to acquisition, construction, order, and retention of material goods; and *Power* relies on independence and on the need to control others (Flett, 2007). The suggested game elements are competitions and guilds for **affection**; badges, challenges, feedback, and meaning for **ambition**; feedback and learning for **information**; customization for **materialism**; and challenges and competition for **power** (Berg and Petersen, 2013). The most used game elements were challenges, competition, and feedback (suggested for two different needs), while the need with more indicated game elements was ambition (four game elements). Still, only one study supports these results.

4.3.5. Age

Three studies also based their analysis on the age of the users, which states the most suitable game elements for **younger people** (i.e., 18–25 years old in Oyibo et al. (2017a), less than 25 years old in Oyibo et al. (2017b), and 30 years old or less in Tondello et al. (2017a)). With a total of 21 different game elements explored, only two of them were suggested in more than one study: competition and learning (Oyibo et al., 2017a; 2017b). The other game elements considered exclusively by Tondello et al. (2017a) were: badges, challenges, collection, customization, exploration, gifting, guilds, levels, lottery, meaning, points, prizes, social discovery, social pressure, social networks, social status, unlockables, virtual economy, and voting. No game element was indicated simultaneously by all three works, and there were no suggestions for users who are more than 30 years old.

4.3.6. Behavior

Three studies investigated the effects of game elements on user behavior (Denden et al., 2017b; Utomo and Santoso, 2015; Xu and Tang, 2015). By behavior, two of works mean the **access frequency**:

while Utomo and Santoso (2015) analyzed the exact average period between accesses (e.g., every three days, every two weeks), Denden et al. (2017b) divided users in two groups: regular ones (i.e., daily or weekly access) and non-regular ones (i.e., monthly access or a more spaced frequency). Badges were the only game element explored by the two studies, being suggested to every user that accesses the system at least every two weeks, and to regular and non-regular users. All other six game elements were proposed only by one study: time pressure for every user that accesses the system at least every three days (Utomo and Santoso, 2015); customization, feedback, leaderboards, and levels for regular users; and points for both, regular and non-regular, ones (Denden et al., 2017b). Meanwhile, Xu and Tang (2015) employed data mining techniques in users' action to establish a gamification recommendation system but did not specify the explored game elements.

4.3.7. Culture

Culture is here considered as "the collective programming of the mind that distinguishes the members of one group or category of people from others" (Hofstede, 1984), divided in five dimensions: Femininity versus Masculinity (also called gender identity, described previously on Subsection 4.3.2 in conjunction with gender), Individualism versus Collectivism, Long-term versus Short-term orientation, Power Distance (i.e., power distribution within society), and Uncertainty Avoidance (i.e., tolerance to unpredictability) (Hofstede et al., 2010). The two studies described here focused on *Individualism versus Collectivism*, which divides scenarios where people are expected to look after themselves and their significant others first (i.e., individualists), and where people are expected to look after and protect other in-group members in exchange for unquestioning loyalty (i.e., collectivists) (Oyibo et al., 2017a; 2017c).

The explored game elements by these two works were: competition, learning, and prizes. While prizes were suggested to **collectivist** individuals by the two studies; competition was a collectivism preference in Oyibo et al. (2017a), being suggested to **individualists** and collectivists in Oyibo et al. (2017c). Learning, however, presented a contradiction: Oyibo et al. (2017c) affirm that it is suitable for individualist individuals, and Oyibo et al. (2017a) say it would be appropriate for collectivist users, while the samples of these studies were considerably similar: Oyibo et al. (2017c) subjects were from Canada (individualism, $n = 213$) and Nigeria (collectivism, $n = 74$), and Oyibo et al. (2017a) had 233 subjects from North America (i.e., individualist) and 127 from Africa and Asia (i.e., collectivism). Thus, more studies are needed to ensure that the Individualism versus Collectivism dimension could be indeed reliable as an exclusive characteristic of the user model.

4.3.8. Other characteristics

Other than the ones exposed above, three different characteristics were analyzed by one single study each. For instance, Tondello et al. (2017b) proposed a recommendation model for gamification but did not specify the game elements nor characteristics of the user, while claiming to be **generic** enough to comprise any of them, such as the ones exposed above (e.g., player types, gender, personality traits, age, culture).

Paiva et al. (2015) analyzed the influence of badges on the way

students **interact with the system**: collaborative, gamification, pedagogical, and social profiles. Students with a *collaborative profile* are interested in assisting others and making the learning environment better, those with a *gamification profile* are interested in using the available game elements, those with a *pedagogical profile* would instead expand and test their knowledge, and those with a *social profile* enjoy engaging in social activities (e.g., chatting, sharing their progress on social networks). This study suggested the use of badges for all profiles; thus, a scenario in which no tailoring would be required.

The only work that explored how users' **performance** influence their game element preferences (Utomo and Santoso, 2015). According to them, signposting would be one element recommended for *low-performance users*, and both low and *high-performance* users would appreciate the narrative.

5. Research agenda

This literature review shows that tailored gamification studies are mostly exploring ways to model the user profile, which is one of the cores for personalization, adaptation, and recommendation methods. Because of this need to correlate and test the most suitable game elements for each user characteristic, statistical techniques are predominant. The most used game elements in the literature were customization, badges, challenges, levels, competition, and leaderboards. The majority of the empirical results relied on surveys and questionnaires, given that both are the instruments employed to collect most of the user characteristics. Overall, tailored gamification aimed to motivate and persuade users and was mainly applied in educational contexts. Several characteristics of the user profile appeared, and the mighty ones were the Bartle player typology, gender, Hexad player typology, and Big Five personality traits. Still, there are several points still to be addressed by future research about tailoring gamification.

- Future research should **examine the automation of tailored gamification:** A few studies began to automatize tailored gamification by using adaptation rules and matrix multiplication (Monterrat et al., 2017), and (collaborative filtering, content-based, and hybrid) recommender systems (Tondello et al., 2017b). However, there is still much to be explored regarding these and other algorithms, such as predictive personalization (Figueiredo et al., 2016), to promote a more prompt response for the tailoring process and prevent extra efforts from designers and researchers. Future works should advance tailored gamification by implementing more algorithms and techniques that allow the system to *autonomously* choose and present the suitable game elements for each user based on the employed model.

- Future research should also **focus on other bases for tailoring gamification than solely the user profile**: While users' characteristics (e.g., player type, gender, personality traits) have been a dominant discussion in the gamification corpus when it comes to tailoring, they do not present all the essential factors that can mediate the effects of gamification in the user experience. In addition to users' characteristics, other factors like task attributes, contexts of use, and discourse facets, might moderate the gamification effects. For example, tailored gamification could be based on the tasks and how relevant they are for each user role, or consider the context of use (e.g., geographical location, device) to provide a more meaningful experience. Moreover, tailored gamification could explore the way people naturally adjust their language according to the task (e.g., the difference in writing technical papers and casual e-mails) and the inherent variation of the speech based on diverse aspects (e.g., socio-economic status, emotional states, cultural context) (Bellegarda, 2004) to present the most suitable game elements (Forsyth et al., 2013). Therefore, we suggest future studies to explore the applicability of other models (e.g., task, domain, discourse) in the tailoring process.

- Future research should **evaluate the impact of the application domain:** Similarly, given that tailored gamification is being investigated in many domains, it is crucial to understand their influence on the outcomes. For instance, four studies (each one from a different domain) suggested badges based on Bartle typology: for achiever player type in the government (Fernandes and Junior, 2016) and services (Akasaki et al., 2016) applications; for explorers in education (Fuß et al., 2014) and services ones; for socializers in academia (Čudanov et al., 2014); and for killers in all of them except in educational scenarios. Since none of the studies evaluated the impact of tailored gamification in different domains simultaneously, this divergence might or might not be related to them. Thus, more *experimental studies* are needed to understand the impact of the domain in the user experience when interacting with game elements, especially considering a *within-subject approach* to prevent group bias. Similar to the whole gamification area (Koivisto and Hamari, 2019), we encourage tailored gamification to exploit controlled experimental research methods to understand the actual outcomes properly.

- Future research should **consider dynamic modeling:** Most of the current studies presented static user modeling proposals that rely on the fulfillment of a questionnaire or survey by each individual. However, if the collected data are unintentionally or deliberately inaccurate (or even missing, if someone refuses to answer), tailoring methods might not provide the most suitable game elements for that specific user. So rather than considering the user input exclusively, we encourage future research to take advantage of implicit data, such as *interaction patterns* (Denden et al., 2017b; Utomo and Santoso, 2015) and *gamification analytics* (Heilbrunn et al., 2017) to periodically update the model. This dynamic modeling is also relevant when thinking to improve user experience in the long term, since users, systems, and contexts change over time. Given the dynamic and cyclical nature of gamification and that user experience might also be boosted by the novelty effect (Koivisto and Hamari, 2019), updating data from the employed models is not only relevant but also essential. Thus, future research could improve tailoring gamification by considering how users may change from time to time, how interaction evolves, and how context varies, while addressing the apt update frequency of data from each of these dynamic models (e.g., continuously, after a specific period or action) and the computational costs of doing so.

- Future research should **understand the imbalance in the number of game elements suggested to each aspect of the users' characteristics:** Overall, there is a lack of balance among the aspects of the characteristics considered to suggest the most suitable game elements. For instance, literature suggested 20 different game elements for Bartle explorers, but only 13 to socializers; 25 for Hexad achievers, but 11 for disruptors; seven for BrainHex achievers and conquerors, and only 2 for survivors; 8 for Ferro et al. dominants, and 3 for humanists. The reasons for that, however, are still unclear. Future research should conduct more empirical evaluations to understand further if these discrepancies are merely related to the distribution of users' characteristics into the sample of the included studies (e.g., users in studies that used the Bartle typology happen to be more explorers than socializers), or if the explored game elements were not as favorable to socializers as they were to explorers. The same applies to age: since there were no recommendations for people over 30 years old, does it mean that studies were not employing any game elements favorable to these age groups, or that gamification itself only works for younger people? Thus, as pointed out by Koivisto and Hamari (2019), gamification researchers need to pay more attention to the *pre-determinants of gamification success,* rather than focusing on its effectiveness for users that are already willing to use it.

- Future research should **deeply analyze the effect of all aspects from the user characteristics:** Several of the characteristics studied

by the literature are rather a composition (e.g., player types) or spectrum (e.g., gender) than a single-choice option. Thus, suggesting game elements based solely on a dominant player type, a binary biological sex, or the more influential personality traits is likely to induce misunderstandings and inaccuracy. Similar to Hallifax et al. (2019a), we recognize that considering the predominant aspect of one user characteristic is not enough to discriminate users' overall preferences and to promote this tailoring effect. A few studies are starting to advise the adoption of the user profile as a whole, rather than using the dominant aspect (Mora et al., 2018; Orji et al., 2018). In this sense, future research still needs to address several questions about this issue, such as: What is the impact of *less dominant aspects* of the user characteristic composition or spectrum for tailored gamification? If the user characteristic is a composition, is it sufficient to consider the "*n* more predominant" aspects, is there a "cutoff score" for the relevant percentages, or should we consider all aspects regardless of how dominant (or not) they are? If we are going to consider all percentages, how could the tailoring effect be presented in terms of *giving more or less focus to the game elements within the interface* rather than simply adding or removing them?

- Future research should **address how some characteristics impact on the suggestions to other characteristics:** Since every user has multiple characteristics, it is unfair to guide the user modeling and tailor gamification exclusively based on one of them. While only five out of the 40 studies considered more than one characteristic (Denden et al., 2017b; Oyibo et al., 2017a; 2017b; Tondello et al., 2017a; Utomo and Santoso, 2015), even less is discussed on how these characteristics influence the game element suggestion of each other. When considering gender and gender identity, for instance, the competition was suggested to men and individuals with predominant femininity, but not to women. Meanwhile, studies that examined gender recommended prizes for both women and men, but the single study analyzing gender identity recommends prizes to femininity dimension of gender identity, not to a specific gender. Thus, considering only one characteristic (e.g., gender) could lead future researchers to wrong design decisions (e.g., using prizes for any gender and not considering the influence of gender identity). We encourage future research to *conduct more studies* considering *many characteristics simultaneously* to evaluate how much one may influence the other.

- Future research should **investigate neutral and negative effects of game elements to user characteristics:** While studies focused on the positive effects (e.g., motivation, persuasion) promoted by the suggested game elements, neutral and adverse effects are still unknown. For instance, does suggesting collection for individuals with high neuroticism imply that all other polarities of Big Five personality traits do not care or bother about this game element (i.e., neutral effect) or that is not suggested to other cases because they create unfavorable experiences (e.g., anxiety, sadness, fear). Mora et al. (2018) presented no significant difference in the game element preferences of experimental and control groups, but their study was not included in this review because no correlation between user profile characteristics and game elements was made. Thus, understanding how different individuals positively or negatively react to each game element is still an issue to be addressed, as previously described by Böckle et al. (2017). Once these reactions are adequately identified, tailored gamification research can focus on exploring and mitigating its harmful, adverse, or non-desirable effects, as also suggested to the overall gamification area Koivisto and Hamari (2019).

6. Conclusion

This article described the state-of-the-art of tailored gamification through a systematic literature review. In the course of the paper, we aimed to answer what methods have been mainly used to tailor game elements in gamified systems based on the characteristics of the user profile (RQ1), in what gamified contexts have user profiles been considered for the gamification process (RQ2), what characteristics of the user profile have been considered during such tailored gamification (RQ3), and what have been the most suitable game elements for the specific characteristics of the user profile (RQ4).

Few methods have been used to promote tailored gamification: almost 66% of the studies proposed methods for user modeling, instead of personalizing, adapting, or recommending game elements (**RQ1**). Since most of the studies focusing on the modeling process, the majority (77%) of the algorithms and techniques were statistical in nature (i.e., hypothesis testing, analysis of variance, reliability). The authors of these 42 studies mostly applied badges (57%) and customization (55%) in the tailoring gamification process, while evaluating them with surveys (27%) and questionnaires (23%), either as an exclusive evaluation method or in combination with other methods. Of the fourteen different aspects of the tailored gamification evaluation, the most used were motivation (31%) and persuasion (20%).

Almost 60% of the studies applied tailored gamification in the educational context, mainly using Moodle (20%) as the virtual learning environment (**RQ2**). The most investigated user characteristics were player typologies (46%), gender (14%), and personality traits (12%) (**RQ3**). Of the 22 studies that analyzed player typology, most of them used the typologies proposed by Bartle (7 studies) and Marczewski (6 studies). From the six studies that explored personality traits, 5 of them were based on the Big Five taxonomy.

The suggested game elements for each player type in Bartle's typology are: challenges and levels for achievers; collections for explorers; badges, leaderboards, and levels for killers, and guilds for socializers. The authors that investigated the Hexad typology indicated achievers prefer challenges and levels; free spirits prefer customization and unlockables; players prefer leaderboards; socializers prefer competition and social networks; while disruptor and philanthropist player types were less explored. Regarding gender, the authors suggested the use of badges, customization, leaderboards, and levels to women; and competition to men. Based on personality traits, literature indicated the use of badges, competition, customization, feedback, levels, leaderboards, meaning, points, and social networks to extroverts; badges, levels, and prizes for people with high neuroticism; and customization to individuals with high openness to experience. Other characteristics and game element suggestions were described along this article (**RQ4**). These results reaffirm the importance of considering the user profile in gamification processes, since no game element was suggested regardless of the user characteristic (i.e., there is *no silver bullet*).

Diverse threats to the validity of this study need to be reported. About the *Construct and Internal Validity* threats, this systematic review could have different results if it had considered other related terms (e.g., customization) in the search string. However, it was not the focus of this work, since customization usually refers to a user's choice and not an automated decision. We understand that some studies may have used this term unintentionally, but the inclusion of this term in the search string would lead to an unmanageable amount of results. We acknowledge that the chosen search engines were the most used by gamification-related systematic reviews, but there might be some relevant publications not included. Another Construct and Internal Validity threat is related to the necessary adaptation of the string to each search engine, which was verified by only one researcher. While following a previously validated protocol with three researchers of the area, all studies were classified and coded according to one single researcher experience, which creates both *Internal and Conclusion Validity* threats. A final *External Validity* threat identified is the possible lack of consideration of a study if it was not accessible to the authors.

Declaration of Competing Interest

All authors have participated in (a) conception and design, or analysis and interpretation of the data; (b) drafting the article or revising it critically for important intellectual content; and (c) approval of the final version.

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Ana Carolina Tomé Klock: Conceptualization, Methodology, Investigation, Data curation, Formal analysis, Visualization, Writing - original draft. **Isabela Gasparini:** Conceptualization, Methodology, Supervision, Validation, Funding acquisition, Writing - review & editing. **Marcelo Soares Pimenta:** Conceptualization, Methodology, Supervision, Validation, Funding acquisition, Project administration, Writing - review & editing. **Juho Hamari:** Supervision, Funding acquisition, Writing - review & editing.

Supplementary material

Supplementary material associated with this article can be found, in the online version, at 10.1016/j.ijhcs.2020.102495

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