A Systematic Mapping of the Customization of Game Elements in Gamified Systems

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Abstract—Gamification is the use of game elements in nongame contexts. It has been widely applied in order to motivate and engage users. However, since each user has different characteristics, the user experience of interacting with these game elements becomes singular and it does not always have the expected outcome. Thus, the aim of this paper is to identify the state-of-the-art of the techniques of adaptation, personalization and recommendation that have been used in gamification to improve the user experience according to the game elements applied. Of the 1296 studies returned by the ACM Digital Library, IEEE Xplore and Scopus search engines, only 20 of them met the selection criteria of the systematic mapping. As a result, besides finding which categorizations of user are considered to lead to different customization, the personalization of the users' player type in educational contexts is the more explored strategy, while some studies suggest the suitable game elements for each typology.

Keywords-Gamification; user experience; adaptation; personalization; recommendation, systematic mapping.

I. INTRODUCTION

Gamification is a motivational approach that applies game elements and design in non-game contexts [1] in order to improve the user experience and promote engagement to achieve a specific goal [2]. This user experience is defined as a consequence of a user's internal state (e.g., predispositions, expectations), the characteristics of the designed system (e.g., purpose, usability), and the context in which the interaction occurs (e.g., meaningfulness of the activity, voluntariness of use) [3].

Thus, one of the factors responsible for the disparity in the motivational levels promoted by gamification is the user profile. In fact, there are already many studies indicating that some demographic, cognitive, behavioural, anthropometric and attitudinal traits influence, positively or negatively, the experience provided by the applied game elements [4] [5] [6] [7] [8] [9].

To deal with these singularities and improve the user experience, several techniques can be adopted. For example, adaptation and personalization are two approaches used in game-related contexts, where the adaptation consists of the continuous adjustment of the game aspects according to the actions and performance of the user, while personalization is understood as a static one-time adaptation of the game to the needs or preferences of each user [10]. Another example of approach is the recommendation, that uses information about user preferences to suggest elements that people with similar tastes liked in the past [11].

Based on that, the paper aims to identify which techniques of adaptation, personalization and recommendation have been applied in gamification by the literature to improve the user experience according to the game elements applied. Therefore, a systematic mapping was conducted to identify the state-of-the-art of this topic in the last 5 years.

This paper is divided as follows: the process of the systematic mapping was briefly described (i.e., research questions, research protocol, search string and engines, and selection criteria) in Section II. The results obtained by the studies that met the selection criteria were classified and presented in Section III by year, vehicle of publication, countries of author's affiliation, technique used, context of application, characteristics of the users, and suggested game elements. The discussion of such results to answer the research questions defined is followed by the conclusion of this study, in Section IV.

II. SYSTEMATIC MAPPING PROCESS

Systematic mapping studies are designed to identify the state-of-the-art of a research area by classifying and counting the contributions available in the literature [12]. This method consists of a set of essential steps, which are: definition of research questions, conduction of the search, screening of studies, classification scheme, and data extraction [13]. Each of these steps are described below.

A. Research Questions

In order to identify the techniques of adaptation, personalization and recommendation that have been explored in gamification context, this work defined four research questions (RQ) to guide the systematic mapping:

RQ1: What techniques or methodologies have been studied to adapt, personalize or recommend game elements in gamified systems based on the characteristics of the user profile?

- **RQ2:** What characteristics of the user profile are considered during such adaptation, personalization or recommendation?
- **RQ3:** In what contexts (e.g., educational, business) can the user profile be considered for the gamification process?
- **RQ4:** What are the most suitable game elements for the specific characteristics of the user profile?

B. Conduction of the Search

The research protocol, inspired by the methodology proposed by Petersen *et al.* [12], was applied to ensure the replicability of this study. This protocol defines the PICO process, the search string, the search engines used and the selection criteria for the returned studies. Each of them is described hereafter.

PICO is a process that aids in the structure of this systematic mapping [13] [12]. This process consists in identifying the population (P), the intervention (I), the comparison (C) and the expected outcomes (O):

- **Population** (**P**): Studies that describe or apply adapted, personalized or recommended gamification based on aspects of the user profile in a computational system;
- Intervention (I): Methodologies or procedures that aid in the adaptation, personalization or recommendation of the game elements applied in gamification;
- **Comparison** (C): Not applicable, since the purpose of the study is to characterize the studies available in the literature;
- Outcomes (O): The methods and techniques that can be applied to adapt, personalize or recommend the gamification based on the user profile and which characteristics of the users are considered for this adaptation already.

Search string is the combination of a set of keywords representing the studies that are expected to be returned by the search engines. Based on the research questions defined, these sets were grouped as follows:

- **Gamification:** encompasses the entire set of keywords related to gamification (e.g., gamification, gamified, gamify);
- **Customization:** covers the whole set of keywords related to adaptation, personalization or recommendation (e.g., adaptation, adaptive interface, player model, user model, personalization, personalisation, personalized user interface, recommender system, recommendation).

Thus, the generic search string for this research is: **gamif*** **AND** (adapt* OR model OR personali* OR recommend*) – where * is a wildcard, being adapted according to the chosen academic search engine, described below.

Search engines are databases available for academic search. Based on related studies (i.e., systematic mappings and reviews about gamification), such as De Souza et al.

[14], Dicheva *et al.* [15], Pedreira *et al.* [16] and Alahäivälä *et al.* [17], the most relevant search engines in this topic were ACM Digital Library, IEEE Xplore and Scopus.

Selection criteria are filters that allow the result obtained for the research to be more accurate. The selection criteria defined are:

- SC1: Studies published from 2012 or later (last 5 years);
- SC2: Studies written in English;
- **SC3:** Full papers (in this case, we considered those with 6 or more pages);
- SC4: Primary studies (i.e., those that are not surveys or systematic mappings or reviews);
- SC5: Studies available for download;
- SC6: Non-duplicate studies;
- SC7: Studies whose main theme is gamification;
- SC8: Studies that explore adaptation, personalization or recommendation;
- SC9: Studies that propose or analyze any form of adaptation, personalization or recommendation of gamification based on the user profile;

Following the process defined, the search was conducted by one researcher at the end of September 2017, due the lack of resources. From the 1296 studies returned by the search engines, only 20 met the selection criteria, as shown in Table I. Such 20 studies had their data extracted to answer the research questions [18] [19] [20] [21] [22] [23] [24] [25] [26] [27] [28] [29] [30] [31] [32] [33] [34] [35] [36] [37]. These results are presented in the next section.

 Table I

 CONDUCTION OF THE SEARCH

Selection Criteria	ACM	IEEE	Scopus	Total
Returned from search	133	198	965	1296
SC1: Last 5 years	131	196	956	1283
SC2: In English	130	191	933	1254
SC3: Full papers	80	116	793	989
SC4: Primary studies	78	112	653	843
SC5: Downloaded	72	104	118	294
SC6: Non-duplicated	72	104	116	292
SC7: Gamification	61	86	108	255
SC8: Customization	22	21	32	75
SC9: Gamific. & Customiz.	9	5	6	20

The data extracted from the 20 studies are classified by the countries of authors' affiliation, year, vehicle of publication, technique used (i.e., adaptation, personalization or recommendation), context and system of application, characteristics of the user, game elements and how they are suggested for the most studied characteristic. Based on the data extracted, some results are described below.

III. RESULTS AND DISCUSSION

About the authors' affiliation, all continents except Africa and Antarctica had some university researching on this subject, as shown in Figure 1. Intercontinental collaboration between universities can also be seen as a paper written jointly by Canadian, British and Austrian universities (0.3 paper each) and another paper collaboratively written between Canadian and French universities (0.5 paper each). The quantity of studies by each country is described in Table II.



Figure 1. Distribution of the publications by affiliations' country.

 Table II

 STUDIES BY AFFILIATIONS' COUNTRY

Country	Studies
Canada	3.8
Brazil	2
Northern Ireland	2
France	1.5
Australia	1
China	1
Finland	1
Indonesia	1
Iran	1
Japan	1
Norway	1
Portugal	1
Serbia	1
United States	1
Austria	0.3
England	0.3

When the year and the publication vehicle are analyzed, it is possible to identify that 2015 was the year with most publications about this topic (35%), while most of the studies were published in conferences (90%), as illustrated in Figure 2. A continuous trend of research in the theme can be seen, although the systematic mapping was conducted before the end of 2017 (which may influence the total of studies published in the last year).

Among the techniques used, there is an emphasis on the personalization of gamification (70% of studies), followed by user modeling and adaptation of gamification. Only one study raised the possibility of recommendation of gamification, shown in Figure 3.

Although some studies analyzed more than one characteristic of the user profile [18] [22] [26] [27] [36] [37],



Figure 2. Distribution of the publications by year and vehicle.



Figure 3. Distribution of the publications by technique.

the player type is the one that stands out most (60% of the studies), followed by user behavior (25% of them), as shown in Figure 4. Personality traits, age, culture, gender and motivation styles were also studied to allow the adaptation, personalization or recommendation of the gamification.



Figure 4. Distribution of the publications by the characteristic of the user profiles explored.

Because the player type is the most studied characteristic, this paper identified the suitable game elements for each one. Since there are many studies, several typologies have been adopted: Marczweski (5 studies), Bartle (3 studies), Ferro *et al.* (2 studies), BrainHex, and Barata *et al.* typology (1 study each).

- Marczweski's typology describes the players according to their motivations to use the system: Achievers, motivated by competence; Disruptors, motivated by the triggering of change; Free Spirits, motivated by autonomy; Philanthropists, motivated by purpose; Players, motivated by rewards; and Socialisers, motivated by relatedness [37]. The extended version of this typology has also been studied, where the four intrinsically motivated (i.e., competence, autonomy, purpose, and relatedness) types have their extrinsically motivated versions: Consumer, equivalent to the Achiever; Exploiter, equivalent to the Free Spirit; Self-seeker, equivalent to the Philanthropist; Networker, equivalent to the Socialiser player type [22]. Five papers described the game elements suggested for each of the players types: Herbert et al. [22], Challco et al. [20], Holmes et al. [24], and Tondello et al. [33][37]. Based on them, Table III describes the suggested game elements. Also, only virtual goods are suggested for Consumer type [22][20].
- **Bartle's typology** categorizes online games players based on two styles of play: action/interaction and player/world. The interrelationship of these two styles allowed the definition of four player types: those who prefer to act on other players (i.e., *Killers*), those who prefer to act in the world (i.e., *Achievers*), those who prefer to interact with the world (i.e., *Explorers*), and those who prefer to interact with other players (i.e., *Socializers*). The studies of Harteveld *et al.* [34], Cudanov *et al.* [21] and Akasaki *et al.* [30] identified some game elements that are suitable to each Bartle's player type, as show in Table IV.
- Ferro et al.'s typology interrelates various personality classifications and player typologies. Five player types are defined: Dominant users need to be visible (whether through sociability, assertiveness, aggressiveness, etc.) and they would be more involved with mechanics that are self-serving and personally relate to their participation (e.g., badges). Objectivist users are those who seeks to achieve and build upon their knowledge (e.g., awards, badges, levels). Humanists users are more social and involved in tasks that rely on social engagement, so their sense of approval comes from the opinions of those who they are engaging with, and they may benefit from group orientated elements and mechanics such as quests and being part of a guild (i.e., group). Inquisitive users like to explore and investigate new things, being more engaged with open worlds, be in control and embark on quests to locate particular items. Finally, Creative users like to create things with the skills that they obtain through experimentation,

preferring the structure to be a guide rather than an instruction and avoid following rules [18]. Monterrat *et al.* [26] used this definition to propose a framework to adapt gamification, where Dominant users would use characters and conflicts as game elements; Objectivist users would use objectives and challenges as game elements; Humanist users would have a narrative and dramatic art as game elements; Inquisitive users would be using aesthetics and boundaries, while Creative ones would have resources and world building as game elements.

• Barata et al.'s typology was defined based on students' performance and gaming preferences [31]. Achievers are those students who excels on all aspects of the course and are the most participative. Regulars are represented by an above average overall performance and participation levels. Halfhearted is a group with a below average points accrual, and performing worse that the Achievers and Regular on the skill tree, quests, quizzes and multimedia presentations. Underachievers had the lowest performance and participation, doing just enough to pass the course. In this case, Barata et al. [31] suggests that Achievers like quests, Regulars like quizzes, while Halfhearted likes points. None elements were suggested to Underachiever player type.

The majority (60%) of the studies applied the adapted, personalized or recommended gamification in the educational context (i.e., e-learning environments), as Figure 5 shows. Some of these studies explored the creation of frameworks for this type of gamification without bounding the context (i.e., generic), while little was explored in the academic, ecologic, health and service contexts.



Figure 5. Distribution of the publications by context of the application.

Of these, most of them had no practical application (3 studies each), being only used in a theoretical framework or in a research model, as shown in Figure 6. Moodle and questionnaires were also used by 2 studies each, while all other applications were used only by one study.

[33] and [37]

Player type

Player type	[22]	[20]	[24]	[33] and [37]
	Exclusive items	Exclusive items	Boss Battles	Boss Battles
er	Levels	Points	Certificates	Certificates
iev	Quests	Quests	Challenges	Challenges
ch	Visible status		Levels	Levels
<			New skills	New skills
				Quests
	-	-	Anarchy	Anarchy
tor			Anonymity	Anonymity
Lup			Development tools	Development tools
Dis			Innovation	Innovation
_			Voting	voting
	Customization	Customization	Chairage	Craativity tools
±.	Unlockable items	Unlockable items	Creativity tools	Customization
pir	Uniockable items	Uniockable items	Customization	Easter eggs
e			Easter eggs	Exploration
Fre			Exploration	Unlockable items
			Unlockable items	emockable items
	Gifts	Gifts	Access	Access
ist	Social status		Care-taking	Collection
do			Collection	Gifts
l uth			Gifts	Sharing
ilaı			Meaning	Trading
ЧЧ			Sharing	_
			Trading	
	-	-	Badges	Badges
H			Chances	Chances
aye			Rankings	Rankings
Id			Points	Points
			Rewards	Rewards
	Control in store allow	Control in store where	Virtual economy	Virtual economy
L	Social networks	Social networks	Competition Guilda on Taoma	Competition Guilda or Taoma
ise	Social status	Social status	Social discovery	Social discovery
cial			Social networks	Social comparison
So	200		Social pressure	Social networks
			Social status	boonar notworks
5	Badges	Badges	-	-
Dite	Points	Points		
ble	Virtual goods	Virtual goods		
Ê	Visible status	_		
er	Badges	Badges	-	-
sek	Exclusive items	Exclusive items		
-se	Rankings	Rankings		
Self	Points			
• • • •	Virtual goods			
er	Badges	Badges	-	-
ork	Points	Points		
itw	Social networks	Social status		
Ne	Virtual goods			
	virtual goods	1	1	1

Table III SUGGESTED GAME ELEMENTS FOR EACH MARCZWESKI'S TYPOLOGY

[24]

[20]

Table IV SUGGESTED GAME ELEMENTS FOR EACH BARTLE'S PLAYER TYPE

Player Type	[34]	[21]	[30]
Achiever	Challenges	Chances	Badges
	Feedback	Gifts	Collections
Explorer	Autonomy	Autonomy Badges	
	Self-identity		Story
Killer	Influence others	Badges	Badges
	Be influenced	_	Collections
Socializer	Interact	Badges	-
	Social networks		

Table V CORRELATION BETWEEN GAME ELEMENTS AND BRAINHEX TYPES

Diavor Type	Game Elements				
Trayer Type	Stars	Ranking	Tips	Walker	Timer
Achiever	1	0.75	0.13	0.88	1
Conqueror	0.75	1	0.13	0.38	0.75
Daredevil	0.63	0.63	0	0.13	0.88
Mastermind	0.63	0.63	0.38	0.25	0.25
Seeker	0.5	0	0.75	0.88	0
Socializer	0.13	0.13	1	0.25	0
Survivor	0.13	0.5	0	0	0.38



Figure 6. Distribution of the publications by system.

As shown in Figure 3, the personalization techniques were the most studied to find the suitable game elements for each characteristic of the user profile (**RQ1**). About these users' characteristics, the most studied ones were: player type, behavior, personality traits, age, culture, gender and motivation, respectively. Thus, Figure 4 answers the **RQ2**.

These personalization, adaptation and recommendation techniques were mostly applied on educational contexts (**RQ3**), as shows Figure 5. Since it deals with typologies based on different personal aspects, it is not possible to unify the existing player types.

Marczweski's typology was the most studied in the literature and, as can be seen in Table III, the various authors who analyzed it defined the same game elements (or at least very similar ones) as the most suitable ones to each player type (**RQ4**). However, the same does not occur with the game elements suggested by the authors who used Bartle's typology, because each author recommends very different game elements (shown in Table IV). Also, as the other typologies found were not very explored, such comparison is not possible.

IV. CONCLUSION

This paper identified that adaptation (i.e., continuous adjustment of the game aspects), personalization (i.e., a static one-time adaptation) and recommendation (i.e., suggesting game elements according to users' preference) have been applied in gamification by the literature to find the suitable game elements according to the user profile. After conducting the search in the ACM Digital Library, IEEE Xplore and Scopus search engines with the search string "gamif* AND (adapt* OR model OR personali* OR recommend*)" at the end of September 2017, 1296 articles were returned. Of these, only 20 met the defined selection criteria.

This topic has been mostly published in conferences since 2015 and by many countries in the world. Also, this paper discovered that most authors try to find the more suitable game elements for a certain user characteristic by personalizing them (RQ1). The most explored characteristic was the player type, and Marczweski's and Bartle's typologies were the most studied typologies (RQ2). The majority of the studies were applied in educational context (RQ3). Also, the game elements recommended depends on each player typology adopted (RQ4): there are some similar game elements recommended by the studies of Marczweski's typology, while there is not a consensus by the studies that analyzed Bartle's typology.

For instante, the Marczweski's achiever is mostly related to levels and quests (4 out of 5 studies), disruptor is mostly related to anarchy, anonymity, development tools, innovating and voting (3 out of 5 studies), free spirit is mostly related to customization and unloackable items (5 out of 5 studies), philanthropist is mostly related to gifts (5 out 5 studies), player is mostly related to badges, chances, ranking, points, rewards and virtual economy (3 out of 5 studies), socializer is mostly related to social networks (5 out of 5 studies) and social status, competition, guilds or teams, and social discovery (3 out of 5 studies), exploiter is mostly related to badges, points and virtual goods (2 out of 5 studies), self-seeker is mostly related to badges, exclusive items and rankings (2 out of 5 studies), and network is mostly related to badges, points and social status (also 2 out of 5 studies). In the same time, Bartle's killer was the only player type that had at least two studies recommending a common game element (badges).

As future work, the other characteristics pointed out by the studies (e.g., behavior, personality traits, age, culture, gender, motivation) will be analyzed in order to find if there is a pattern found by the studies. These patterns would allow the gamified systems to analyze and merge the preferences of game elements based on several users characteristics.

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