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A systematic mapping study of gamification models oriented to motivational characteristics

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ABSTRACT

Context: Gamification focuses on the improvement of users' engagement when performing tasks by making use of game mechanics and elements in order to increase their motivations. Many researches have developed gamification models supporting a variety of motivational characteristics to provide engagement solutions for different areas.

Objective: This paper carries out a systematic mapping in the field of gamification, looking for models with motivational characteristics in an attempt to characterise the state of the art of this field, identifying gaps and tendencies for further research.

Method: We carried out a systematic mapping aiming at finding the primary studies in the existing literature, which were later classified and analysed according to twelve criteria.

Results: We analysed 70 papers that resulted in 17 primary studies, published until September 2016. Most of them focus on Education, making use of Gamification to increase the motivation of a learning process. The gamification mechanics and elements most used were Badges/Achievements and Points/ExperiencePoints(XP), and most of the studies were not validated, thus not providing empirical evidence of the impact of gamification.

Conclusions: Existing research in the field is somehow preliminary, and more research effort to analyse the applicability of the models and their respective evaluations would be needed.

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KEYWORDS
Systematic mapping; gamification; models; motivational characteristics

1. Introduction

The word gamification has been defined as 'the use of game design elements in non-game contexts' (Deterding et al. 2011). By making use of game mechanics and elements, gamification aims to increase the motivation and engagement of users when they have to execute a task in a non-game environment, such as the workplace, the school or a software application.

The gamification field has grown significantly and its popularity increased over the years, thus being applied in several areas (Deterding et al. 2011; Zichermann and Cunningham 2011; Werbach and Hunter 2012; MacMillan 2011; Hamari, Koivisto, and Sarsa 2014). Nowadays, there is a considerable amount of gamification works providing a variety of motivational solutions for users. Often, these solutions are presented in the form of models, describing what gamification mechanics and elements are included, the specificity of the model, and sometimes what type of user the model supports.

Once the main key of gamification is to increase the engagement of users, models oriented to motivations often include not only the gamification elements and mechanics but also the motivational characteristics provided by each of these elements. The motivational characteristics usually represent a variety of concepts that are connected to different user types, thus enabling such models to focus the motivation on a specific set of users based on their types and characteristics. These concepts lead to another field of gamification: personalisation (Mulvenna, Anand, and Büchner 2000). Personalisation, also described as adaptability, means the individual adaptation of products, services and information. Personalisation technology usually involves programs that learn user's patterns, habits, and preferences. The main purpose of modern personalisation systems is offering to users what they want without requiring them to explicitly state this (Mulvenna, Anand, and Büchner 2000). A way to obtain the user's preferences is by storing their actions on profiles. Profiles with useful information are the key to identify the behaviour of users, their interests and, combined with a profile manager, also make suggestions regarding future actions (Wagner, Barbosa, and Barbosa 2014).

The focus of this work is to analyse in the existing literature gamification models with characteristics related to the aforementioned ideas. Therefore, a systematic

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mapping has been carried out to that end. The aim is to provide a more structured view of the state of the art in the field and to identify possible trends, existing gaps and weaknesses (Budgen et al. 2008; Cooper 2016; Petersen, Vakkalanka, and Kuzniarz 2015). Systematic mapping is a methodology that involves searching the literature to verify the nature, extent and number of studies published in the area of interest (Petersen et al. 2008). The rest of the paper is structured as follows: Section 2 presents the related works. Section 3 describes how the systematic mapping was planned. In Section 4 we present the results obtained during the study, providing answers for the research questions. Section 5 describes the threats to validity of this research. Section 6 discusses the results obtained in the study and Section 7 presents the conclusions of the paper with challenges that may lead to future works.

2. Related work

To the best of our knowledge, in the relevant literature there are no systematic mapping studies about gamification models oriented to motivational characteristics. However, we can find works providing the state of art in specific fields of gamification. These works are related to this research in aspects of objectivity, since most of them try to map specific properties from other gamification studies, as a way to verify their similarities and potential opportunities of improvement. In this line, Pedreira et al. (2015) conducted a systematic mapping study on gamification in the area of Software Engineering with the aim of characterising the state of art in this field, identifying gaps and opportunities for future research. The author concluded that to analyse the impact of gamification in the area of Software Engineering, more research works in this field will need to be performed.

Systematic mapping studies about gamification focused on education are also present in the literature. The study of Klock et al. (2015), for example, performs a systematic mapping about the individual characteristics in the gamification of virtual learning environments, in order to verify if students with different characteristics react differently to the gamification elements. At the end of the study, the authors identified that characteristics such as age, gender, motivation, and many others can influence in the gamification of a virtual learning environment. The study of de Sousa Borges et al. (2014) carries out a systematic mapping whose objective is to synthesise an overview about the area of gamification applied to Education. The authors concluded that the overview obtained through the mapping process suggests that most studies focused on investigating how gamification can be used to motivate students, improve their skills, and maximise learning.

Another systematic mapping study focused on gamification in education is present in the study of Dicheva et al. (2015). The authors researched for papers that explicitly discuss the effects of using game elements in specific educational contexts, performing a thorough category classification to organise the results obtained from the researches. The mapping process indicated some needs found in the works that apply gamification to education, such as a proper technological support for controlled studies demonstrating reliable results of using specific game elements in particular educational contexts. The authors concluded that more substantial empirical research is needed to determine whether both extrinsic and intrinsic motivation of the learners can be influenced by gamification.

Mora et al. (2015) conducted a review of the literature on gamification design frameworks. The authors synthesised the process of gamification design present in eighteen different frameworks for a successful engagement experience, categorising existing approaches and providing an assessment of their main features. The authors concluded that, despite the existing approaches be on the right way, they do not take into account some necessary keys to get a more effective gamified process for success, thus considering for a future scenario the development of a complete and generic framework from a new perspective and its application to different environments.

Aiming to create a gamification model for e-learning participants' engagement, Rutkauskiene et al. (2016) provided an overview of the existing approaches and models of gamification. The authors described different approaches that apply gamification on the learning process, and how it can be more effective by increasing the motivation and engagement of a person. The gamification model created by the authors is based on extrinsic motivation, thus using methods like pointing system, social competition and achievements to boost learner's engagement to the learning content. The gamification model was implemented into a learning platform and tested with pupils, obtaining positive results once most of the students were motivated to learn by themselves. The authors concluded that the created gamification model still requires further development, once part of students did not show the expected interest, indicating a problem with motivation boost or the platform.

3. Planning of the systematic mapping

The purpose of this study is to determine and characterise the state of art of gamification models with

motivational characteristics, analysing the existing proposals and research work and thus identifying potential gaps and opportunities for future research. Therefore, the main research question of this study is:

What is the state of art of Gamification Models oriented to motivational characteristics?

To carry out this systematic mapping, we followed the recommendations defined in Petersen et al. (2008) and updated in Petersen, Vakkalanka, and Kuzniarz (2015). In this section we present the planning of each step of the systematic mapping study, which based on the guidelines proposed by Petersen, Vakkalanka, and Kuzniarz (2015), can be resumed in the following steps:

(1) define the research questions;
(2) define the search process;
(3) define the criteria for text selection;
(4) execute the data extraction;
(5) execute the analysis and classification of the selected texts.

3.1. Research methods and questions

The research questions selected for this study attempt to provide specific information related to the relevant aspects of existing gamification models oriented to motivational characteristics. These include questions about the domains that the gamification models have been applied, what are the motivational factors included, what type of users are supported, which gamification mechanics and elements have been used in existing work, what designs have been used by the models, and what methods have been used to validate them. In an attempt to identify the shared properties from models with motivational characteristics, we established focused questions to identify what models are generic, what are presented in the form of ontologies, what have adaptive or personalised characteristics, and what models support profiles. We also wanted to identify how many models have appeared in recent years and in which type of research forums these works have been published. The research questions of this systematic mapping study and their respective classification categories (explained in Section 3.4) are presented in Table 1.

Table 1. Research questions of the study.

Ref.	Research question	Classification category
General questions		
GQ1	In what domains are the gamification models applied?	Applied domain
GQ2	What motivational factors are included in the gamification models?	Motivational factor
GQ3	What user types the gamification models support?	User type supported
GQ4	What are the gamification mechanics and elements present in the current models?	Gamification mechanics/ elements
GQ5	What gamification designs the models follow?	Design followed
GQ6	What methods are used to validate the models?	Validation method
Focused questions		
FQ1	What are the existing generic gamification models?	Generic model
FQ2	What models are presented in the form of ontologies?	Ontology representation
FQ3	What models have adaptive or personalised characteristic?	Adaptive/ personalised model
FQ4	What models support profiles?	Profiles Support
Statistical questions		
SQ1	How many gamification models have appeared in recent years?	Year of publication
SQ2	Where the gamification models have been published?	Type of publication

3.2. Data sources and search strategy

To build the search string we chose the major search terms 'Gamification' and 'Model'. However, since the search process and filtering options available differ among the different search engines, the studies that include these two terms are not always returned, due to the way in which such terms are distributed throughout the studies. In this way, from these two terms, different 'alternative terms' have been derived, thus providing the build of a broader search string, which was used similarly in all search engines, only being inserted in different ways according to the tools offered by each search engine. The search string, as well as the relationship of the main terms and their respective alternative terms can be seen in Table 2.

Table 3 demonstrates the search strategy used in this study. The scope of the search considers academic publications (journals, conferences and workshops) over six different search engines (*ACM Digital Library*, *IEEE Explore*, *Science Direct*, *Scopus*, *Springer Link* and *Wiley Online Library*), applying the terms of the search string to abstracts, keywords and titles. We looked for the major open search scientific databases containing peer-reviewed publications from Computer Science and Information Technology subjects. All chosen databases have more than 1 million indexed publications. Alternative

Table 2. Search string.

Major terms	Alternative terms
Gamification	(('gamification' OR 'gamified') AND
Model	('model' OR 'ontology' OR 'profile' OR 'profile management' OR 'profiles' OR 'personalised' OR 'customised' OR 'adaptive'))

Table 3. Summary of the search strategy.

Search strategy	
Academic databases searched	•ACM Digital Library •IEEE Explore •Science Direct •Scopus •Springer Link •Wiley Online Library
Target items	•Conference papers •Journal papers •Workshop papers
Search applied to	•Abstract •Keywords •Title
Language	•Papers written in English
Publication period	•Until September 2016

search methods like Snowballing (Wohlin 2014) differ from Petersen, Vakkalanka, and Kuzniarz (2015) guidelines in terms of primary search results width. Snowballing requires a balanced seed of relevant papers covering different years, publishers and authors (Wohlin 2014), where new papers are selected throughout new iterations. On the other hand, the guidelines have no distinction in preliminary search results and usually cover different scientific search databases. In this way, Petersen, Vakkalanka, and Kuzniarz (2015) approach might result in a larger primary set of papers. However, both approaches (guidelines and Snowballing) could miss relevant papers, due to an unbalanced set of papers, in the case of Snowballing (Wohlin 2014) method, or due to a lack of a database, in the case of Petersen, Vakkalanka, and Kuzniarz (2015) guidelines.

The study included papers that met all of the following criteria: have a gamification work represented as a model, make use of the Software Engineering area, include motivational factors or user types, were published until September 2016. We excluded papers that met some of the following criteria: work consists in a literature review or systematic mapping study, not written in English, not accessible in full-text, book or gray literature, duplicated work. The selection strategy is presented in Table 4.

Table 4. Summary of the selection strategy.

Selection strategy	
Inclusion criteria	
IC1	Gamification works represented as models
IC2	Works in the area of Software Engineering
IC3	Works that include motivational factors or user types/ personalities
IC4	Works published until September 2016
Exclusion criteria	
EC1	Works consisting in literature reviews or systematic mapping studies
EC2	Works not written in English
EC3	Works not accessible in full-text
EC4	Books and gray literature
EC5	Duplicate works returned by different search engines

3.3. Data extraction

To extract the data from the representative work selection (presented in Section 4), we used the template shown in Table 5. Each data extraction field has a data item, a value and (if applicable) the associated research question. The extraction was performed and reviewed by the corresponding author.

3.4. Analysis and classification

During the data analysis, the information of each item extracted was tabulated and grouped according to their values, providing the information required to generate the figures and tables presented in Section 4. To generate the statistical data, the papers belonging to each group of an item were counted.

Throughout the study, the papers were organised under twelve classification categories, corresponding to each of the research questions of the systematic mapping, including focused and statistical questions. In details, the classification highlighted from the papers are the following data:

(1) *Applied domain*: The domain where the model has been applied, independently of its specificity. This field is related to GQ1.
(2) *Motivational factor*: The motivational or engagement factors included in the model. Since there is no commonly accepted taxonomy, we standardised the terms based on the most recent gamification design (Marczewski 2015). This field is related to GQ2.
(3) *User type supported*: The user types (or gamified user types) supported by the model, generally establishing a relation with a motivational factor.

Table 5. Data extraction form.

Data item	Value	RQ
Headers		
Study ID	Integer	
Article title	Name of the article	
First author	Name of the first author	
Source	Name of the source (e.g. conference name)	
General questions		
Applied domain	Name of the domain in SE	GQ1
Motivational factor	Set of motivations' names	GQ2
User type Supported	Set of types of users supported	GQ3
Gamification mechanics/ elements	Set of names of each gamification mechanic and element	GQ4
Design followed	Set of designs' names	GQ5
Validation method	Name of the validation method	GQ6
Focused questions		
Generic model	Boolean	FQ1
Ontology representation	Boolean	FQ2
Adaptive/personalised model	Boolean	FQ3
Profiles support	Boolean	FQ4
Statistical questions		
Year of publication	Calendar year	SQ1
Type of publication	Conference, Journal or Workshop	SQ2

The taxonomy changes according to the gamification design, so we also standardised the terms based on the same design of GQ2 (Marczewski 2015). Although user personalities are no user types, their relations are very similar to the motivational factors, so models supporting user personalities were also considered in the study. This field is related to GQ3.

(4) *Gamification mechanics/ elements*: This term has the most extensive variation among all of the classified data, since every model name is based on different sources of study (Points, Experience Points, XP). For such, we also standardised the terms based on the same design of GQ2 (Marczewski 2015). This field is related to GQ4.

(5) *Design followed*: The gamification design followed by the model. Although there are many motivational designs that can be used to develop gamification models, only those that were developed with a focus on gamification or gamified user types were considered. This field is related to GQ5.

(6) *Validation method*: Any official method used to validate or evaluate the model. This field is related to GQ6.

(7) *Generic model*: The specificity of the model, if it is generic or not, independently of its applied domain. This field is related to FQ1.

(8) *Ontology representation*: If the model is represented in the form of ontologies. This field is related to FQ2.

(9) *Adaptive/ personalised model*: It determines if the model has any adaptive or personalised characteristic or purpose. This field is related to FQ3.

(10) *Profiles support*: It identifies if the model contains profiles on its concept or stores user-related information on profiles. This field is related to FQ4.

(11) *Year of publication*: The year that the study has been published or presented. This field is related to SQ1.

(12) *Type of publication*: The type of forum where the study has been published. It can be academic journals, conferences or workshops. This field is related to SQ2.

4. Results of the systematic mapping

4.1. Results of the search

The search process and criteria may have restricted access to studies in such a way that relevant jobs in the search area may have been removed. To mitigate this risk, the techniques presented by Petersen et al. (2008) and Petersen, Vakkalanka, and Kuzniarz (2015) were used, which were also applied in studies by Gonales et al. (2015), Dias, Barbosa, and Vianna (2017) and Vianna and Barbosa (2017).

Figure 1 shows the different steps present in the studies filtering process. The searches were performed following the search string shown in Table 2 and in the Initial Search step a total of 1366 articles were returned over six different search engines. The searches were conducted at the end of September 2016, and no search filter was applied in this first return, such as a publication date limit period.

In the second filtering step we performed an Impurity Removal, this time applying the inclusion criteria (IC2) and the exclusion criteria (EC2) and (EC4), resulting in

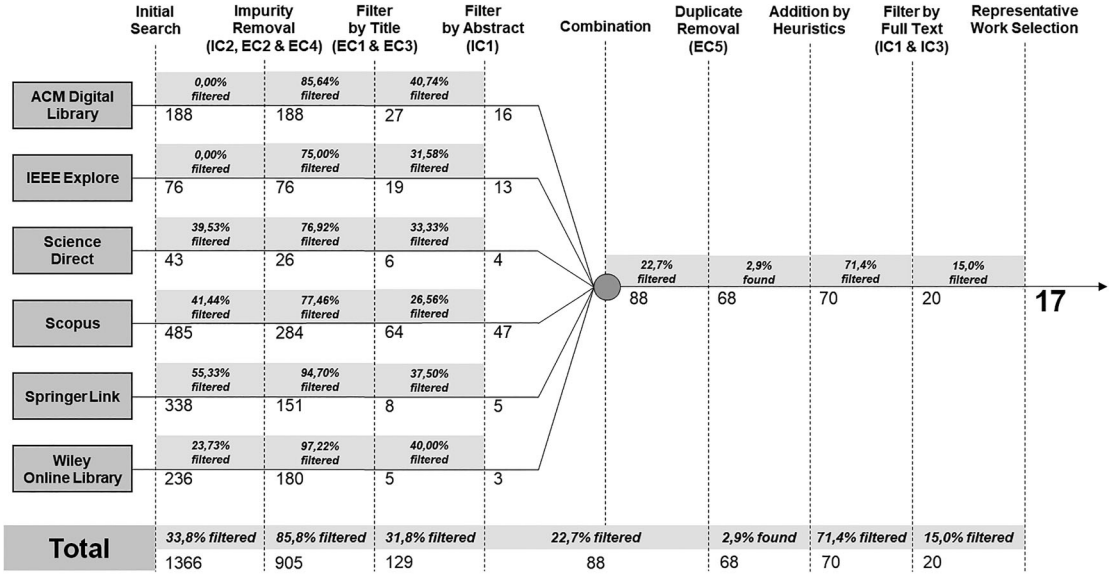

Figure 1. Studies filtering.

a reduction of the total number of results in 33.8%, totalling 905 works at the end of this step.

Subsequently, we filtered the studies by title, where the exclusion criteria (EC1) and (EC3) were applied. This step was the most thorough since it required a careful reading of each title in order to try to identify the main purpose of each work. As a result, it was possible to reduce the number of works to be mapped by 85.8%, which resulted in a total of 129 works.

In the fourth step, we performed a filtering by abstract, applying the inclusion criteria (IC1). After the unification of results from different search engines (Combination step), a reduction of 31.8% in the total number of results was observed, totalling 88 papers.

In the subsequent step, we applied the exclusion criteria (EC5) to remove the duplicate studies, eliminating 22.7% (20) of the works resulting from the previous step.

In the next step (Addition by Heuristics), we added two papers compatible with the inclusion and exclusion criteria of the systematic mapping that were not returned in any of the search engines, increasing the number of results by 2.9%.

From the 70 papers resulting from the previous step, 71.4% of them were removed by applying the inclusion criteria (IC1) and (IC3) throughout the text (Filter by Full Text step), resulting in a total of 20 selected papers.

Analysing the 20 works selected in the filtering step, it was observed that some studies from the same author or research group were technically similar, being updates of previously published studies. Thus, only the most representative study was selected and the remainder removed. Consequently, 3 studies were excluded (15%), totalling 17 selected representative works, which are listed in Appendix 1.

4.2. Research questions

In this section, we performed an analysis of the primary studies obtained from the results of the studies filtering process. Each information related to the gamification model present in the studies was classified and organised according to the research questions that have been outlined previously. The answers to the research questions, which include general questions (GQ), focused questions (FQ) and statistical questions (SQ) are described in the next sections.

4.2.1. GQ1. in what domains are the gamification models applied?

Figure 2 shows the distribution of the primary studies according to the domain that the gamification models were applied. According to Inclusion Criteria 2, only works in the area of Software Engineering were included,

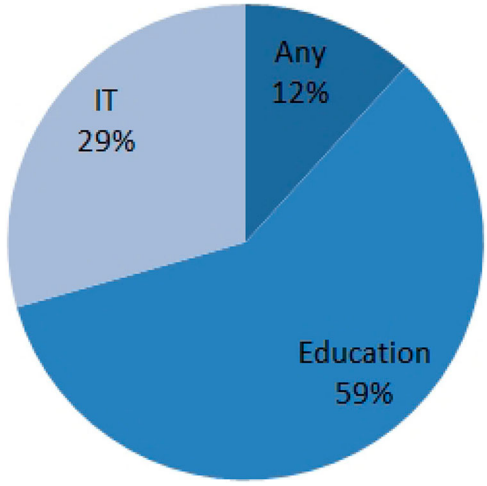

Figure 2. Distribution of primary studies by applied domain.

that is, primary studies that present gamification models used to gamify software, independent of the domain they were applied. The results of this classification show that 88% of the models were developed for and/or applied on a specific domain, with the Education domain being the target of more than half of the primary studies, where most of them present a gamification model to increase the motivation of learning processes.

Another domain identified in this classification is the Information Technology (IT). This term (IT) was used to encompass related fields such as Information Systems, Computer Science, and so on. Five models were developed for this domain, thus representing 29% of the representative studies.

The remaining models (12%) were classified under Any domain due to the models not be focused or applied to a specific domain. The classification of each primary study is described in Table 6.

4.2.2. GQ2. What motivational factors are included in the gamification models?

The motivational factors mapped in this work followed the definitions present in the gamification design Hexad (Marczewski 2015). In short, they can be defined as:

- *Autonomy*: The need to feel independence or freedom;
- *Change*: The desire to perform positive or negative changes;

Table 6. Distribution of primary studies by applied domain.

Applied domain	Studies
Any	[A1], [A2]
Education	[A3], [A4], [A5], [A6], [A7], [A8], [A9], [A10], [A11], [A12]
IT	[A13], [A14], [A15], [A16], [A17]

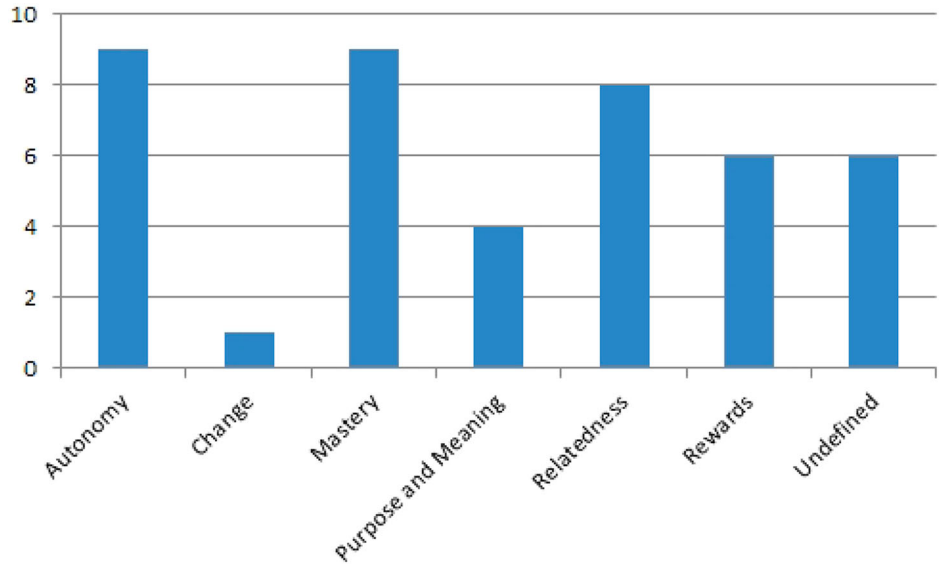

Figure 3. Distribution of primary studies by motivational factor.

- *Mastery*: The desire to learn new skills and develop expertise in them;
- *Purpose and Meaning*: The feeling of greater meaning or a desire to be altruistic;
- *Relatedness*: The desire to be connected to others;
- *Rewards*: The desire to collect rewards.

Figure 3 shows the distribution of the primary studies according to the motivational factors identified throughout the models. Among the 17 studies selected, a total of 43 motivational factor occurrences were identified (after the terms' standardisation). Autonomy and Mastery are the main motivations used by the models, with 20.9% of the occurrences each.

The less used motivations by the models are Change and 'Purpose and Meaning', with only 2.3% and 9.3%, respectively. However, 35.3% of the studies did not mention motivational factors in their models, thus representing 14% of the total occurrences and being classified as 'Undefined'. The classification of each primary study is described in Table 7.

4.2.3. GQ3. What user types the gamification models support?

To adopt the same organisation utilised in GQ2, the user types mapped followed the definitions present in the gamification design Hexad (Marczewski 2015). In brief, they can be defined as:

Table 7. Distribution of primary studies by motivational factor.

Motivational factor	Studies
Autonomy	[A1], [A3], [A4], [A6], [A8], [A9], [A11], [A14], [A16]
Change	[A11]
Mastery	[A1], [A3], [A4], [A6], [A7], [A8], [A9], [A12], [A14]
Purpose and Meaning	[A3], [A6], [A8], [A12]
Relatedness	[A1], [A3], [A4], [A7], [A9], [A11], [A14], [A16]
Rewards	[A3], [A4], [A8], [A11], [A12], [A16]
Undefined	[A2], [A5], [A10], [A13], [A15], [A17]

- *Achiever*: It looks to gain knowledge, learn new skills and improve itself. It usually wants challenges to overcome;
- *Disruptor*: It wants to disrupt a system, either directly or through other users to force positive or negative change;
- *FreeSpirit*: It wants to create and explore;
- *Philanthropist*: It is altruistic, wanting to give to other people and enrich the lives of others in some way (with no expectation of reward);
- *Player*: It will do what is needed to collect rewards from a system and not much more. It is in it for itself;
- *Socialiser*: It wants to interact with others and create social connections.

Figure 4 shows the distribution of the primary studies according to the gamification user types identified throughout the models. Among the 17 studies selected, a total of 47 user type occurrences were identified (after the terms' standardisation). Achiever, FreeSpirit and Socialiser are the main user types used by the models, with 21.3% and equally 19.1% of the occurrences, respectively.

The less used user types by the models are Disruptor and Philanthropist, with only 8.5% and 2.1%, respectively.

According to the design selected to standardise the terms in this study (Marczewski 2015), the motivational factors and user types relate with each other with a cardinality of one-to-one. Nevertheless, there is a variation present in the number of results, due to some studies do not make use of both terms. Despite that relation, we also

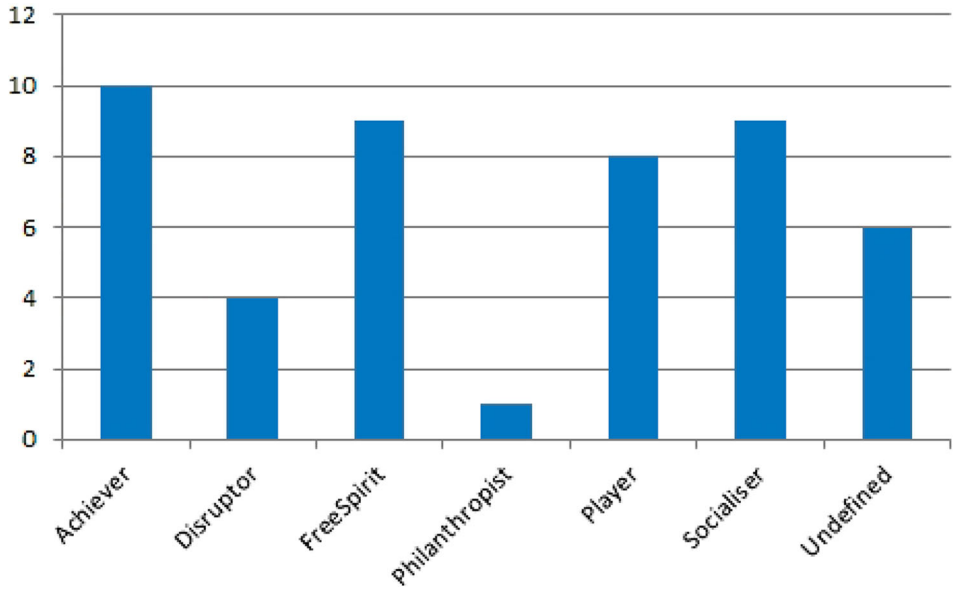

Figure 4. Distribution of primary studies by user type.

Table 8. Distribution of primary studies by user type.

User type	Studies
Achiever	[A2], [A3], [A4], [A5], [A6], [A7], [A10], [A13], [A15], [A17]
Disruptor	[A2], [A5], [A6], [A11]
FreeSpirit	[A2], [A3], [A4], [A5], [A6], [A10], [A11], [A15], [A17]
Philanthropist	[A3]
Player	[A2], [A4], [A5], [A6], [A10], [A11], [A13], [A17]
Socialiser	[A2], [A3], [A4], [A5], [A6], [A7], [A10], [A11], [A17]
Undefined	[A1], [A8], [A9], [A12], [A14], [A16]

identified that 6 studies did not mention user types in their models, thus representing 12.8% of the total occurrences and being classified as 'Undefined'. The classification of each primary study is described in Table 8.

4.2.4. GQ4. What are the gamification mechanics and elements present in the current models?

Figure 5 presents the distribution of the primary studies according to the gamification mechanic or element identified throughout the models. After the terms' standardisation, a total of 137 occurrences were identified among the 17 studies selected. *Badges/Achievements*, *Points/ExperiencePoints(XP)* and *Leaderboards/Ladders* are the main gamification elements and mechanics used by the models, with equally 9.5% and 8.8% of the occurrences, respectively.

The less used gamification elements and mechanics by the models are *Collect&Trade*, *Learning/NewSkills*, *Meaning/Purpose*, *Theme* and *TimePressure*, with 0.7% of the occurrences each.

Even with a considerable variety of gamification mechanics and elements (totalling 32) identified in the models, 15 terms present in the design of Marczewski (2015) were not used, thus concluding that the resulting models of this study cover 68.1% of the complete set of gamification mechanics and elements available.

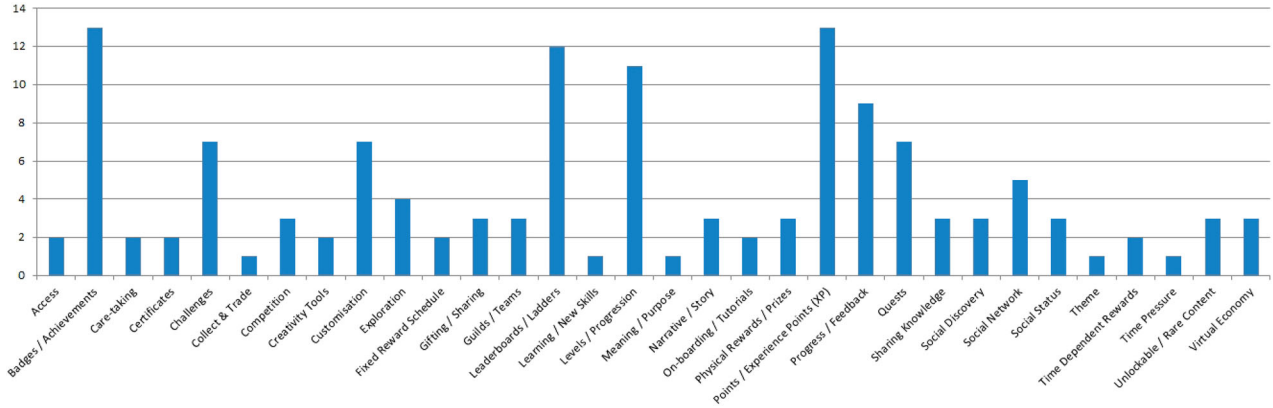

Figure 5. Distribution of primary studies by gamification mechanic/element.

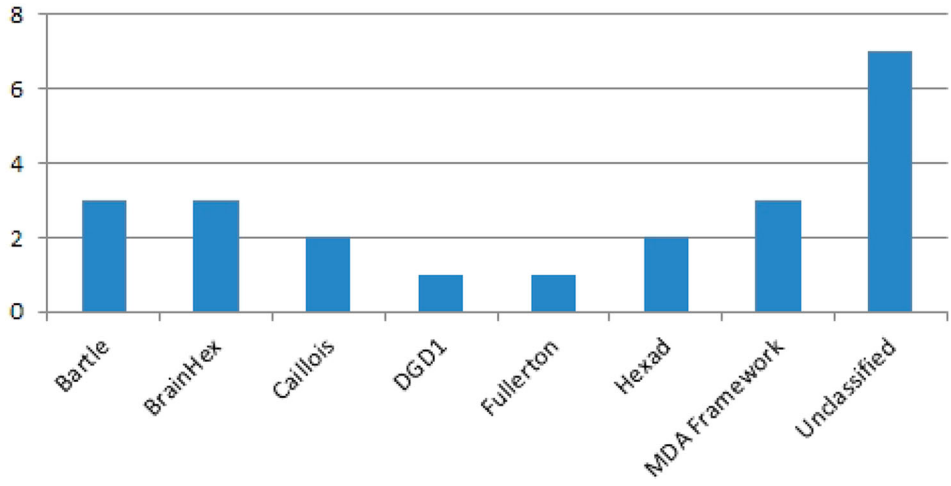

Figure 6. Distribution of primary studies by design followed.

4.2.5. GQ5. What gamification designs the models follow?

Figure 6 shows the distribution of the primary studies according to the gamification design followed by the models. The results of this classification show that 7 studies do not follow any externals gamification design, thus representing 31.8% of the total occurrences and being presented as 'Unclassified', since they can be following their own design.

The less used gamification designs by the models were DGD1 (Demographic Game Design) and Fullerton, with 4.5% of the occurrences each. Some gamification designs do not have an official name, so for such studies the name of the author who created the gamification design was used.

It is also important to highlight that some designs provided by the results of this study were built or inspired on other (and previous) designs, by making use of some ideas and concepts, so future research in the next years could help to identify the most followed gamification design over the time. The classification of each primary study is described in Table 9.

4.2.6. GQ6. What methods are used to validate the models?

Figure 7 presents the distribution of the primary studies according to the methods used to validate the models.

Table 9. Distribution of primary studies by design followed.

Design followed	Studies
Bartle	[A2], [A10], [A15]
BrainHex	[A2], [A5], [A6]
Caillois	[A2], [A11]
DGD1	[A2]
Fullerton	[A2]
Hexad	[A3], [A4]
MDA framework	[A8], [A10], [A12]
Unclassified	[A1], [A7], [A9], [A13], [A14], [A16], [A17]

The results of this classification show that 59% of the models were not validated or at least did not mention throughout the text any validation method used, being classified in this study as 'Not validated' and 'Undefined', respectively. A factor that justifies this elevated percentage is the fact that some studies were still on their conceptual stage, thus resulting in premature models.

Five different validation methods were identified among the remaining models (41%). The validations were used not only to verify if the model accomplishes its purpose but also to evaluate among the different uses provided by the model where it succeeds or fails. The classification of each primary study is described in Table 10.

4.2.7. FQ1. What are the existing generic gamification models?

Figure 8 presents the distribution of the primary studies organised by the focused question identified in the models. For a better viewing, all of the questions were presented in the same figure, including an extra data

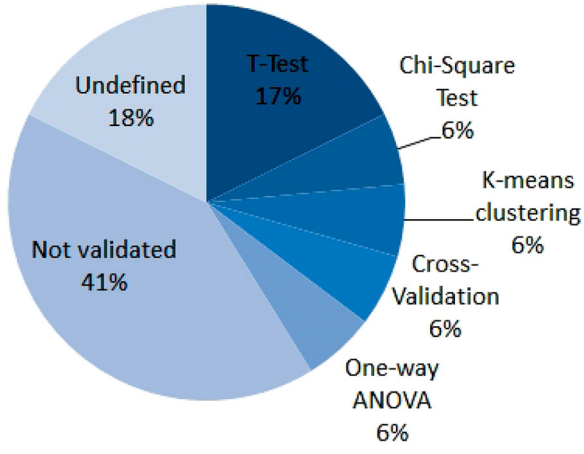

Figure 7. Distribution of primary studies by validation method.

Table 10. Distribution of primary studies by validation method.

Validation method	Studies
T-test	[A5], [A13], [A16]
Chi-square test	[A10]
K-means clustering	[A4]
Cross-validation	[A6]
One-way ANOVA	[A17]
Not validated	[A1], [A2], [A7], [A9], [A11], [A12], [A15]
Undefined	[A3], [A8], [A14]

representing the studies that did not answer positively to any of the focused questions, thus being grouped as 'Not Applicable'. The classification of each primary study is described in Table 11.

The results of this classification show that four studies developed a generic gamification model, thus representing 23.5% of the total studies.

The classification decision used to answer this question is provided by the studies that explicitly informed that their models had a generic purpose or use, despite the domain they were (if applicable) designed to.

4.2.8. FQ2. What models are presented in the form of ontologies?

The results of this classification show that only one study developed a gamification model represented by an ontology, resulting in only 5.9% of the total studies.

The classification decision used to answer this question is provided by the studies that used ontologies as a core component of their models, making use of their advantages to provide a gamification model with knowledge representation.

Table 11. Distribution of primary studies by focused question.

Focused question	Studies
What are the existing generic gamification models?	[A1], [A2], [A3], [A5]
What models are presented in the form of ontologies?	[A7]
What models have adaptive or personalised characteristic?	[A5], [A6], [A7], [A9], [A15]
What models support profiles?	[A4], [A5], [A6], [A9], [A14], [A15], [A17]
Not applicable	[A8], [A10], [A11], [A12], [A13], [A16]

4.2.9. FQ3. What models have adaptive or personalised characteristic?

The results of this classification show that five studies developed an adaptive or personalised gamification model, thus representing 29.4% of the total studies.

The classification decision used to answer this question is provided by the studies which the main purpose is to provide adaptive or personalised gamification or that explicitly informed that their models contain such characteristic. Most of these studies also make use of profiles as a mean to provide adaptability or personalisation.

4.2.10. FQ4. What models support profiles?

The results of this classification show that seven studies developed a gamification model that supports profiles, being the highest percentage of positive results among the studies (41.2% of the total studies).

The classification decision used to answer this question is provided by the studies which explicitly stated that their models support user profiles or can keep user-related information on profiles, even for those that in the first instance do not make use of that information.

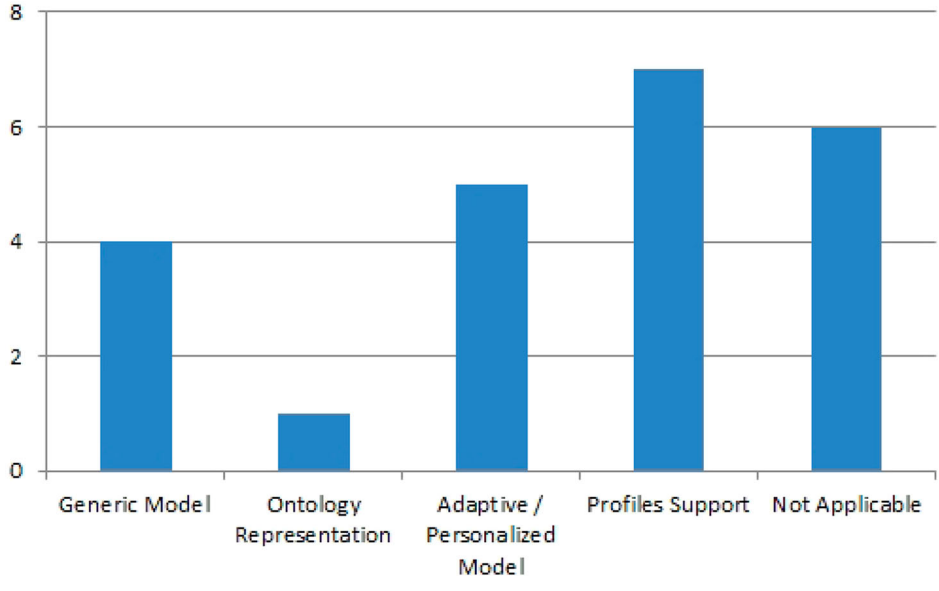

Figure 8. Distribution of primary studies by focused question.

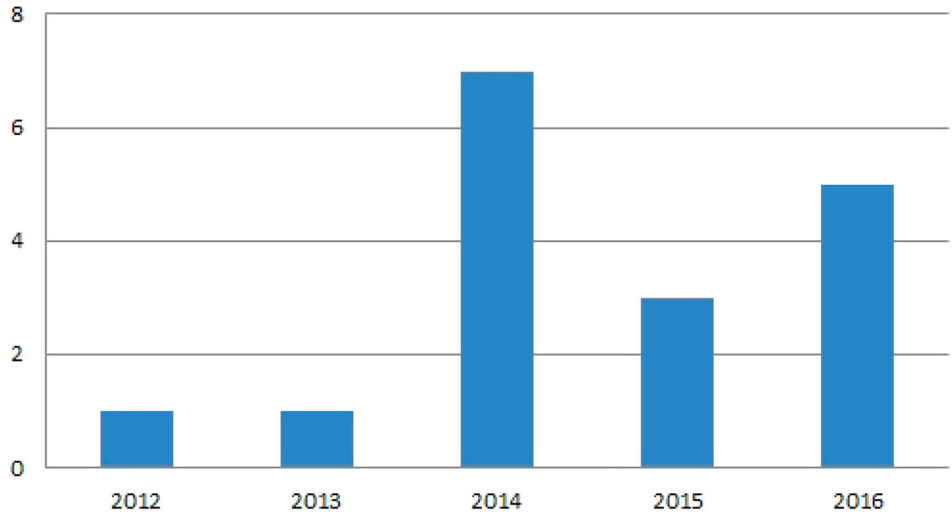

Figure 9. Distribution of primary studies by year.

A total of 6 'Not Applicable' studies also resulted from the classification process, representing 35.3% of the models that do not answer positively to any of the focused questions selected for this study.

4.2.11. SQ1. how many gamification models have appeared in recent years?

Figure 9 presents the distribution of the studies classified by the year they were published. The first primary study presenting a gamification model that follows the criteria of this Systematic Mapping Study appeared in 2012. The same result appeared in the subsequent year. The number of studies published in 2014 is seven times bigger than in 2013, and the number was less than a half in 2015 compared to the previous year. However, the number of primary studies published in the first three quarters of 2016 already exceeds the number of papers published in 2015. This result seems to follow the same growth trend of gamification in general (Amm 2017), that is not specifically focused on models. According to Werbach and Hunter (2012), the first use of gamification as it is nowadays understood happened in the year 2003. On the other hand, and according to Deterding et al. (2011), the first documented use of the term 'gamification' happened in 2008.

4.2.12. SQ2. where the gamification models have been published?

Figure 10 presents the distribution of primary studies by the type of forum in which they have been published. The classification shows that 77% of them were published as conference or workshop papers, being 71% in conferences and only 6% in workshops.

Almost one-quarter of the papers were published in journals, representing 23% of the total results and indicating that the majority of the research under these aspects is still somehow preliminary. Table 12 presents the primary studies for each type of forum.

Another interesting information to analyse are the conference's occurrences. Whilst many of them present only one representative study, three studies ([A9], [A11] and [A15]) were presented in the same conference, entitled as *Proceedings of the Second International Conference on Technological Ecosystems for Enhancing Multiculturality*. This certainly indicates that gamification received a particular focus on that event.

In an attempt to associate the extracted data of each study in relation to the research questions presented, Table A1 in Appendix 2 was elaborated to provide a

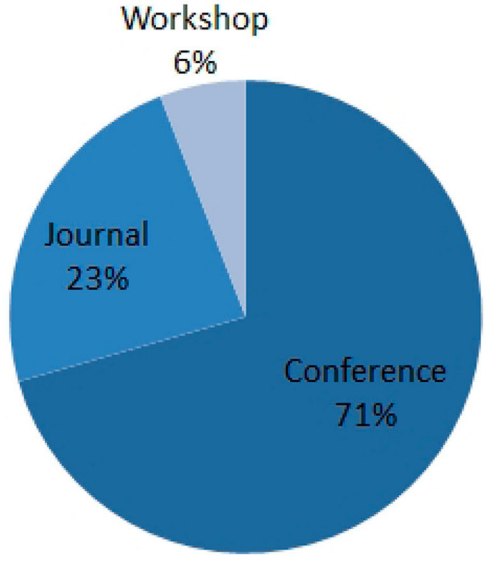

Figure 10. Distribution of primary studies by type of forum.

Table 12. Distribution of primary studies by type of forum.

Type of forum	Studies
Conference	[A1], [A2], [A3], [A4], [A5], [A9], [A11], [A12], [A13], [A15], [A16], [A17]
Journal	[A6], [A8], [A10], [A14]
Workshop	[A7]

better overview of the findings. The content shows the distribution of research questions' results by primary study, which includes *General Questions*, *Focused Questions* and *Statistical Questions*.

5. Threats to validity

Being this research a systematic mapping study, it has some risks that could affect the results found. Risks can occur as a result of decisions made during the conduction of the systematic mapping.

In order to guarantee better research results, six databases were selected, each one having more than 1 million indexed publications. Trying to mitigate the risk of the databases affect the obtained results, we looked for the major open search scientific databases containing peer-reviewed publications from Computer Science and Information Technology subjects.

Two major terms and their alternative terms were chosen to build the search string. For the term 'Gamification', alternative terms used in the papers of the area were selected to have a better assertiveness in the search. For the term 'Model', terms involving the scope of this research were used to guarantee better findings. Therefore, the search string was elaborated considering the main terms and their alternatives, with the broadest possible coverage of keywords in the research. Thus, the search string elaboration process avoids an incomplete combination of terms that results in an ineffective search.

When defining the inclusion and exclusion criteria, we opted to inform that the research was conducted in September 2016 by adding this information as an Inclusion Criteria. This indicates that papers published after that date could not have been retrieved from the selected databases at that search time. On the other hand, this might add a transparency level to the search process, once it can be reproduced at any given date to validate the data presented in Figure 1.

The filtering process could have restricted the results in such a way that relevant works could have been removed. To mitigate this risk, the filtering process was based on the guidelines of Petersen et al. (2008).

The Snowball sampling (Wohlin 2014), one of the filtering process steps of Petersen, Vakkalanka, and Kuzniarz (2015) was not performed in this research. Thus, to avoid the risk of not include studies that might have been missed during the study selection process, we included the step 'Addition by Heuristics' in the filtering process, where relevant studies to the research were added heuristically. This technique was also applied in other mapping studies (Dias, Barbosa, and Vianna 2017; Bischoff et al. 2019).

The data extraction process was performed and reviewed by the corresponding author. A recommendation of Petersen, Vakkalanka, and Kuzniarz (2015) is to have two authors involved in this step, where one extracts the data and the other checks the correctness of the extracted data. Therefore, to reduce the researcher bias, the corresponding author followed the same review technique of Petersen, Vakkalanka, and Kuzniarz (2015), which consists in trace back the information in the extraction form to the statements in each paper, and check their correctness.

Additionally, some papers, which do not have validated or evaluated their models, were presented in the final results and this is common as mapping studies usually do not take the quality assessment. In order to aware readers about this issue, we have signalled these papers in Table 10.

6. Discussion

In this section, we discuss the results obtained from the classification and analysis of the studies, along with an identification of gaps and opportunities for future research.

As a result of this analysis, the first point to highlight in this work is the lack of material in the literature concerning gamification models oriented to motivational characteristics, which is the main research question of this study. After many filtering steps, from the 1366 results obtained in the Initial Search, only 17 studies were approved throughout the filtering process, representing only 1.25%. It is true, however, that many models available do not consider including motivational characteristics, since if we remove this restriction, the representative work selection would have been a way bigger (more than 2 times the current amount).

As mentioned before, we also observed that only a small part of the studies selected have been published as journal articles, which indicates that the status of the research is somehow preliminary, reinforced by the fact that almost 60% of the studies do not validate or evaluate their models.

Another important result collected from this study is the focus of the works on the Education domain. It is conclusive that the literature is interested in different attempts to increase the motivation of learning processes, as can be seen in Figure 11. It is the only domain

with studies covering all the focused questions of this study, although they are provided by different studies, once we did not find a unique study answering positively to all of the focused questions.

A possible gap found in this analysis is the use of ontologies to represent the knowledge of the models. Only one study (5.9% overall studies) developed a gamification model using ontologies. With an extensive amount of gamification mechanics and elements, motivational factors and user types available in the gamification field, ontologies and its applicability can be a powerful tool to engage future researches and provide new possibilities for gamification models.

A tendency found in this study is the common choice of motivational factors and user types applied in the models, identified throughout the data extraction process. As mentioned before, we standardised the terms in order to be able to provide statistical data about the information collected from the models. In short, this standardisation creates a relation between the motivational factor and the user type, where a specific motivational factor motivates a specific user type. Even with that relation not being present in many models, once some of them make exclusive use of motivational factor or user type, the results confirmed the aforementioned relation. The most used motivational factors by the models are Autonomy, Mastery and Relatedness, which means that the most motivated user types by the models are FreeSpirit, Achiever and Socialiser.

Gamification is indeed very effective and can provide an increase in motivation, but will it be effective when implemented randomly or following a poor gamification model? In previous years, Gartner (Pettey and Meulen 2012) predicted that '80% of current gamified applications will fail to meet business objectives primarily due to poor design'. As stated previously, more than 40% of the models resulted from this study do not follow any known gamification design, also indicating that even models might follow the same success rate path of gamified applications.

We made a second analysis studying the applied domain of gamification models, now focusing on the gamification mechanics and elements selected, as can be seen in Figure 12. Following the same pattern observed in Figure 11, the domain which provides most coverage is Education. But a dubious question remains: are the selected mechanics and elements the best choice for their models? There is a strong tendency to choose the mechanics and elements identified as *Badges/Achievements*, *Points/ExperiencePoints(XP)*, *Leaderboards/Ladders* and *Levels/Progression* as the main option to be applied in these models, but will they reach their goal in the Education domain? With many segments under the Education domain, will these choices be the safest way to build a successful model? Moreover, which of these elements have their effectiveness proven on their application domain? As pointed out by the study [A13] in the IT domain, gamification elements have a different effect on a varied set of user types and their personalities, and although commonly used gamification mechanics and elements like *Badges/Achievements* and *Levels/Progression* have a good adherence on users that match a specific set of personalities, there is no guarantee that they will have the same effect on other user types with different personalities.

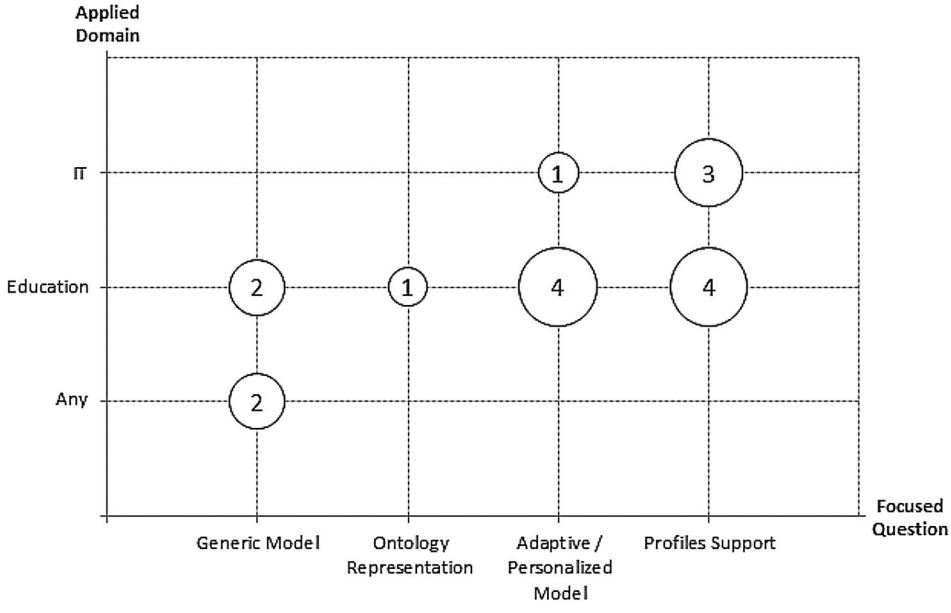

Figure 11. Summary of classification (applied domain by focused question).

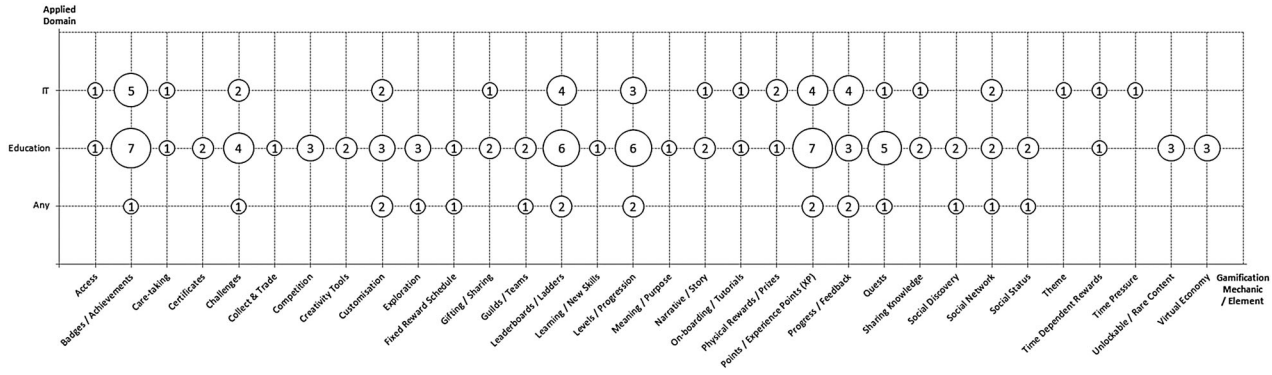

Figure 12. Summary of classification (applied domain by gamification mechanic/element).

A different perspective is presented in the study [A17], where the authors analyse the correlation between specific gamification mechanics and elements with the behaviour of the users. The results follow a line similar to other studies, since the findings suggest that a specific gamification element have a strong association with the specific behaviour of a user.

A third analysis was made to study the applied domain of gamification models focused on the motivational factors contained in these models, as can be seen in Figure 13. The domain which provides most coverage is Education, repeating the pattern previously observed in Figures 11 and 12. The tendency this time leads to motivational factors identified as *Mastery*, *Autonomy*, *Relatedness* and *Rewards* as the main option to be included in these models. On the other hand, motivational factors identified as *Change* and '*Purpose and Meaning*' were not even included in any models of the other domains. This absence is understandable when present in gamification models applied on the IT domain, once their coverage is more limited, but certainly it would be better if models built to be applied on 'Any' domain could cover more motivational factors, after all, multiple domains indicate different user types, personalities and motivational factors needed to reach the engagement of different users.

With the extensive variation of concepts involved in gamification and since the models present in the representative works cover a different set of concepts (elements, motivations and user types), it is still not possible to conclude what gamification model is the most effective, neither what gamification mechanics and elements will work better if the motivational characteristics of the users are not properly identified and considered in the scope of the model. Among an enormous variation of mechanics and elements available, we must be very careful with our choices, considering the psychological needs of the users, their types and personalities, factors that motivate them and most important: 'do not follow any path just because everybody's doing it' (Davis 1993).

7. Conclusions and future work

In this paper, we conducted a systematic mapping study to characterise the state of art of gamification models with motivational characteristics. After carrying out the search for primary studies, we classified them according

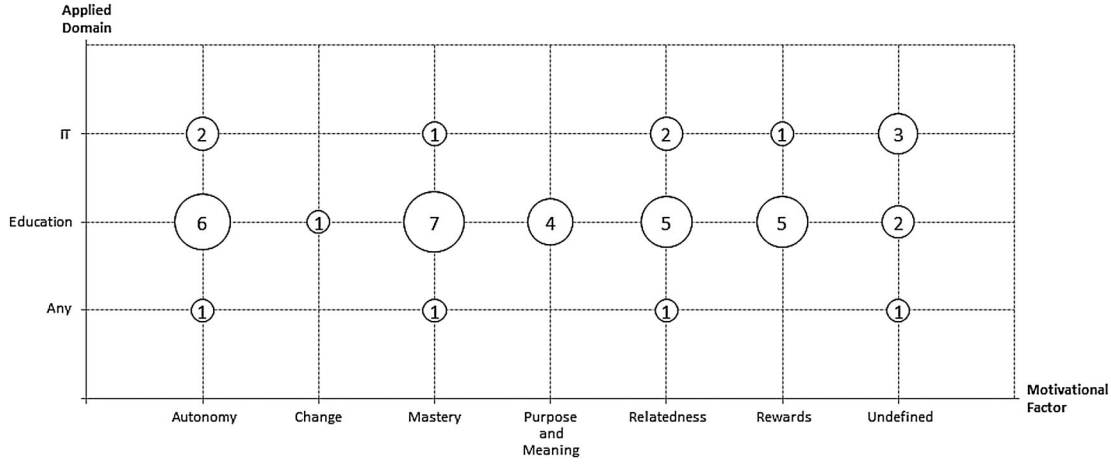

Figure 13. Summary of classification (applied domain by motivational factor).

to eight categories, namely the domains that the gamification models have been applied, what motivational factors were included, what type of users they supported, which gamification mechanics and elements have been used, what designs the models followed, what methods have been used to validate them, how many models have appeared in recent years and in which type of research forums they were published. We also created an additional classification according to four categories (in response to the focused questions of the study), namely the models that are generic, what are presented in the form of ontologies, what have adaptive or personalised characteristic and what models support profiles.

The results we obtained during the analysis of the primary studies show that the existing research of gamification models is somehow preliminary and immature, since most studies have been published in workshops or conferences, and few of them were validated or evaluated due to be in a conceptual stage of development. Further research providing empirical results about the application of these models would provide richer information about the effectiveness of their gamification proposals.

Most of the studies we have analysed focus on Education, commonly referred as 'Gamification of Learning'. This leads to an important gap in the field, since gamification by itself offers mechanics and elements to be applied on diversified domains, and Education is not the only domain which suffers with lack of motivation by the users.

Another aspect that deserves further research effort is the gamification design to be followed when a model is being created. In our opinion, the gamification designs offer an opened way to build a model, not referring to the implementation itself but to the gamification knowledge that needs to be carefully analysed. More than 40% of the models did not follow a gamification design, resulting in similar choices of gamification mechanics and elements between them, so different options should have been considered and explored a little more.

Another research gap which we found during the study is the lack of user type analysis. Although some models analysed the whole scenario of possibilities, many of them followed the same trend, thus also choosing the same motivational factors. Unpopular user types like Disruptor and Philanthropist certainly have a space in some domains, although they were completely ignored by many models.

A research opportunity we found is the development of gamification models that comply with all of the focused questions proposed in this study. We identified many combinations, but with most of them only answering positively in up to half of the questions. We believe that a model with generic purposes, making use of the benefits of ontologies, organising all of the gamification user types and their motivations in profiles to provide adaptability and personalisation, surely covers the existing research gaps highlighted in this work and deserves a full evaluation to validate the aforementioned concepts, thus proving its applicability.

From the results of the systematic mapping, we conclude that the development of gamification models is still growing, and more domains and uncovered gamification mechanics and elements should appear in future researches, as well as the number of studies and the completeness of their ideas.

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Appendix 1. Complete list of all primary studies included in the study

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Appendix 2. Distribution of research questions' results by primary study

Table A1. Distribution of research questions' results by primary study.

Study	GQ1	GQ2	GQ3	GQ4	GQ5	GQ6	FQ1	FQ2	FQ3	FQ4	SQ1	SQ2
[A1]	Any	Autonomy, Mastery, Relatedness	Undefined	Custo., Progr., Chall., XP, Levels, Lboard., Guilds, S.Disc., S.Net.	Unclassified	Not validated	Yes	No	No	No	2012	Conference
[A2]	Any	Undefined	Achiever, Disruptor, FreeSpirit, Player, Socialiser	Badges, XP, Lboard., Levels, Progr., F.Sched., Quests, S.Stat., Custo., Explo.	Bartle, BrainHex, Caillois, DGD1, Fullerton	Not validated	Yes	No	No	No	2013	Conference
[A3]	Education	Autonomy, Mastery, Purpose and Meaning, Relatedness, Rewards	Achiever, FreeSpirit, Philanthropist, Socialiser	Chall., Quests, Levels, Certi., Explo., Unlock., Custo., C.Tools, Guilds, Compet., S.Stat, S.Net, S.Disc., Meani., Care, S.Know., Access, Collect, Gift.	Hexad	Undefined	Yes	No	No	No	2015	Conference
[A4]	Education	Autonomy, Mastery, Relatedness, Rewards	Achiever, FreeSpirit, Player, Socialiser	Badges, XP, Lboard., S.Stat., Unlock., Custo., Levels	Hexad	K-means clustering	No	No	No	Yes	2014	Conference
[A5]	Education	Undefined	Achiever, Disruptor, FreeSpirit, Player, Socialiser	XP, Badges, LBoard.	BrainHex	T-Test	Yes	No	Yes	Yes	2015	Conference
[A6]	Education	Autonomy, Mastery, Purpose and Meaning	Achiever, Disruptor, FreeSpirit, Player, Socialiser	Explo., Chall., XP, Learn., Quests, Badges, S.Know.	BrainHex	Cross-Validation	No	No	Yes	Yes	2016	Journal
[A7]	Education	Mastery, Relatedness	Achiever, Socialiser	Quests, S.Disc., XP, V.Econ., Progr.	Unclassified	Not validated	No	Yes	Yes	No	2016	Workshop
[A8]	Education	Autonomy, Mastery, Purpose and Meaning, Rewards	Undefined	Levels, Quests, F.Sched., Progr., XP, Lboard., Badges, V.Econ., T.Reward, Unlock., Tutor.	MDA Framework	Undefined	No	No	No	No	2015	Journal
[A9]	Education	Autonomy, Mastery, Relatedness	Undefined	S.Net., Guilds, Custo., Levels, Certi., Lboard., Voting	Unclassified	Not validated	No	No	Yes	Yes	2014	Conference
[A10]	Education	Undefined	Achiever, FreeSpirit, Player, Socialiser	XP, Levels, Badges, Progr., Lboard., Quests, Chall., Compe., Story	Bartle, MDA Framework	Chi-Square Test	No	No	No	No	2016	Journal
[A11]	Education	Autonomy, Change, Relatedness, Rewards	Disruptor, FreeSpirit, Player, Socialiser	Chall., Compe., Badges, Explo., Story, C.Tools, P.Reward	Caillois	Not validated	No	No	No	No	2014	Conference
[A12]	Education	Mastery, Purpose and Meaning, Rewards	Undefined	Levels, XP, Lboard., Badges, V.Econ., Gift.	MDA Framework	Not validated	No	No	No	No	2014	Conference
[A13]	IT	Undefined	Achiever, Player	Badges, Progr., XP, P.Reward, Lboard.	Unclassified	T-Test	No	No	No	No	2014	Conference
[A14]	IT	Autonomy, Mastery, Relatedness	Undefined	XP, Quests, Badges, Lboard., S.Net., S.Know.	Unclassified	Undefined	No	No	No	Yes	2016	Journal
[A15]	IT	Undefined	Achiever, FreeSpirit	Progr., Levels, Custo., Lboard., Badges, Gift., Access	Bartle	Not validated	No	No	Yes	Yes	2014	Conference
[A16]	IT	Autonomy, Relatedness, Rewards	Undefined	XP, Badges, Lboard., Levels, Chall., Custo., Tutor., Care, Story, Progr., T.Press., S.Net., P.Reward	Unclassified	T-Test	No	No	No	No	2016	Conference
[A17]	IT	Undefined	Achiever, FreeSpirit, Player, Socialiser	XP, T.Reward, Badges, Chall., Levels, Progr., Theme	Unclassified	One-way ANOVA	No	No	No	Yes	2014	Conference