

Gamification strategies for Mobile Device Applications: a systematic review

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Abstract — In the quest to engage and motivate users on the use of mobile applications, the gamification concept has been excelling in the market since incorporates game elements in a non-game context. Scoring systems, challenges, competitions and badges, are some of the elements implemented in many fields, such as health, education, ecological awareness, among others. In this context, this study aimed to systematically review available literature to identify gamification strategies used in mobile applications. A search was conducted in ACM, Science Direct and Scopus databases, from March to June 2016. A total of 402 studies were found, 23 of which met the eligibility criteria. The results demonstrated the heterogeneity of gamification elements being used and the impact they caused in the applications, especially as a motivational factor for users. This study provides the basis for future research on gamification methods and emphasizes the importance of this concept to increase engagement and provide enjoyment to users.

Keywords - mobile devices; gamification strategies; motivation; systematic literature review.

I. INTRODUCTION

User engagement is one of the main factors that keep users to mobile applications, reducing abandonment rates through motivation. Among the available techniques, gamification, a relatively new concept [1] which consists of the use of “game elements in a non-game context” [2] emerges. The purpose is to help solve problems, promote learning and explore user motivation [3].

Ryan and Deci [4] say there are two types of motivation: extrinsic and intrinsic. Extrinsic motivation is related to rewards or bonuses for achieving goals and should be stimulated because tends to be unstable, depending on external factors. Intrinsic motivation originates from internal factors, such as interests and tastes, tending to be constant, because depends solely on the person. Thus, motivation mainly corresponds to the human tendency “to look for what is new and challenging, to extend and exercise capacities, to explore and learn”. The establishment of intrinsic motivation can be reached through numerous strategies. McGonigal [5] proposes four main types of rewards that lead to intrinsic motivation: i) recognition of efforts; ii) hope to be successful, continually getting better results; iii) social connection as a human need to share thoughts and perform tasks with others; iv) rewards as part of something greater than itself, such as the collective pursuit of a goal difficult to achieve.

The gamification paradigm proposes the combination of both types of motivation to establish a commitment in software with pragmatic purposes [6] using heuristic design patterns and game dynamics to enrich the user experience and involve the user in the software during interaction [7]. Gamification is used in the application of well-known game mechanics, such as scores systems, as a fundamental structure to an intrinsic reward system. Research shows that results of engagement and motivation to participate, use, learn, socially interact or perform in-house tasks [9-14] may vary depending on the platform or device implemented by the system.

Seixas et al. [40] adds that gamification is directly linked to the positive effects on the involvement of users in the proposed context, being that, presenting highest levels of engagement in the evaluation indicates users who were more rewarded.

The conception of an interface design with elements that motivate the user is also a crucial aspect for the success of any application. Therefore, ubiquity and other aspects of mobile technologies can contribute to this success, especially to attract two types of public, ordinary smartphone and tablet users as well as gamers [15].

Studies indicates gamification is a term yet to be developed [16], since the design principles are widespread and diverse. Hence, this study aimed to systematically review the literature in order to identify gamification strategies that are employed in mobile applications.

This article has three sections. Section II stipulates methods for selecting studies that meet the criteria proposed in this systematic review of the literature. Section III presents the results obtained in the previous section, analyzed and discussed in order to gain further insight into the research questions.

II. METHODS

The present study is a systematic literature review (SLR), which refers to a way of identifying, evaluating and interpreting all relevant research available for a specific research question, issue or phenomenon of interest [17].

A. Research Question

To meet the objective of the study, three research questions were elaborated:

- Q1. Which gamification strategies are being employed in mobile applications?

- Q2. How was the implementation of these strategies evaluated?
- Q3. What were the results of these evaluations?

These questions allow filtering fields of knowledge and gamification mechanisms used in mobile application development, in addition to exploring the assessment models adopted and the effectiveness of embedded elements.

B. Criteria, Databases and Search Term

For the search and selection of the relevant studies, a strategy was elaborated with keywords relevant to the context. The keywords were grouped using the search string: “(A1 OR A2 OR A3) AND (B1 OR B2 OR B3 OR B4 OR B5 OR B6) AND (C1 OR C2 OR C3)”. Table I shows the search terms that comprise the string.

TABLE I. SCAN TERMS TO IDENTIFY RELATED STUDIES

A1. gamification	B1. strategy	C1. Mobile
A2. gamified	B2. technique	C2. smartphone
A3. gamifying	B3. mechanism	C3. Tablete
	B4. method	
	B5. recommendation	
	B6. practice	

There was no change in the search key from one database to another. Searches were limited to title, abstract and keywords in the following electronic databases: Springer, ACM, Science Direct, IEEE, Web of Science and Scopus, considering the specific functionality of each indexer. Eligible criteria for the search were articles written in English and Portuguese and published until May 2016 and month in which the research on the databases was performed. The systematic review protocol selected explicitly defines eligibility criteria for inclusion in the final analysis of the studies, as shown in Table II.

TABLE II. ELIGIBILITY CRITERIA.

- (1)Especificação de estratégias/mecanismo/técnicas de gamificação.
- (2)Desenvolvido para aplicações móveis.
- (3)Elementos de design de jogo em um contexto de não-jogo

C. Selection Process of Primary Studies

selection process was performed in two stages:

- Phase 1: Papers found after the application of the search string in the databases were evaluated for their suitability, from the title, abstract and keywords. At this stage, the publications that did not clearly meet the criteria were excluded.
- Phase 2: Publications identified during Phase 1 were submitted to a more thorough analysis that included reading the methods, conclusions or even the full text, ensuring the publication definitely contained information relevant to the study.

III. RESULTS

402 papers were identified in the databases surveyed from the search strategy adopted. 15 articles were removed for being duplicates, as shown in Fig. 1.

Fig. 2 represents each database selection process. The blue color represents the papers retrieved from each consulted database; the red color shows the number of studies that passed the selection process first stage. Finally, the number of papers that were included in this SLR are in green.

Fig. 3 shows all the papers from Phase 1 according publication year. 2015 was the most published year, totaling 64, which reinforces the growing interest in the area.

Figure 1. Selection Process.

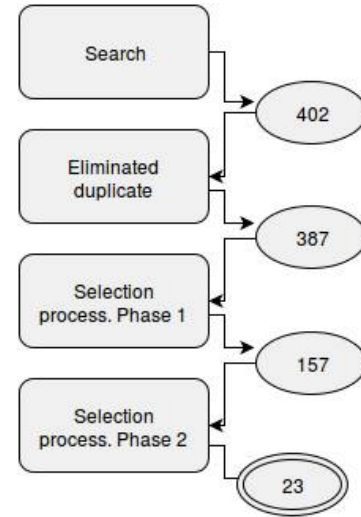


Figure 2. Databases and studies.

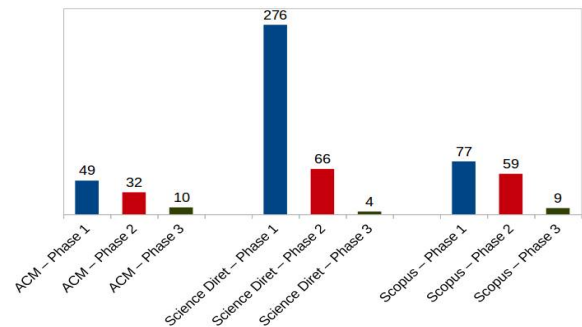
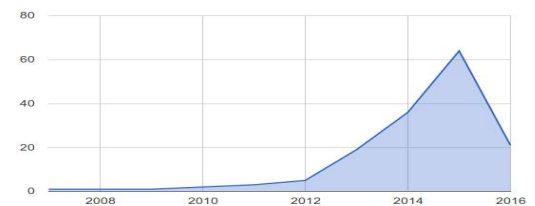


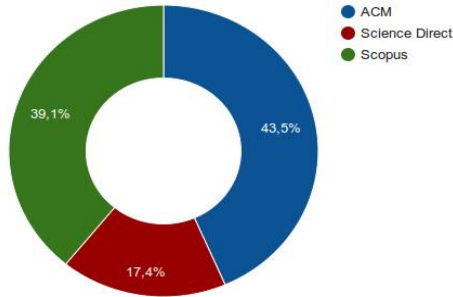
Figure 3. Papers published in relation to the year of publication.



In the second stage, 134 studies were excluded. In the end, 23 papers were selected, getting through all selection stages and suiting the criteria, as shown in Table III.

Percentage of the selected studies according to each database is shown in Fig. 4. Due to the amount of duplicate studies obtained from Scopus database, totalizing 7, ACM was the indexer that provided the greatest number of studies for this SLR.

Figure 4. Percentage of selected studies according to databases.



C. Research Results

Given the presented research results, it is possible to analyze the research questions.

- RQ1. Which gamification strategies are being employed in mobile applications?

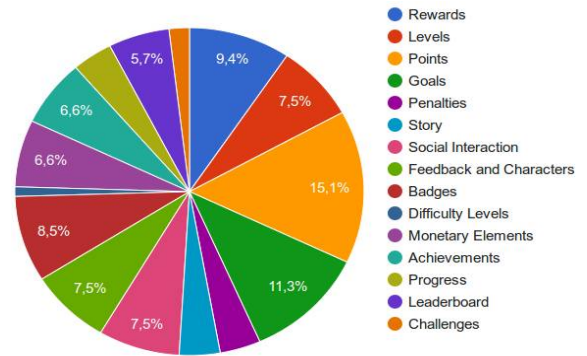
Table IV shows the elements found in each study. Fig. 5 shows 15.1% of studies incorporated a point system as a way to gamify the applications. This element aims to give bonuses to the user for each task performed, keeping the interest in achieving more points and getting to next phase in other elements, as in levels, leadership table, among others.

According to Table IV, a few studies incorporated considerable amount of elements in their application, such as Browne and Anand [18]. Rewards, levels, points, goals, penalties, narratives, social interaction and feedback were essential for the successful completion of the application tasks for 5 out of 6 participants. The one unable to complete the tasks was distracted by external factors.

Liu et al. [8] explains two case studies to evaluate gamification efficacy. The first is a crowdsourcing application and the other is an ecological awareness application, both having different game elements. While the first application has points, rewards and badges, the second has goals, feedback, achievements, as well as rewards. Therefore, if the users do not have environmental concerns, they will not use the application, aside system game mechanics. On the other hand, game components have less influence for those users who already are deeply interested in collecting data by crowdsourcing.

Another element generally used by the studies are badges, these are used to identify user achievements and can be conquered with the help and collaboration of other participants, according to Law et al. [25] and Su and Cheng [38] studies, or individually, as seen in other studies shown in Table IV.

Figure 5. Gamification Elements.



Social interactions represent 7.5% of selected studies. Most applications were positively evaluated in this regard, but authors such as Browne and Anand [18] reported negative feedback on the time taken to run the game with more than one player. Both Thiel and Lehner [39] rated "low relevance" to some participants. Moreover, social interaction or competition did not appear to be prominent, even unnoticed by participants. This may have occurred because of the limited testing time with participants who were unfamiliar with the application.

TABLE III. ELIGIBILITY CRITERIA.

Title – Authors	Year	Study Area	Platform
Gamification and serious game approaches for introductory computer science tablet software - Browne, Kevin and Anand, Christophe [18]	2013	Education	Tablet
Using gamification to motivate children to complete empirical studies in lab environments - Brewer, Robin and Anthony, Lisa and Brown, Quincy and Irwin, Germaine and Nias, Jaye and Tate, Berthel [20]	2013	Education	Mobile
HealthyTogether: exploring social incentives for mobile fitness applications - Chen, Yu and Pu, Pearl [32]	2014	Physical Activities	Mobile
Gamifying intelligent environments - Liu, Yefeng and Alexandrova, Todorka and Nakajima, Tatsuo [8]	2011	Data Collection by Crowdsourcing and Ecological Awareness	Mobile

Driven to drive: Designing gamification for a learner logbook smartphone application - Fitz-Walter, Zachary and Wyeth, Peta and Tjondronegoro, Dian and Scott-Parker, Bridie [19]	2013	Learn to Drive	Smartphone
ICTs in Rural Education: Let the Game Begin - Botha, Adele and Herselman, Marlien [27]	2015	Education and Agriculture	Tablet
The ecoGator app: gamification for enhanced energy efficiency in Europe - Peham, Melanie and Breidfuss, Gert and Michalczuk, Rafael [29]	2014	Ecological Awareness	Mobile
Crowdsourcing Urban Accessibility: Some Preliminary Experiences with Results - Salomoni, P and Prandi, C and Rocchetti, M and Nisi, V and Nunes, N Jardim [21]	2015	Data Collection by Crowdsourcing	Mobile
Exploring the effects of game elements in m-participation - Thiel, Sarah-Kristin and Lehner, Ulrich [39]	2015	Education	Mobile
Health gamification - Vicente, Oliver and Vicente, Sandra and Martin, Daniel and Rodriguez-Florida, Miguel Angel and Maynar, Manuel [22]	2014	Health	Mobile
Gamification and serious game approaches for adult literacy tablet software - Kevin Browne [28]	2014	Education	Tablet
RANTORE: A Strategic Exertainment System Using Location Information - Jun Munemori [33]	2013	Physical Activities	Tablet
Gamifying French Language Learning: a case study examining a quest-based, augmented reality mobile learning-tool - Bernadette Perry [35]	2015	Education	Mobile
Explora México: A mobile application to learn Mexico's Geography - Pablo Ramírez [23]	2013	Education	Mobile
Mobile technology and Gamification: The future is now! - Sylvia Chin [24]	2014	Education	Mobile
Designing a Gamification Mechanism to Encourage Contributions in a Crowdsourcing System - Flavia A. de França [30]	2015	Data Collection by Crowdsourcing	Mobile
Bloodhub: A Context Aware System to Increase Voluntary Blood Donors' Participation - Setiawan, MukhammadAndri and Putra, HeruHangtry [36]	2015	Health	Mobile
A mobile gamification learning system for improving the learning motivation and achievements - Su, C-H and Cheng, C-H [38]	2015	Education and Ecological Awareness	Mobile
Gamification towards Sustainable Mobile Application Foong - Law, Foong Li and Kasirun, ZarinahMohd and Gan, Chun Kiat [25]	2011	Traffic Accidents Prevention	Mobile
Group-based mobile learning: Do group size and sharing mobile devices matter? - Melero, Javier and Hernández-Leo, Davinia and Manatunga, Kalpani [31]	2015	Education	Mobile
Gamification for Behavior Change: Lessons from Developing a Social, Multiuser, Web-Tablet Based Prevention Game for Youths - Schoech, Dick and Boyas, Javier F and Black, Beverly M and Elias-Lambert, Nada [34]	2013	Violence Prevention	Tablet
Treasure Hunt Game to Persuade Visitors to Walk around a Shopping Mall - Wakao, Asuka and Matsumura, Kohei and Suzuki, Mao and Noma, Haruo [37]	2015	Entertainment	Mobile
Virtual learning scenarios for qualitative assessment in higher education 3D arts - Vicent, Llus and Villagrasa, Sergi and Fonseca, David and Redondo, Ernest [26]	2015	Entertainment	Mobile

Fig. 6 shows percentages of selected studies according to technologies where gamification was implemented. The authors chose to deploy their mobile applications in different platforms, 21.7% specifically for Tablets, 73.9 % for Tablet and Smartphone and only one study was developed exclusively for smartphones.

RQ2. How were the implemented strategies evaluated?

In order to validate the gamification elements included in the studies, the authors used evaluation tools. Such tools are shown in Fig. 7. Considering the graph, most studies opted not to use evaluations tools. However, for the authors that included

evaluations in their studies, eight chose to apply questionnaires to the users.

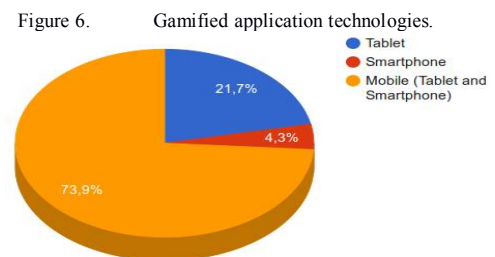
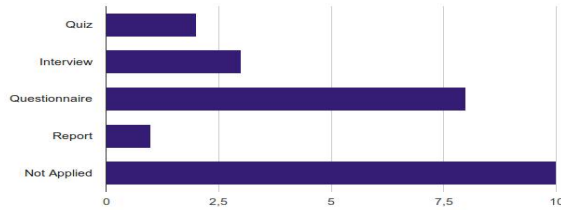


TABLE IV. GAMIFICATION STRATEGIES.

Strategies	Definition	Studies
Rewards	Bonuses for achieving certain goals	[18][19][20][8][21][22][23][24][25][26]
Levels	Stages to be reached, advancing to the next	[18][27][28][29][22][30][31][26]
Points	Ratings for achievement of tasks	[33][34][18][32][8][29][21][22][35][24][30][36][25][31][37][26]
Goals	mandatory tasks to be performed	[18][27][28][35][33][34][19][8][25][21][24][38]
Penalties	Points or penalty loss for error committed	[18][34][19][37]
Story	Plot of activities in the application	[18][27][29][35]
Social interaction	direct competition with other application users	[18][27][33][29][35][39][22][24]
Feedback and Characters	Game assistance for task accomplishment	[18][8][22][35][23][24][31][37]
Badges	Identification of collection of achievements	[27][28][8][29][35][24][38][25][26]
Difficulty levels	game mode between easy, medium and hard	[27]
Monetary elements	Treasures, medals, coins and virtual bonuses	[33][34][29][23][30][31][37]
Achievements	Scope and unlocking objectives	[19][8][29]
Progress	Toolbar to track activity progress	[39][22][24]
Leaderboard	Ranking with the best user performance	[29][22][24][30][38][25]
Challenges	Obstacles to be overcome	[39][35]

Figure 1. Evaluation methods of gamification elements.



- RQ3. What were the results of these evaluations?

All thirteen studies using gamification evaluation methods of elements reported success in their results, especially in the motivation and engagement of users. Browne et al. [18] reported that in applications where gamification was incorporated, result was 'fun' and 'interactivity'. Another relevant point is Feedback, when not implemented, participants reported problems in understanding the goals. Apps that did not incorporate gaming elements were considered 'boring'.

Fitz-Walter [19], Peham et al. [29], Munemori et al. [33], Setiawan and Putra [36], Su and Cheng [38], Melero et al. [31] and Vincent et al. [26] concluded that addition of gamification elements in general resulted in achieving the user motivation.

Salomoni et al., Browne et al. [21,28], Thiel and Lehner [39], Yu and Pu [32], result was obtained by using specific elements such as rewards, missions and competitiveness. Users of the Perry [35] application evaluated the elements of virtual characters, quests, badges and collaborating social as "fun", "useful", "motivators" and "relevant".

IV. CONCLUSIONS

32 studies showing gamification strategies being used in mobile applications were identified. From the results analysis, selected studies incorporated fifteen different elements, "score" being the most commonly used element, and "difficulty levels" less chosen. There is no consensus on what elements to use, the developer is free to decide which gamification methods are most appropriate for a determined application.

The absence of evaluation in most applications shows the lack of evidence on effects of gamification elements implied in the study. However, among the studies that performed an evaluation, either through a quiz, interview or questionnaire with users, gamification proved to be a motivating factor, an effort to promote fun and entertainment, thus resulting in accession and acceptance by application users.

This SLR was performed to identify, evaluate and interpret all relevant research available on gamification elements in mobile devices applications, supporting a theoretical basis on the subject to be applied in practice as a master's degree in Applied Computing.

As future work, the present study offers a basis for a research on gamification methods and the importance of game elements in non-game applications to make users more engaged and motivated while interacting with mobile applications.

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