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Development of a gamification characteristics measurement scale for mobile application users

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ABSTRACT

The objective of this article is to present the development of a gamification characteristics measurement scale for mobile application users. The developed model was inspired by the framework called Octalysis created by Yu-kai Chou. Defined a preliminary version of the scale, it was necessary to carry out the face validation procedure conducted with 12 judges. After this initial phase, the purification of the scale was chained, via calculation of the reliability, and the application of the model from a pre-test conducted with 30 respondents. The next step was to implement a survey that was attended by 452 respondents from all over the country. The quantitative research approach followed an exploratory descriptive phase and another subsidized by the application of Structural Equation Modeling. As a result, the judges confirmed 6 of the 8 proposed constructs of the original model, and through analyzes carried out along with the sample of mobile application users, it was possible to verify that these 6 confirmed constructs confirmed the statistical significance of the scale developed. Therefore, the model proposed in this study is consistent and can be applied in future research.

1. INTRODUCTION

Games have always been one of humanity's common pastimes. With the constant advances of the digital era and the dissemination of the internet, it was not difficult to imagine that electronic games would prevail and spread (Terlutter & Capella, 2013).

In 2011, people were already spending an average of three billion hours a week gaming, and this number has only increased. This is because a game is an opportunity for individuals to concentrate their energy on something at which they excel and that distracts them from their craving for work that is more satisfying, a stronger sense of community and a more meaningful life (McGonigal, 2011).

New technologies have been created to inspire people's motivation and help them to develop beneficial behaviors, both individually and collectively. The most popular trend in this respect is gamification, which is using technologies that are engaged in promoting intrinsic motivations by using a number of characteristics found in games (Kim, 2015).

The scientific literature in the last five years has introduced few models that have been applied to find explanations for the effects of gamification. Jorge and Sutton (2016) developed a gamification model called Funication, which enables organizations to transform their internal environments into gamified environments. The other models found in the literature serve as guides for practical gamification practices, such as the Gamified ID Model, created to provide orientation for a gamified course project and its development (Asleitner, 2000; Becker, 2015).

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Thus, due to the scarcity of models proposing the measurement of gamification characteristics, this work seeks to contribute to the field with an original model based on the framework developed by Chou (2014), with empirical testing. Therefore, this work proposes to study gamification techniques that have been used in applications for mobile devices by their users. The aim is to develop a scale of gamification characteristics for users of applications in mobile devices.

The Gartner Group consultancy, in its article entitled *The use of game mechanics and experience design to digitally engage and motivate people to achieve their goals*, claimed that gamification goes beyond simple traditional entertainment in game form. Its elements can be used to motivate people and engage them in different goals, such as learning, development and problem solving (Lee & Hammer, 2011; Burke, 2015). Furthermore, the *Gamification Market* report by the Solution consultancy (2016) reinforces the estimate of growth in the gamification market, from US$ 1.65 billion in 2015 to US$ 11.10 billion in 2020.

Researchers have argued that the use of mobile apps is an evolution in the form of applications for social media services, especially in light of the integration of different applications (Hong *et al.*, 2013; Oghuma *et al.*, 2016). This suggests that the use of applications in mobile devices (smartphone or tablet) is not only a utilitarian aspect oriented for specific tasks, but can also encourage people to reflect more the communication process. Actually, a strong demand for gamification can already be seen in these mobile apps. According to the study conducted by Andriotis (2014), 79% of young people consider university or work activities more productive if they are similar to a gamified game in an app for mobile devices.

Therefore, this article seeks to present the theme of gamification, as due to the low number of scientific publications in this field, it has yet to be widely diffused in schools of management, being restricted to technology courses. For the same reason, few models have been applied to find explanations for the effects of gamification. In this perspective, the opportunity emerges to propose a protocol for constructing scales to measure the characteristics of users of apps in mobile devices.

The article is structured as follows. The theoretical framework identified in the literature is presented, followed by the methodological procedures, data analysis and conclusions.

2. THEORETICAL FRAMEWORK

In this section, the theoretical concepts and studies on which this research is based are presented. To facilitate understanding, the referential framework has been subdivided into two main subjects: the general context of games and gamification; and the characteristics of gamification.

2.1 The general context of gamification

Games have been used to exercise the mind, entertain children and adults and integrate people socially for thousands of years (Terlutter & Capella, 2013). With the spread of electronic games and smartphones, the importance and role of games in society have grown rapidly. The recent propagation of games beyond entertainment, to areas such as marketing and education, has proved to be a key factor of economic and social reality (Jagoda, 2014).

Games are structured and challenging systems that make learning gratifying. They enable deeper engagement, a sense of autonomy and allow users to be the heroes in their own stories. Setting aside the differences found in each genre of game and their technological complexities, all games share four characteristics that define them: goals, rules, feedback system and voluntary participation (Salen & Zimmerman, 2003; McGonigal, 2011; Vianna *et al*., 2013; Chang & Wei, 2016).

Gamification is the use of technologies engaged in promoting intrinsic motivations by using diverse characteristics of games in other domains outside the entertainment industry, such as education, public administration, marketing, politics and health. It is an emerging trend derived from the huge popularity of games and their intrinsic ability for call to action to solve problems or enable learning in different fields and in people's lives (Hunter, 2012; Schell, 2014; Kim, 2015).

Therefore, gaming uses a range of characteristics found in games. Thus, it is often difficult to differentiate between a game for a service or an application that uses gamification. Nevertheless, it is important to emphasize that creating a gamified solution does not mean developing a game (Fardo, 2013). Thus, gamification uses some of the defining

characteristics of games, so that the final result is not a complete game.

2.2 The characteristics of gamification

Gamification uses a range of elements from games to stimulate motivation. These include points, leaderboards, badges, virtual currency, narratives and avatars (Dicheva *et al.*, 2015). Authors who study gamification often use structures or frameworks of elements that are created to make the process clearer and more organized. This is a way to study the application of gamification in products that have already been launched and to guide its use in new products and projects.

The framework chosen to guide this study is known as Octalysis (Figure 1). Originally published in 2014, this structure is based on an octagon with eight gamification drivers, each representing one of the sides. This framework was created by Yu-kai Chou, an international gamification lecturer. The author has conducted business research at innovative organizations like Google, Stanford University and TEDx (TEDxLausanne in 2014). In 2015, he was classified as #1 among the *Gamification Gurus Power 100* by *RISE*, and was awarded the Gamification Guru of the Year Award in 2014 and 2015 by the Gamification World Congress, based in Europe.

The first driver is **Epic Meaning & Calling**. It is associated with the implementation of the significant goal in which people can believe they are contributing to something bigger than they are, or that they were chosen to do something. The main concept of this driver is to combine users' aims with the altruistic characteristic of human nature (Kanov *et al.*, 2004). By combining these two elements, a behavioral path to altruism is created, which is a reward for users through actions that benefit the whole community (Zichermann & Cunningham, 2011).

Development and Accomplishment is the second driver and is related to the sensation of progress, development of skills and achieving complex goals followed by a reward or feeling of great

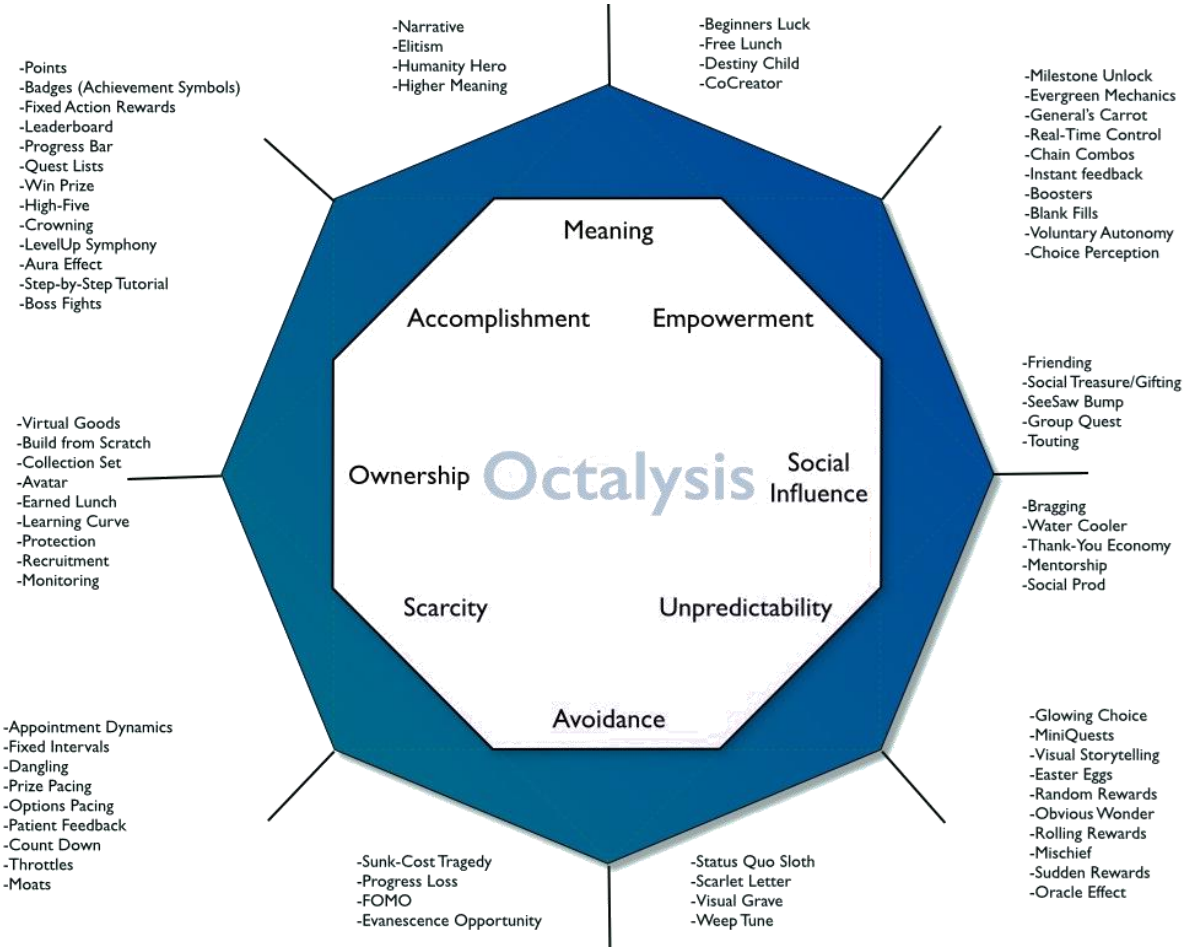

Fig. 1
Octalysis Framework (Chou, 2014).

accomplishment. This is the most commonly used driver in gamification projects, normally using techniques for points, badges, progress bars and leader boards. The human brain has a natural desire to experience progress, growth and rising numbers (Sailer *et al*., 2013). In games, players normally begin at very simple levels and move up to the more complex ones, creating a system intended to encourage the continuation of the game (Medler, 2011). Performance indicators provide players with additional goals, encouraging friendly rivalry and comparisons between users (Montola *et al*., 2009).

The third driver, Empowerment of Creativity, is used to involve users in a creative process to express their individuality. They need to discover different forms of approaching a challenge and attempt to reinvent the system at will. People want and need opportunities to express their autonomy and originality. Individuals desire chances to distinguish themselves from those around them. This feeling is directly linked to the human desire to show a sense of style, identify and personality, and show that they identify with a group or community (Kapp, 2012; Zichermann & Cunningham, 2011).

Ownership and Possession is the fourth driver. It is associated with motivating people who are directly related to so-called "virtual goods" or "virtual currency", the use or trade of which has become extremely popular and an important model of recipes for online services, social networks or massively multiplayer online games (Hamari & Lehdonvirta, 2010). Lehdonvirta, Wilska & Johansson (2009) examined the ownership of virtual items from a sociological perspective and, in a case study, discovered that virtual goods are normally used to show distinctions between people.

Social Influence is the fifth driver of the Octalysis model. It is related to activities inspired by what people think, do or say to each other, and includes all the social elements that motivate them: acceptance, competition, envy, the need not to feel excluded and companionship. An important source of knowledge of oneself lies in comparison with others (Wood, 1989; Gilbert *et al*., 1995; Nan, 2008; Suls *et al.*, 2002). In gamified applications, users win points and are classified based on the total number of points accumulated, and the exhibition of other people's performance is common (Vorderer *et al*., 2003).

The sixth driver is Scarcity & Impatience, in which the key concept is that people want something they cannot have because it is difficult to obtain immediately. There are two kinds of techniques involving scarcity: limited amount and limited time. Limited amount is a technique in which individuals are told that the product, service or action cannot be guaranteed due to limited stock (Cialdini, 1985).

Unpredictability & Curiosity is the seventh driver. It includes techniques that flirt with users' desire to discover what will happen (Zichermann & Cunningham, 2011). Gamification uses curiosity through actions that offer surprise rewards a stimulus in people to know that they can win something at any time while they play (Hidi *et al.*, 2004; Marczewski, 2016).

The eighth and final driver of the Octalysis structure, Loss & Avoidance, is based on loss aversion theory, when individuals are more greatly motivated to act when they risk losing something rather than winning something (Kahneman & Tversky, 1979). In other words, if there is a small chance of people losing something rather than winning it, they will do whatever possible to avoid the loss (Ariely *et al*., 2005).

3. METHODOLOGICAL PROCEDURES

This section presents the study design, containing the development of the scale, the research subject, its instruments, procedures and data treatment and the proposed models.

3.1 Development of the scale, concept and generation of items

The proposed protocol was constructed to present the logical steps towards the construction of a gamification characteristic measurement scale. It is incremental in nature and the fruit of the knowledge and critical analysis of the principal studies in this field. Every stage in the preparation of the scale is discussed in the following sections.

The preparation of the measurement scales involved constructing an instrument and associating the qualitative concepts with the quantitative metrics. In other words, attributing numbers to objects according to a determined rule (Pooja & Sagar, 2012), seeking to discipline the study of the phenomenon. With these guidelines, a protocol for preparing the scales is an organized set of stages to follow, using selected techniques to construct a valid measurement scale (Rossiter, 2002).

The preparation of any scale begins with defining its constructs, as without a correct definition of what will be measured, any measurement will be inaccurate. In this sense, a construct is considered a conceptual term to describe a phenomenon of interest theoretically (Edwards & Bagozzi, 2000).

Initially, an in-depth research of the literature available in scientific databases was conducted, enabling a clear view of the theme in terms of scientific research, identifying the best models for evaluating the proposed dimensions. Thus, the constructs of this study were based on the Octalysis model. As proposed by Chou (2014), eight constructs were used to evaluate the proposed dimensions: Epic Meaning and Calling; Development and Accomplishment; Empowerment of Creativity; Ownership; Social Influence; Scarcity and Impatience; Unpredictability and Curiosity; and Loss and Avoidance.

The generation of items for this new scale was based on this model, from which 74 items were initially generated for distribution in the eight previously determined analysis dimensions, following semantic adaptation to the constructs as a fundamental criterion, maintaining with these a clearly reflective relationship enabling the correct measurement of the scale (Jarvis, Mackenzie & Podsakoff, 2003). After arriving at a preliminary version of the scale, a face validation was required (DeVellis, 2003). The face validation was strengthened by the judges (Malhotra, 2014).

As suggested by Hardesty and Bearden (2004), the objective of this stage was to observe the agreement among the group of guest specialists, referred to here as judges, with the scaling ability to measure each construct and determine whether the items of the scale were clear and adequate for the estimate. It was also necessary to determine their ability to calculate the reliability of the scale in the second stage (Gountas *et al*., 2012).

The use of two phases in the purification stage is mentioned in studies like that of Gountas *et al*. (2012), as the stages are complementary and the face validation has the advantage of having an instrument more likely to be approved by statistical testing.

The face validation procedure initially included inviting judges (specialists) to return the questionnaire forwarded by e-mail. To achieve greater objectivity during the face validation, the judges were asked to complete three forms (Positive Motivation Face Validity, Neutral Motivation Face Validity and Negative Motivation Face Validity), in which they marked a number in each of the items relating the constructs with their respective assertions, which were randomly arranged (DeVellis, 2003; Hardesty & Bearden, 2004). The evaluation of the ability to relate the variable to the construct was given a score. Scores of 0.65 or over were considered acceptable as levels of convergent agreement (Stratman & Roth, 2002) or over 0.80 in accordance with Hair *et al.* (2006).

The aim of this stage, as stated by DeVellis (2003) and Bright *et al.* (2012), is to gauge, in a group of specialists, whether the items on the scale can be considered adequate for measuring a construct. After defining the face validation, by preparing the protocol, the purification of the scale is begun by calculating the reliability of the application of the model by electronic questionnaire to a sample of respondents. In the case of this study, this phase was aided by the application of Structural Equation Modeling (SEM).

To form the panel of judges, 20 professionals with academic and scientific production were invited by convenience, seeking individuals that matched the desired profile of the study, i.e., researchers and/or professionals directly involved in gamification. All the professionals that were contacted agreed to participate. However, 8 of these did not return to the study and did not sent their responses.

When the research instrument was ready, it was sent to the twenty experts for content analysis of its items. They were asked to consider the form of presentation, how easy it was to read, the comprehension and clarity of the items and conceptual relevance (scope of content) in terms of gamification.

The judges were invited to participate in an e-mail forwarded by the researcher. The e-mail included the title, goals of the study and form of evaluation of the instrument. The judges were asked to return the instrument within fifteen days. Twelve reports were received within the deadline. Following receipt of these reports from the judges (experts in the field), a descriptive analysis of the responses was conducted regarding the items of the proposed instrument. From this analysis, adjustments were suggested and made. All the judges are researchers whose work has been published at conferences and in important

scientific periodicals in the field or who belong to gamification research groups.

In short, the experts agreed that the proposed instrument included gamification characteristics and that the items cover the aspects that permeate the proposed constructs. This procedure resulted in some corrections in the wording to facilitate understanding, pointing out items of little relevance, and the exclusion of two constructs: "Empowerment of Creativity" and "Scarcity and Impatience". After the face validation, all the items were reassessed based on the suggestions and criticisms in the questionnaires completed by the judges, with 33 items remaining, subdivided among the 6 main dimensions. There were 4 statements for "Epic Meaning and Calling", 7 for "Development and Accomplishment", 6 for "Ownership", 6 for "Social Influence", 6 for "Unpredictability and Curiosity", and 4 for "Loss and Avoidance".

3.2 Participants, collection instrument, procedures, data treatment and validity

The population analyzed was made up of people who used mobile apps in smartphones to one degree or another. The data were collected by convenience, resulting in a non-probabilistic sampling technique. This limits the generalization of the outcome of this study (Kim & Malhotra, 2005).

The present study was based on data collected in a survey, adapted to test the scale model developed by the author, as described above. This data collection instrument was made up of 46 statements that were answered using a Likert scale, with end points ranging from 1 = I totally disagree to 5 = I totally agree. There are also demographic questions. The questionnaires were completed by the respondents in the presence of the researchers following a brief introduction to the study.

The data collection instrument was prepared in an electronic format with the purpose of presenting the measurement items identified in the previous phase of the study to the participants. The data collection involved an electronic questionnaire that was self-applied online using the TypeForm platform through a link. The questionnaire could be completed using mobile or desktop devices. The link to access the questionnaire was made available on Facebook and online discussion forums, such as the UOL Forum and Outerspace Forum, intentionally chosen as their discussions mostly focused on games and technology. The data were collected between August and October 2016.

Hair *et al.* (2006) highlights that the sample size for pre-testing should involve a minimum of four and a maximum of thirty individuals. Malhotra (2014) claims that the sample size for pre-testing should vary between fifteen and thirty interviewees. Thus, the model was submitted for pre-testing with 30 research subjects to gauge whether they understood the research instrument. The next step was to apply the survey to a larger sample. A total of 452 questionnaires were returned. There was no need to exclude any questionnaires because of incorrect completion or blank spaces.

For this study, models based on Partial Least Squares (PLS) were chosen. Due to the presence of abnormal distribution in the data sets of several variables in the sample, a decision was made to use the Partial Least Squares Structural Equation Modeling (PLS-SEM) approach, leading to the use of the Smart-PLS Professional v.3 application.

3.3 Validation model of the gamification characteristics

The proposed research model in this study (see Figure 2) was developed based on the Octalysis Framework created by Chou (2014), in which the gamification characteristics are subdivided into eight different previously presented constructs that were adapted in accordance with the face validation.

Fig. 2
Final validation model of the gamification characteristics
Source: Prepared by the authors.

Tab 1
Detalhamento dos Construtos

Construct[1]	Octalysis[2]	Description	Main references
Purpose	*Epic Meaning & Calling*	This construct is associated with people's motivation to believe they are contributing to a higher purpose or that they have been chosen to do something.	Kanov *et al.* (2004) Zichermann e Cunningham (2011)
Development	*Development & Accomplishment*	This construct is related to the feeling of progress, development of skills and achieving complex goals followed by a reward or feeling of great achievement.	Montola *et al.* (2009) Medler (2011) Sailer *et al.* (2013)
Ownership	*Ownership & Possession*	Construct associated with people's need to feel that they own something in the application or some aspect of it. It is based on the principle that when we own something, we feel a need to improve it, protect it and get the most out of it.	Lehdonvirta *et al.* (2009) Hamari e Lehdonvirta (2010)
Social Influence	*Social Influence*	This construct is related to activities inspired by what people think, do and say to each other.	Wood (1989) Gilbert *et al.* (1995) Suls *et al.* (2002) Vorderer *et al.* (2003) Nan (2008)
Unpredictability	*Unpredictability & Curiosity*	This construct is associated with curiosity and the unexpected. It uses people's desire to find out what is going to happen.	Hidi *et al.* (2004) Zichermann e Cunningham (2011) Marczewski (2016)
Purpose	*Loss & Avoidance*	This construct is related to the fear of losing something in a negative event. It is directly linked to loss aversion theory.	Kahneman e Tversky (1979) Ariely *et al.* (2005)

Observations: [1]Proposed model adapted from Chou (2014); [2]Nomeclature from Chou (2014).
Source: Prepared by the authors

Table 1 shows in detail the construct present in the final composition of the validation model of the gamification characteristics proposed in this study.

4. ANALYSIS OF THE RESULTS

This section contains the descriptive and estimative analyses of the structural model in relation to the latent variables and their implications for the results.

4.1 Characterization of the respondents

The characteristics of the respondents are shown here to contextualize the socio-economic reality of the participants in this study. Table 2 shows detailed information on gender, age group, region of the country, education level and family income.

An analysis of the demographic data shows that most of the respondents are male, corresponding to 63.05% of the sample. Of the respondents, 80.53% are aged 16 to 30. Although the respondents are from all regions of Brazil, most of them (71.68%) live in the southeast of the country, 60.84% are undergraduates and 23.67% have a family income between R$ 4,427.36 and R$ 8,695.88.

Both genders were equally distributed among the socio-economic divisions, with most ranging between R$ 2,409.01 and R$ 8,695.88 (male 45.1%, female 46.4%), with the exception of the R$ 8,695.88 to R$ 20,272.56 income bracket, which included more males. Furthermore, the north and northeast regions had a similar socio-economic division, with most in the R$ 4,427.36 to R$ 8,695.88 bracket. The Midwest had the highest rate of respondents in the R$ 639.78 to R$ 1,446.24 bracket. On the other hand, the south had a higher concentration of interviewees in the R$ 4,427.36 to R$ 20,272.56 bracket.

4.2 Premises for the use of structural equation modeling

In multivariate analysis techniques that use metric variables and statistical tests, multivariate normality is the fundamental condition for application. The normality of the data was verified by observing the kurtosis and asymmetry present in the data sample using the Kolmogorov-Smirnov test and the respective p-value of each variable. This procedure was necessary to limit the possible use of some statistical analysis techniques that have normal data distribution as a characteristic. Regarding the predictive variables related to the latent "gamification" variable in the context of the theme of this study, it was possible to accommodate

multicollinearity in the model (all the Variance Inflation Factors (VIFs) were below 5, as the lowest VIF was 1.083 and the highest 2.144). All the p-values of the test regarding the indicators were significant, with p<0.01. Moreover, the result of the normality test, by not finding adherence of the data to Gaussian distribution, corroborated the structural model estimation by analyzing the correlation of the variables in partial least squares (Hair *et al*., 2014; Ringle *et al*., 2014).

Tab. 2
Characterization of the respondents

Charact.	Type	N	Freq. (%)
Gender	Male	285	63,05
	Female	167	36,95
	Total	**452**	**100**
Age group	From 16 to 20	86	19,03
	From 21 to 25	195	43,14
	From 26 to 30	83	18,36
	From 31 to 35	45	9,96
	From 36 to 40	21	4,65
	From 41 to 45	8	1,77
	From 46 to 50	2	0,44
	From 51 to 55	5	1,11
	From 66 to 70	2	0,44
	Missing	*5*	*1,11*
	Total	**452**	**100**
Region of the country	North	19	4,20
	Northeast	29	6,42
	Midwest	31	6,86
	Southwest	324	71,68
	South	46	10,18
	Missing	*3*	*0,66*
	Total	**452**	**100**
Education	High school (incomplete)	2	0,44
	High school (concluded)	23	5,09
	Undergraduate	275	60,84
	Graduate	81	17,92
	Doing post-graduation	24	5,31
	Post-graduation concluded	44	9,73
	Missing	*3*	*0,66*
	Total	**452**	**100**
Family income	Under R$ 639,78	5	1,11
	R$ 639,78 to R$1.446, 24	30	6,64
	R$ 1.446,24 to R$ 2.409,01	48	10,62
	R$ 2.409,01 to R$ 4.427,36	99	21,90
	R$ 4.427,36 to R$ 8.695,88	107	23,67
	R$ 8.695,88 to R$ 20.272,56	71	15,71
	Over R$ 20.272,56	17	3,76
	Missing	*75*	*16,59*
	Total	**452**	**100**

Source: Prepared by the authors.

4.3 Analysis of the gamification characteristics model

The analysis of the measurement model should precede the analysis of the relationships between the latent variables. During the first iteration, to analyze the convergent validity, the results of the factor loadings for each latent variable showed that two variables had values under 0.5 (Ringle *et al*., 2014). In this case, it was necessary to eliminate the variables OWNP01 (0.362) and DEV06 (0.454), allowing the adaptation of the model. The next step was to examine the Average Variances Extracted (AVE) and the quadratic correlations between the constructs, the convergent validity and the composite reliability.

After the initial adjustments of the model, in some constructs the AVEs were found to have values of less than 0.5. According to ingle *et al.* (2014), in these situations, it is necessary to eliminate variables observed or measured in the constructs with low factor loading. To raise the value of the AVE it is necessary to eliminate variables with lower value factor loadings. In this case, the eliminated variables were: DEV05=0.629; AV02=0.655; UNP04=0,538; SI02=0.584; OWN03=0.348; OWN05=0.572; and DEV02=0.659 to raise the value of the AVE.

In this sense, it was possible to adjust the model and all the latent variables had an Average Variance Extracted higher than 50%, meeting the criteria for indicating the convergent validity on the proposed measurement scale (Appendix 1).

Given that all the variables in a questionnaire use the same measurement scale, the coefficient is calculated from the variance of the individual items (Table 3). The Cronbach's alphas varied from 0.549 to 0.758. Values over 0.60 up to 0.75 are considered moderate, and from 0.75 to 0.90 high. The composite reliability consists of the evaluation conducted from the results obtained from the confirmatory factor analysis model for the measurement coefficients and measurement errors. Thus, the composite reliabilities ranged from 0.763 to 0.838, which is considered "very good". For this model, the AVEs varied from 0.511 to 0.581. Furthermore, the R^2 value measures the predictive accuracy of the model, representing the combined effects of the endogenous variables on the exogenous variables. In the present study, the R^2 value demonstrated that the model has predictive relevance and accuracy in all the constructs, which means substantial predictive accuracy analyzing the variables in question (Malhotra, 2014).

Tab. 3
Analysis of the relationships between the constructs

Constructs	Nº Items	Cronbach's Alpha (>0,7)	Composite Reliability (>0,7)	(AVE) (>0,5)	R^2
Development	4	0,723	0,828	0,546	0,629
Avoidance	3	0,549	0,763	0,520	0,409
Unpredictability	4	0,737	0,835	0,560	0,676
Social Influence	5	0,758	0,838	0,511	0,486
Ownership	4	0,716	0,825	0,541	0,607
Purpose	3	0,629	0,804	0,581	0,582

Source: Prepared by the authors.

Discriminant validity evaluates whether items that reflect the factor are not excessively correlated with other factors. According to the criterion of Fornell and Larcker (1981), discriminant validity is demonstrated when the Average Variances Extracted are higher than or equal to the square of the correlation between the factors. Another possibility is the square root of the average variances of the construct being greater than the correlation of the construct with the other latent variables of the model in question. In Table 4, all the average variances extracted are higher than or equal to the square of the correlation between the factors. Therefore, it was not necessary to eliminate items form the measurement model.

Tab. 4
Discriminant Validity: Fornell-Larcker Criterion

Latent Variables	(1)	(2)	(3)	(4)	(5)	(6)
(1) Development	**0,739**					
(2) Avoidance	0,457	**0,721**				
(3) Unpredictability	0,571	0,381	**0,748**			
(4) Social Influence	0,317	0,411	0,487	**0,715**		
(5) Ownership	0,722	0,498	0,565	0,334	**0,736**	
(6) Purpose	0,511	0,335	0,607	0,515	0,480	**0,762**

Nota: A diagonal em destaque apresenta as raízes quadradas da AVE
Fonte: Elaboração própria.

Following the convergent and discriminant validation phases, the structural paths were analyzed. The result of this phase is shown in Figure 3.

The proposed model was estimated using the bootstrapping technique, comparing the original sample with the samples generated by this technique. In this sense, another 500 samples were generated, and Student's t-test was performed as shown in Table 5. The path significance analysis, in accordance with Benjamin and Gaskin (2014), can be checked from the t-values and the factors loadings of the observable variables. These values are interpreted below.

The results of this path significance analysis show that most did not obtain a difference between the original sample and the subsamples generated by the statistical technique with the critical limits for Student's t-test. This test allows the analysis of the correlation/regression coefficients to be equal to zero (Hair *et al.*, 2014). Student's t-test was considered for values considered significant of $p<0.001$.

The techniques that use the willingness of users to discover what will happen to gamify apps in mobile devices, represented by the "Unpredictability" construct, in addition to a significant coefficient, had the highest loading (0.822). This shows a strong relationship of preference among the respondents for apps that continually provide unexpected and unpredictable information during use. It is interesting to note that this is a negative gamification construct, i.e., it has elements that can leave the consumer with an unpleasant feeling, showing that if applied correctly these elements can be excellent motivators. However, the second negative construct of this study, "Avoidance", where the fear of losing something is used to gamify, according to the interviewees, is not as powerful a technique as the others and had a lower loading (0.640).

It is possible to observe the positive force of gaming, as the techniques lead the user to perceive greater meaning in their actions or feel successful by improving. This is represented here by the constructs of "Development", related to the feeling of progress, with the second highest loading (0.793), and "Purpose" with a loading of 0.763.

5. CONCLUSIONS

This study is an attempt to advance research on gaming characteristics and the influence of their

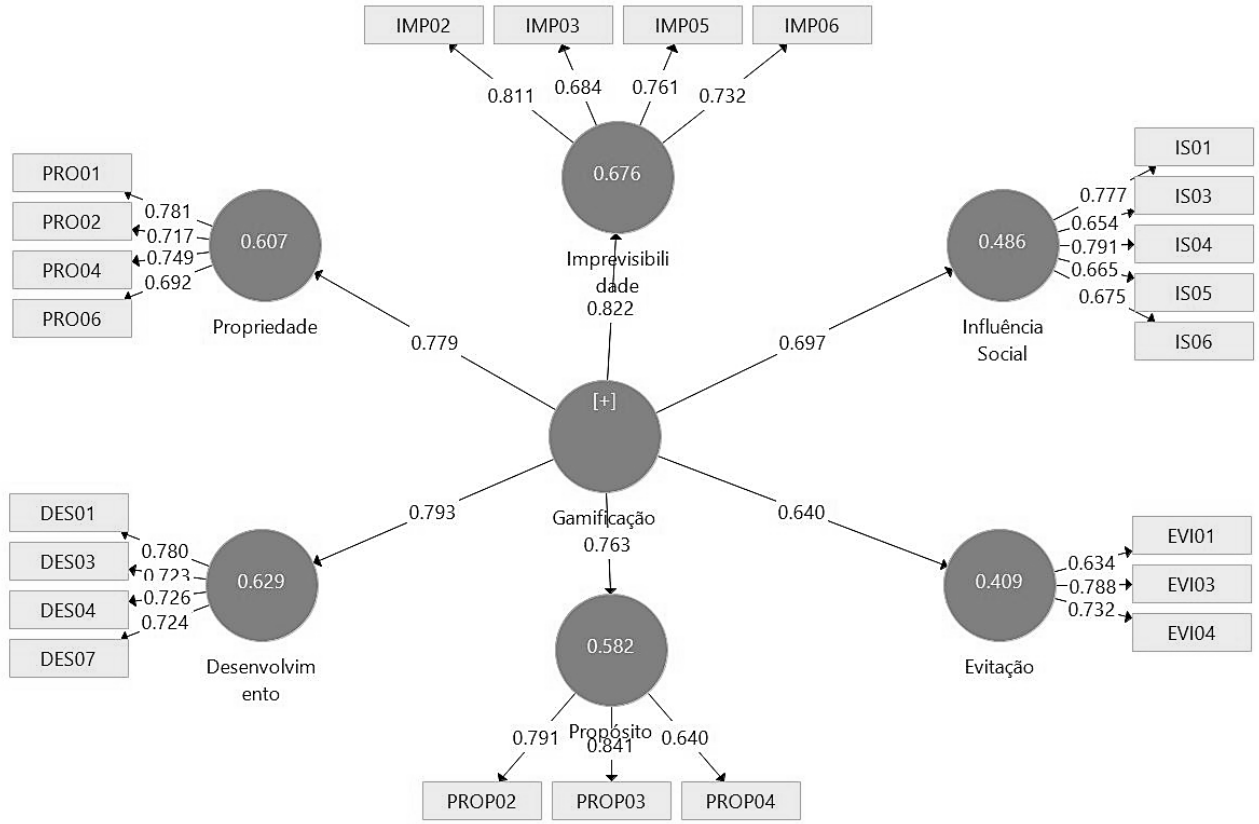

Fig. 3
Validation model of gamification characteristics.
Source: Prepared by the authors.

elements on users of mobile devices and through the development of a scale to measure these characteristics. Based on Yu-kai Chou's Octalysis model, it was shown that most constructs are applicable to mobile devices and influence their use. This fact aids the analysis and implementation of projects involving gamification in the country and consequently encourages the development of mobile apps that use these tools (Robson *et al.*, 2014).

By perceiving a gap on the not entirely consistent use of measuring gamification techniques by constructed or adapted scales, without the rites of preparation and validation, thereby producing results in a context without the necessary methodological reliability, an initiative emerges to formulate a protocol for the development the scales in this study using diverse techniques.

The result was that the judges confirmed 6 of the 8 constructs theoretically postulated and through analyses with the sample of users of apps in mobile devices, it was verified that these 6 constructs indicated the statistical significance of the scale developed for the use of gamified apps for mobile devices. Therefore, the proposed model is consistent and can be applied in future research.

Of the paths proposed by the model developed in this study, the study sample showed that the greatest

Tab. 5
Analysis of the significance of the paths

Path	(β)	*Bootstrapping* 500	SE	Teste t	P values
Gamification Characteristics -> Development	0,793	0,795	0,028	28,214	0,000
Gamification Characteristics -> Avoidance	0,640	0,641	0,033	19,142	0,000
Gamification Characteristics -> Unpredictability	0,822	0,824	0,020	40,548	0,000
Gamification Characteristics -> Social Influence	0,697	0,698	0,032	21,787	0,000
Gamification Characteristics -> Ownership	0,779	0,782	0,025	31,452	0,000
Gamification Characteristics -> Purpose	0,763	0,765	0,026	28,956	0,000

Critical values for t=> 1,96 p<5%; 2,57 p<1%; 3,64 p<0,1%
Source: Prepared by the authors.

influences on the use of gamified apps are the Avoidance, Unpredictability and Ownership constructs. Therefore, the respondents are more greatly motivated to act if they run the risk of losing something or wish to avoid this occurring (Kahneman & Tversky, 1979), have individual preferences for exploratory behavior (Hidi *et al.*, 2004) and feel motivated when they own a virtual good that distinguishes them from other people (Lehdonvirta *et al*., 2009).

A suggestion for future studies is to analyze the application of the gaming characteristic measurement scale developed in this study in relation to different aspects of gamification, such as motivation, engagement and productivity. Likewise, the instrument could be applied to larger samples in different contexts of society.

Companies could benefit by using the validation model for gamification characteristics developed in this study to guide the creation of gamified products and services for apps. On the other hand, this does not necessarily mean that all the constructs have to be used simultaneously. Thus, it is evident that each company should value its gamification goals carefully and the needs of their customers or potential customers to obtain better results.

In general, it was seen that gamification has the potential to encourage engagement in different contexts. By combining the main elements of games with an attractive proposal of value, gamification can help companies to improve their employees' productivity with clear goals and recreational objectives, and make training more interesting with constant feedback, competition and cooperation. It can also motivate customers to use apps for mobile devices or websites.

Finally, gamification is a tool that could lead to greater motivation, engagement and productivity by involving gamified app users. In this respect, a possible suggestion is to conduct studies that enable the use of these new constructs (motivation engagement and productivity) as dependent variables of the proposed model.

For companies, it is important to reflect on the fact that the unplanned use of game elements outside of the current reality or "mode" will probably not stimulate app users. Therefore, a possible managerial recommendation would be for companies who intend to embark on a gamification journey to strive to understand what is actually being gamified. They have to understand the motives, their audience (users or potential users) and what the gamification process will look like. A suitable strategy would be to create or use performance indicators or metrics. They could also use testing in pilot projects with users to help develop gamified apps with more rigorous quality. Listening to feedback from users or potential users could aid a systematic review to improve gaming strategies and the planned implementation of gamified apps.

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APPENDIX 1

Scale for measuring gaming characteristics for users of applications in mobile devices

Construct	Item	Assertion
Development	DES01	I feel motivated and perform actions that give me points in a GApp.
	DES03	I feel motivated to continue using a GApp when my progress bar is almost complete.
	DES04	I often use a GApp if there is a chance I can win prizes with it.
	DES07	I prefer GApps that give me a sense of achievement when I win a complex challenge.
Avoidance	EVI01	I continue using a GApp even after I get tired of it to avoid losing my progress.
	EVI03	I am motivated to perform an action quicker in order not to miss a unique opportunity in the GApp.
	EVI04	I feel motivated to continue progressing when other people can see I am falling behind in the GApp.
Unpredictability	IMP02	I am motivated to perform actions that give me a surprise reward in the GApp.
	IMP03	I am motivated to use GApps that give me a different vision of the environment around me.
	IMP05	It motivates me to know I can win a reward at any time when I use the GApp.
	IMP06	I am motivated to use GApps when I can try to predict what will happen or have hunches.
Social Influence	IS01	I prefer GApps where I can add people on a list of friends.
	IS03	I prefer GApps that let me show or share my achievements implicitly.
	IS04	I am motivated to use GApps with locations to share ideas and talk with other people.
	IS05	I prefer GApps that allow me to orient or be oriented by other people.
	IS06	I prefer GApps that let me interact with other people in a few easy steps.
Ownership	PRO01	I prefer GApps that allow me to collect virtual items or resources.
	PRO02	I am driven to finish tasks in a GApp to complete a collection of rewards I have begun to collect.
	PRO04	I prefer GApps that give me benefits or rewards for my efforts.
	PRO06	I prefer GApps that link me to items, attributes or characters to the point that I care about them.
Purpose	PROP02	I feel motivated to use a GApp that helps me contribute to a better world. ("Every time you get it right, we will plant a tree")
	PROP03	I feel motivated to use a GApp through which I can contribute to a greater cause.
	PROP04	I feel motivated to use a GApp when it makes me feel as if I am the only person that can win a challenge. ("The Chosen One")

Source: Elaborated by the authors.
Note: GApp (Gamification for Mobile Apps).

Desenvolvimento de uma escala de mensuração de características de gamificação para usuários de aplicativos em dispositivos móveis

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RESUMO

O objetivo deste artigo é apresentar o desenvolvimento de uma escala de mensuração de características de gamificação para usuários de aplicativos em dispositivos móveis. O modelo desenvolvido foi inspirado no framework denominado Octalysis criado por Yu-kai Chou. Definida uma versão preliminar da escala foi necessária a realização do procedimento de validação de face conduzida com 12 juízes. Após essa fase inicial, encadeou-se a purificação da escala, via cálculo da confiabilidade, e a aplicação do modelo a partir de um pré-teste conduzido com 30 respondentes. A próxima etapa foi aplicar um survey que contou com a participação de 452 respondentes de todo o país. A abordagem de pesquisa quantitativa obedeceu uma fase descritiva exploratória e outra subsidiada pela aplicação da Modelagem de Equações Estruturais. Como resultado, os juízes confirmaram 6 dos 8 construtos propostos de modelo original, e por meio das análises realizadas junto com a amostra de usuários de aplicativos em dispositivos móveis, foi possível verificar que estes 6 construtos confirmados confirmaram a significância estatística da escala desenvolvida. Logo, o modelo proposto neste estudo é consistente, podendo ser aplicado em futuras pesquisas.

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