Towards the understanding of cultural differences in between gamification preferences: A data-driven comparison between the US and Brazil

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ABSTRACT

Research on tailored gamification has shifted from analysing single students' characteristics (e.g. gender or behavioural profiles) to multiple characteristics and how they are influenced by gamification (e.g. context and system log usage). Yet, few studies have been conducted that are concerned with culture, which influences many of the students' characteristics and, consequently, their learning performance. In order to provide a better gamified experience, it is important to understand culture and how it impacts on students' perceived importance of gamification elements, so these elements can be adapted to specific cultures. To this end, we conducted an exploratory study using Association Rule Mining, to explore how the cultural landscape (country) influences the students' behaviour and perceived importance of gamification elements in educational environments. We collected and analysed data (N = 1296) from two different countries, Brazil (N = 428) and the United States (N = 868) and identified significant differences between the perceived importance of some gamification elements.

Keywords

gamification, association rules, culture, personalisation

1. INTRODUCTION

Personalised gamification in learning environments has become a trend in the past few years [7, 6]. This field of study focuses on enhancing existing gamification approaches with user-centred and personalised design, tailored to the specific characteristics of the user, which will have an impact on their perceived satisfaction, engagement, and motivation, when using a gamified system [4]. Tailored gamification engaged the interest of researchers and educational professionals, due to facilitating positive effects associated with it, such as motivation and performance increase [12].

Recent studies focused on the use of personalised approaches using student demographics (e.g. gender) [21], gamer profiles (e.g. using the HEXAD [22] model), and gaming preferences (e.g. users' favourite game genres or elements) [14] as part of the gamification design.

Whilst these recent studies demonstrated that personalised gamification tends to have a positive influence on students' motivation and performance, there is still no consensus on what kind of personalisation and which attributes should be considered, since most studies focus only on single factors [16]. Literature on personalised gamification points to a lack of studies that deal with other learners' characteristics that can also influence their perception and interaction with gamification; one such important characteristic being *culture* [6, 13].

Culture is not a trivial concept to define; according to [18], culture is an evolving cognitive structure, which influences the behaviour of members of a given group. Features included in the schema of this structure are those that influence and are influenced by the geographical location of an individual and educational contexts they are exposed to [17]. It is this aspect of 'culture' that we will seek to investigate within the rest of this paper. Recently, culture's importance to gamification has come to the fore [2, 24, 19]. In spite of this surge in interest, according to [19], most existing gamification studies that address education and culture are focused on language learning, rather than on understanding how culture can impact on gamification design.

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Based on what has been exposed, this paper aims to answer the following research question *"Does culture impact on the importance of gamification elements?"*. We answer this research question, by conducting a relatively large and representative[1] quantitative study, analysing the perceived importance of gamification elements in two different countries (United States and Brazil). Our results provide empirical evidence on the differences between the perceived importance of gamification elements for these two different countries, which can guide designers when considering national culture as a set of variables[2] in gamification design for learning environments, and also guide researchers to conduct new research in this field. In summary, our main contributions are new insights on which game elements for education are preferred in different countries.

2. METHODS

Considering our main research question, we designed an initial sub-research question to identify if a certain gamification element is more important in a country than in another (here, Brazil versus US). We use <gamification element> for any element from the Taxonomy of Gamification Elements for Education (TGEE) proposed by [20], while the 'country' refers to data collected from people living in a given country.

We opted for the TGEE [20] due to it being the first classification created and evaluated for educational purposes. TGEE is composed of 21 gamification elements, alongside its synonyms, descriptions, and examples of use. These elements are classified in 5 categories that deal with students' performance, sociability, personal information, and experience, and the environment ecosystem.

Through analysing the perceived importance of gamification elements in different countries, we can infer how the culture can influence the design of personalised gamified applications for education. To conduct this research, first we used inferential statistics, to test our assumption that the elements' perceived importance differs, depending on the country of residence. To do so, we used the Mann-Whitney U test (due to the non-parametric and independent nature of our data [11]) and Cliff's delta, to understand to what extent perceptions differ (i.e., the effect size) [10]. Following this we conduct an exploratory analysis, using unsupervised learning algorithms and descriptive/inferential statistics to provide inferences that can be explored deeply in future studies. The data-driven pipeline consists of data collection, filtering, and analysis, further explained in the respective sections.

To collect our data, we relied on the survey method, due to its low cost and other benefits (e.g. speed of obtaining answers) [8]. The survey used in this study was designed in Google forms and consists of two parts. The first collects self-reported demographic information about the respondents, such as gender, country (of residence) and some information regarding their 'gamer' status, such as: years playing games, hours per week spent playing, favourite game genres and favourite setting (single or multiplayer games). Whilst it is known that games and gamification are not the same, however, recent studies [15] demonstrated that gaming characteristics of users do influence their gamification acceptance. Previous literature also showed that students' player profile might additionally influence their performance when using gamified learning environments. Based on these premises, we collect the participants' gaming culture information, to establish how it influences the perceived importance of the gamification elements. The second part of the survey consists of 21 gamification elements that were proposed for educational contexts, where we asked what the respondents' perceived importance for each of the 21 gamification elements was, on a Likert scale [9] from 1 to 5, where 1 meant "not important at all" and 5 "extremely important".

The recruitment of respondents occurred via (1) Amazon Mechanical Turk, demonstrated to be an effective platform to obtain a representative sample of answers especially in the US [3], and (2) social networks, which allow us to reach a broad audience and can also be useful tools for survey recruitment [3], social networks were used mainly to collect data from Brazil. We left the survey open for answers for 3 months. The first page of the survey contained the informed consent form[3], which the participant needed to agree to, in order to participate in the study, as well as the information regarding the study's objectives, as suggested in [5].

After preparing our dataset, we used descriptive statistics and ARM to explore it. Descriptive statistics allow us to understand the significant differences between countries, which in addition can support us in answering. ARM consists of verifying the associations between the data, by presenting *if-then-else* clauses that are explained using a given set of metrics. It is mainly used in market-basket analysis, to identify possible combinations of elements [1]. In this work, we will consider support (related to the frequency of a given item), confidence (related to the strength of the clause based on its frequency), and lift (which measures the independence of the items in the clause) as the main metrics for ARM.

3. RESULTS AND DISCUSSIONS

In this section, we present the results of our analyses using the given dataset. Initially, our raw data consisted of 1952 answers; after applying our filters, as described in the previous section, we obtained a total of 1296 respondents who live in Brazil (n = 428; 33%) or the US (n = 868; 67%). Considering the country distribution and genders (Table 1), 428 are from Brazil (33%) and 868 from the US (67%). Among the respondents, 447 identify themselves as female (34.5%), 839 as male (64.7%), nine as non-binary (0.7%) and one person preferred not to disclose (0.1%).

Considering their age and time spent on games distribution: the minimum age (in years) is 16, with maximum age

[1]According to Sample Size calculator, our sample is representative for both US and Brazil. Link: `https://www.checkmarket.com/sample-size-calculator/`

[2]It is important to note that culture itself cannot be defined in one single variable (e.g. country), but a set of characteristics from that might be associated with the place of origin, social group, etc..

[3]The consent allows us to analyse and publish the answers of the respondents. The data collected within this study is in accordance with the General Data Protection Regulation (GDPR[4]) and any kind of personal information was removed prior to the analysis. This research was also approved by an ethical committee 42598620.0.0000.5464 at University of Sao Paulo.

Table 1: Gender distribution

Gender distribution	Brazil		US		Total
	N	%	N	%	
Female	81	18.93	366	42.17	447
Male	344	80.37	495	57.03	839
Non-Binary	3	0.70	6	0.69	9
Prefer not to disclose	0	0	1	0.12	1
Total	428	100	868	100	1296

77. The medium age of the population is 29.7 with a standard deviation of 10. Considering the experience and gaming preferences of our population, they had an average of 18.7 years of playing games (SD = 8.2), and an average of 14 hours per week (SD = 13.8). The top 3 favourite game genres were RPG (499 answers, 38.5%), adventure (259 answers, 20%) and strategy (186 answers, 14.4%).

The favourite setting (Table 2) of the respondents was single player games (898 answers, 69.3%), followed by multiplayer games (398, 30.7%). In Brazil, the top 3 favourite game genres were RPG (N = 182, 42.5%), followed by Adventure (N = 66, 15.4%), and Strategy (N = 65, 15.2%). As for the US, they considered RPG (N = 317, 36.5%), followed again by Adventure (N = 193, 22.24%), and Strategy (N = 121, 13.94%).

Table 2: Favourite setting distribution

Favourite setting	Brazil		US		Total
	N	%	N	%	
Multiplayer	137	32,009	261	30,069	398
Singleplayer	291	67,991	607	69,931	898
Total	428	100	868	100	1296

When applying our sub-research question formula to each of the elements, we can see in Table 3 that only 6 elements showed a significant difference ($p < 0.05$, after corrected with False discovery rate (FDR)). We also applied Cliff's Delta to measure the effect size (since this delta can be used to measure the effect size of different size populations) and obtained small effect size results on the same 6 elements [23].

Considering the results seen in Table 3, we can observe that 6 elements (Cooperation, Novelty, Stats, Sensation, Narrative, and Storytelling) had a significant difference in the hypothesis tests ($p < 0.05$), and a small effect-size (up to 0.3). In practice, this means that each of the analysed countries consider these elements to a different degree of importance. The low effect-size indicates that these element differences may pose a significant impact when tied with other elements considering the respondents' country; this must be confirmed with empirical studies using these elements.

As for the Association Rules, when mining all the rules that contain the variable country, we found 937 rules. In this work, we considered only rules that contained a gamification element and that satisfies the following conditions: (A) $confidence > 0.8$; and (B) $lift > 1.1$, similar as seen in [21].

Considering our conditions, we found 44 rules for condition (A); and 295 for condition (B). When considering the intersection between condition A and B, we found 40 rules ($A \cap B = 40$). The strongest rule (rule 3275, confidence = 0,93; lift = 1,99) that was mined was associating Brazil with Objective, Storytelling, and Narrative. The following rules also associated Brazil with different gamification elements as Progression (rule 3279), Sensation (rule 3270) and characteristics as favourite setting as single player (rule 3278). The same set of gamification elements (Narrative, Storytelling, Progression, and Objectives) were also associated with the United States. The major difference was in the Sensation element that was found in the strongest rules associated with Brazil (Table 4).

4. CONCLUSIONS AND FUTURE WORKS

This paper presented a data-driven work focusing at exploring cultural differences between Brazil and the US regarding their perceived preferences on gamification elements. We found significant and interesting associations and groups of gamification elements that can be used in educational environments (both virtual and non-virtual). These can also be used as input for adaptive gamification environments as a new set of variables that can be grouped by the country of origin of the student.

In summary, we provide as the main contributions of our work the first empirical evidence on the impact of culture in the perceived importance of gamification elements, comparing Brazil and the US, as well as providing new strategies based on respondents' country of origin and others easy-to-obtain characteristics that can be used in adaptive gamified learning environments.

In future works, we intend to expand the research by applying other unsupervised algorithms, and investigating other sub-cultures within these countries and identify different and similar patterns. We also intend to expand the concept of culture and not associate it only with a country, but also including the region the respondent was raised and live nowadays, as well as other variables that can be related to their education level, or gaming preferences that might have an influence on their perceived importance of gamification elements. Another future work is related to the implementation of these strategies in a real educational environment. Finally, it would be interesting to also analyse other countries and see the differences and similarities between patterns.

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Table 3: Summary of gamification elements. Elements were organised based on the order they appeared in the survey.

Element	Brazil		US		Mann-whitney P-value	FDR	Cliff's Delta Effect Size
	Mean	SD	Mean	SD			
point	3.4	1.23	3.34	1.23	0.46	0.48	0.03
level	4.02	0.96	3.87	1.06	0.03	0.08	0.07
cooperation	**3.55**	**1.16**	**3.31**	**1.25**	**0**	**0.01**	**0.10**
competition	3.05	1.29	3.17	1.34	0.14	0.21	-0.05
renovation	3.64	1.01	3.52	1.05	0.09	0.16	0.06
progression	4.41	0.82	4.35	0.81	0.08	0.16	0.05
objectives	4.35	0.83	4.25	0.88	0.05	0.11	0.06
puzzle	3.82	0.99	3.73	1.12	0.35	0.41	0.031
novelty	**3.98**	**0.92**	**3.72**	**1.01**	**0**	**0**	**0.14**
chance	3.19	1.20	3.08	1.12	0.10	0.17	0.05
social_pressure	2.59	1.22	2.50	1.25	0.16	0.21	0.05
acknowledgement	3.55	1.18	3.45	1.21	0.15	0.21	0.05
stats	**4.05**	**0.97**	**3.82**	**1.07**	**0**	**0**	**0.12**
rarity	3.38	1.18	3.30	1.19	0.39	0.43	0.03
imposed_choice	3.14	1.09	3.24	1.1	0.09	0.16	-0.06
time_pressure	2.58	1.15	2.64	1.24	0.51	0.51	-0.02
economy	3.14	1.28	3.2	1.26	0.36	0.41	-0.03
sensation	**4.31**	**0.9**	**3.80**	**1.1**	**0**	**0**	**0.27**
reputation	3.02	1.18	3.16	1.2	0.04	0.11	-0.07
narrative	**4.41**	**0.91**	**3.93**	**1.12**	**0**	**0**	**0.26**
storytelling	**4.35**	**0.91**	**4.05**	**1.13**	**0**	**0**	**0.15**

Table 4: Top 15 rules found in ARM.

Rule ID	Left-hand side	Right-hand side	Support	Confidence	Coverage	Lift
3275	{country=Brazil,objectives=5, storytelling=5}	{narrative=5}	0.11	0.93	0.11	1.99
3279	{country=Brazil,progression=5, storytelling=5}	{narrative=5}	0.11	0.88	0.12	1.88
3269	{country=Brazil,sensation=5, narrative=5}	{storytelling=5}	0.10	0.87	0.12	1.74
3287	{country=Brazil,fav_setting=Singleplayer, storytelling=5}	{narrative=5}	0.12	0.87	0.14	1.86
3270	{country=Brazil,sensation=5, storytelling=5}	{narrative=5}	0.10	0.87	0.12	1.85
3273	{country=Brazil,objectives=5, narrative=5}	{storytelling=5}	0.11	0.87	0.12	1.73
2321	{country=Brazil,storytelling=5}	{narrative=5}	0.17	0.86	0.19	1.84
3374	{gender=Female,fav_setting=Singleplayer, progression=5}	{country=United States}	0.10	0.85	0.12	1.27
3310	{country=Brazil,fav_setting=Singleplayer, progression=5}	{gender=Male}	0.10	0.85	0.12	1.32
2692	{gender=Female,renovation=4}	{country=United States}	0.11	0.85	0.13	1.26
3283	{gender=Male,country=Brazil, storytelling=5}	{narrative=5}	0.13	0.85	0.15	1.81
2732	{gender=Female,fav_setting=Singleplayer}	{country=United States}	0.21	0.84	0.24	1.26
3765	{country=United States,fav_setting=Singleplayer, progression=5,narrative=5}	{storytelling=5}	0.11	0.84	0.13	1.68
2695	{gender=Female,novelty=4}	{country=United States}	0.11	0.84	0.13	1.25
1573	{country=United States,fav_genre=Adventure}	{fav_setting=Singleplayer}	0.12	0.82	0.15	1.19

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