

# The role of game modality in the outcomes of gamification: A research agenda

Federica Gini<sup>1,2</sup>, Simone Bassanelli<sup>1,2</sup> and Antonio Bucchiarone<sup>2</sup>

<sup>1</sup> University of Trento, Via Calepina, 14, 38122 Trento TN, Italy

<sup>2</sup> Fondazione Bruno Kessler, Via Sommarive, 18, 38123 Povo TN, Italy

## Abstract

The interest in gamification is growing every year, as demonstrated by the continuous increase in scientific and commercial outputs. Along with the number of publications, researchers have produced a significant amount of gamification frameworks, with the intent of guiding designers in the creation of gameful systems. Despite the differences between frameworks, and the fact that a holistic framework is still missing, there is one feature common to all the schemes: the consideration for the game modality, intended as different types of social interaction between users (individual, cooperative, competitive, and cooperative-competitive), is none or limited. The current paper represents an attempt to underline the importance of game modality in gamification, presenting evidence about the impact that the modality has on social, behavioral, and psychological outcomes in traditional activities, video games, and gameful systems, along with a research agenda aimed at deepening the knowledge of this connection.

## Keywords

Gamification, game modality, research agenda, design

## 1. Introduction

Gamification, intended as the implementation of game elements in non-game contexts [1], has raised significant interest in different domains [2, 3], producing a continuous increase in scientific output [4] and commercial apps [5, 6] each year. Despite that, the design of gameful systems is quite complex and requires numerous precautions in order to achieve a well-functioning system. Gamification is still in its infancy [2], hence the understanding of the phenomenon is not totally clear. In fact, gamification is typically used to positively influence human motivation and behaviors [2, 4], but the final outputs are not always totally positive. Several authors [3, 7, 8, 9, 10] suggest that during the design of gamification, and in particular in the implementation of game elements, designers should take into account the

final users' differences and preferences. Nevertheless, a large number of systems implement a shortcoming *one size fits all* strategy [11]. In other words, gameful systems are often designed without taking into account that different categories of people have different interactions with these systems and within themselves [7, 12], and that different game elements have characteristics that may vary from the context of use [3]. One of the most common *one size fits all* strategies is the *PBL (points, badge, leaderboard)* implementation, which relies on the interaction between points, badges, and leaderboard in promoting users' motivation. Fewer expert people believe that the sum of gamification methodology and philosophy is merely the process of adding points, badges, and leaderboards to products [13].

In order to face these problems and enhance gamification reliability, several personalization

7th International GamiFIN Conference 2023 (GamiFIN 2023), April 18-21, 2023, Lapland, Finland.

EMAIL: federica.gini@unitn.it (F. Gini);

simone.bassanelli@unitn.it (S. Bassanelli); bucciarone@fbk.eu

(A. Bucchiarone)

ORCID: 0000-0003-3427-3747 (F. Gini); 0000-0001-6061-8169

(S. Bassanelli); 0000-0003-1154-1382 (A. Bucchiarone)



© 2023 Copyright for this paper by its authors. Use permitted under Creative Commons License Attribution 4.0 International (CC BY 4.0).

CEUR Workshop Proceedings (CEUR-WS.org)

approaches [14] and gamification design frameworks [15] have been developed during the last few years. Specifically, according to some literature reviews [14, 16], most of the personalization approaches focus on predicting and modeling the user profile and the correspondent game elements, placing a particular focus on what to modify, and not how to modify.

A good number of gamification design frameworks are specific to fields such as education and learning [17, 18, 19], while others can be generalized to different contexts [20]. Despite the differences among frameworks, in the vast majority, there is a lack of consideration of the effects that the modality has on users' behavior. As described in detail in **Section 2**, modality refers to the characteristics of the social interaction between users, and therefore the level of social interdependence [21] between people, and it can be mainly divided into (1) individual, (2) cooperative, (3) competitive, and (4) cooperative-competitive. If we take into account recent literature [4, 15, 20], it emerges that just a few authors include the analysis of the modality in their framework. In particular, only the GamiDOC framework [4] explicitly refers to modality as one of the features taken into account during the design phase. Based on the current literature on gamification frameworks, can we state that the analysis of the modality is redundant in the design of gameful systems? The aim of the paper is to show evidence of the impact of modality on the outcome of gamified systems and provide a research agenda. In **Section 2** we present the four main modalities (individual, cooperative, competitive, and cooperative-competitive) on the basis of the Social Interdependence Theory, along with the impact and the preferences for different modalities in traditional activities, video games, and gamified systems. In **Section 3** we define a research agenda aimed at expanding the knowledge about the role of modalities in gamification, and finally, in **Section 4** we present the conclusions.

## 2. Modality

The structure of the interaction between users, along with the choice of objectives, outlines the modality of the gameful system. Therefore, it is important to understand the impact of modality on the effectiveness of gamification, and what elements can guide designers in choosing the most appropriate kind of interaction between users. In

gamification, we can mainly distinguish between four modalities: individual, cooperative, competitive, and cooperative-competitive [2, 22]. The distinction, originally described by Morschhauser et al. [2], derives from the classification of video games in four main modalities done by Liu and colleagues [22]. The distinction relies on the *Social interdependence theory* [21], and it classifies video games and gamified activities based on the characteristics of the interaction between users.

### 2.1. Social interdependence theory

Social interdependence theory was first formulated in 1968 in the work of Morton Deutsch [21, 23, 24], who re-elaborated the Gestalt school's notions of the group and inter-group relationships [25, 26] by looking further into how relationships between people's goals could influence groups' dynamics. Based on how goals are set, there can be positive or negative interdependence between people's goals. Positive interdependence rises when the achievement of one's goal facilitates the other members of the group to get closer to their objectives, and it commonly leads to cooperation [21, 23, 24]. Negative interdependence represents the opposite situation: by reaching one's goal, the other members of the group are driven away from their goals. In this second case, people tend to compete to reach the desired result. Finally, there is no interdependence when there is no relationship between people's goals [21, 23, 24].

### 2.2. Modality in traditional activities

Social and motivational psychology literature studies how different kinds of interdependence affect people's performance and psychological outcomes. Studies on positive interdependence (which we will call simply "cooperation" from now on) show that cooperative activities can enhance people's performance, if compared to other modalities [27, 28], such as individual (lack of interdependence) and cooperative activities (negative interdependence). These findings are consistent with the fact that cooperation is related to a higher frequency of insights and higher cognitive functioning in participants. Also, people tend to spend more time focusing on the task during cooperative activities, rather than

individual or competitive ones [27, 28]. As for the psychological outcomes, during cooperative activities, people feel more motivated and reported higher levels of well-being [27, 29]. These effects of cooperation are the basis of the success of cooperative learning [21, 30, 31].

Other findings in the literature furthermore state that when positive interdependence is mixed with negative interdependence, individuals gain even more benefits from social interaction: when cooperation and competition (i.e. team competitions) are both present in the activity, individuals are even more motivated [27, 32, 33]. In particular, when participants are divided into teams, it is possible that positive influence [34, 35, 36], and a process of social identification rise among team members, which are also related to Toumela's concept of we-intentions [35, 36, 37].

In traditional learning, the effects of cooperation and competition have been thoroughly studied. Cooperation in learning has a positive influence on motivational, emotional, cognitive, meta-cognitive, and social dimensions of learning [30], and students perceive collaborative learning activities as more satisfying than individual ones [31]. On the other hand, there are controversial opinions on the usefulness of competition in education [38]. Some authors state that competition can motivate students and encourage learning [38, 39, 40], while others argue that competition can promote orientation to performance over the desire for mastery of the topic [41]. Also, competition can represent a source of stress, as pointed out by Vockell et al. [42], and supported by students' preference for anonymous competitions [43]. As a compromise between the pros and cons of competition, and the clear evidence about the effectiveness of cooperation, other authors suggest cooperative-competitive structures as the most appropriate to motivate students [44]. The literature on traditional learning also provides some guidelines for adopting "safe" competition in education: short competition, characterized by a clear goal definition and a prize with low or symbolic value for the winners, so that students gain little motivation from the reward [38, 45].

### 2.3. Modality in video games

Based on these definitions, Liu [22] first, and Morschheuser [2] later, divided video game and gamified activities into four main modalities:

- **Individual modality:** lack of interdependence among users, which means that there is no connection among the players' goals.
- **Cooperative modality:** positive interdependence among the users' goals, promoting player interaction.
- **Competitive modality:** negative interdependence among users' goals, which obstacles interaction among players.
- **Cooperative-competitive:** characterized by positive and negative interdependence, mostly found in team competitions. In this modality, interaction is sustained among teammates, and discouraged with other teams.

The choices that game designers take in terms of the structure of the objectives and the game elements introduced in the game, along with the complementarity of players' roles, shape the kind of interdependence among players, and therefore the modality of the video game.

According to the literature, competition represents one of the elements of success in video games [46, 47, 48]. Competition represents a source of immediate feedback about one's performance, and it makes the player feel competent [46, 49]. The satisfaction of the need for competence is considered by *Self Determination Theory* [50] one of the bases for the rise of intrinsic motivation. Despite many players being attracted by competition, this modality can also have negative effects on the appreciation of the game if competition becomes perceived as too controlling; users become too goal-oriented, rather than performance-oriented; or there is no balance between players' abilities [51, 52, 53]. As we can see, motivation is not always enhanced by competition, and the features that make competition attractive or demotivating depend on the kind of activity and users' characteristics. On the other hand, cooperative video games have a whole other set of positive effects on users' behavior and well-being. Positive interdependence in video games promotes cooperation also into the real world [54], other than having positive effects on people's fun, and effort [55]. Playing video games characterized by social interaction, particularly cooperative ones, was found to be correlated with overall psychological well-being [47, 56, 57, 58]. Finally, the cooperative modality is useful to satisfy players' need for relatedness, another one of the three basic needs identified in *Self Determination Theory* [50].

## 2.4. Modality in gamification

In this section, we present how modality can impact the user experience of gamified systems in the general population and primary evidence of a possible mediation role of demographic and cultural features.

### 2.4.1. Differences in the general population

Given the effects of adopting different modalities highlighted in social psychology and studies on video games, it seems natural to suspect that different amounts of interdependence can have consequences on the effectiveness of gamified activities. At first, competition gained popularity in gamification, since the introduction of leaderboards and other competitive game elements resulted in greater effects on motivation if compared to the individual modality [59, 60, 61]. As for video games, competition can not be considered a universal solution to engage users [53, 59, 60, 61, 62, 63]. Literature shows that competition can not be considered a universal solution to engage users, since competitive elements seem to have different impacts on people, based on personality and other interpersonal differences [59, 60, 61, 62]. Leaderboards, in particular, provide a great affordance for competition, since they are seen as a goal to reach [64]. Data suggest that extroverts enjoy competition elements more than introverts [59, 60, 61, 62]. Also, in the case of crowd-sourcing, more skilled and engaged users can discourage the less participative ones from contributing at all [53, 63]. Gabrielle [65] reported how hotel employees can be negatively affected by competitive gamification. In an attempt of increasing productivity, a hotel introduced gamification in the workplace - using a leaderboard to take note of employees' performance - with the result of increased stress and negative emotions. Studies that compared different modalities highlighted some similarities between the effects found in gamification and traditional activities, such as levels of fun and participation [2, 66]. Chen and Pu [66] compared three versions of the same gamified software, each characterized by a different modality. The results show how the cooperative and cooperative-competitive versions positively impacted individuals more than the competitive one.

Morschheuser et al. [67] found similar effects comparing three modalities (cooperative, cooperative-competitive, and competitive) in a gamified crowd-sourcing software. Other authors highlighted that cooperative gamification enhances users' participation and has long-term effects on motivation, fun, and intention to share knowledge if compared to other modalities [2]. Finally, as for traditional activities, also in gamification the cooperative-competitive modality seems to be even more effective than introducing cooperation or competition alone [66]. In a recent study [67] emerged that while users reported similar levels of perceived usefulness and used the software for a similar amount of time, individuals in the cooperative-competitive condition showed higher levels of fun and participation.

In Klock et al. [14] systematic review, the authors describe the preference for game elements in different player types and different personality traits. According to Bartle's player types taxonomy, people can be divided into achievers, explorers, killers, and socializers, based on their game-playing preferences [68]. In the results included in Klock et al. [14] review, competition was suggested only for killers in [69] and [70], while leaderboards were suggested for achievers [71, 72], explorers [71], and killers [71, 72, 73]. Moreover, in Tondello et al.'s [7] analysis between Hexad traits [74] and preference for elements, the results showed that social competition is particularly appreciated by socializers and disruptors, while leaderboards were preferred by players. As for the personality traits, the majority of papers included in the review referred to the Big 5 or OCEAN model [75], and competition was linked to higher levels of extraversion [76]. More recently, Pakinee & Puritat [77] interviewed seventy-two students who participated in an experimental application of a gamified software for learning. The results, coherently with the literature [76, 78, 59], showed that students with higher traits of extraversion and openness were particularly motivated by competition. On the other hand, students with a higher trait of neuroticism were negatively affected by the presence of the leaderboard, as also reported in Orji et al. [79].

### 2.4.2. Demographic differences

So far we have discussed differences in the general population. There is evidence suggesting

that the social component in gamification software is more or less appreciated, based on the demographic characteristics of individuals [14, 80]. For example, in Klock et al. [14] review about tailored gamification, the authors analyzed game elements and modalities suggested to different genders. For example, in two studies [8, 81], leaderboards were suggested to women, and in one other study, leaderboards were suggested for either gender [82]. Other two studies suggested competition, in general, to men, and guilds for both men and women [83, 84]. Interestingly, Busch et al. [84] studied femininity and masculinity instead of focusing on the two genders, and suggested social status and competition to femininity. It is evident that the body of data regarding gender differences in gamification, and furthermore the relationship between gender and modality, is still in its early stages, and research is needed to clarify the topic. Also, Koivisto & Hamari [80] compared the differences in the user experience related to an exercise gamified software (Fitocracy) divided by age and gender and discovered a preference for social features in women. Finally, Itoko et al. [85] reported that competitive gamification may have more positive outcomes in younger users than in the older population. The authors used gamification to motivate senior workers in crowdsourcing tasks, such as proofreading, and discovered that younger people appreciated competition more than older workers, who did not like to compare their contribution with other users. In light of these findings, it seems that the effects of modality may be mediated by demographic characteristics, other than interpersonal differences.

### 2.4.3. Cultural differences

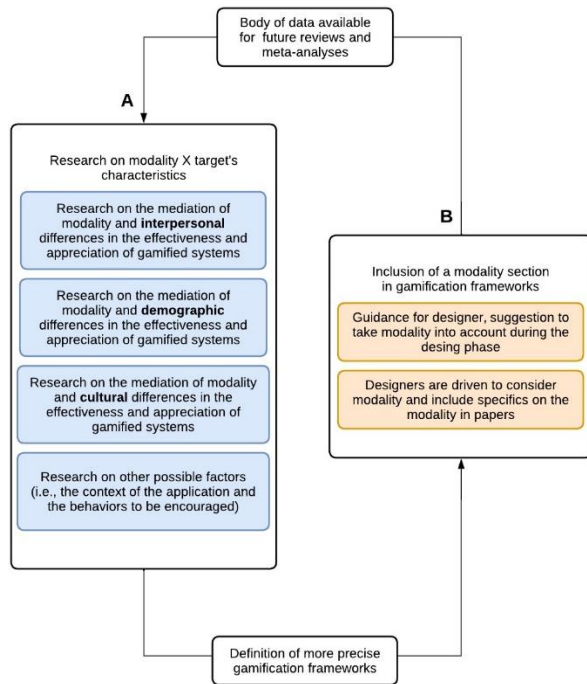
Culture is an umbrella term that refers to habits and preferences often expressed in a group of people, which include but it is not limited to social behavior, food preferences, art, and the expression of emotion [86, 87, 88]. The presence of cultural differences might lead to the marginalization of some users, especially in the educational environment. Indeed, several authors reported how factors such as age, ethnic differences, gender, sexual orientation and disability may affect the effectiveness of gameful systems [89, 90, 91]. For this reason, several authors suggest using a cooperative or cooperative-competitive approach [92, 93, 94, 95]. Oyibo et al. [96, 97]

researched the appreciation for game elements in different populations, particularly individualistic and collectivist cultures. Individualistic cultures focus on the individual, self-dependence, and personal goals rather than the idea of the community, while collectivist cultures see the individual as part of the society, and prioritize the latter over single individuals [98]. In particular, the authors compared individualistic (North America) and collectivist (Asia, Africa) populations to study which gamification features (competition, learning, and prizes) were more suited for the two cultures [96, 97]. Competition, in particular, was suggested to individualistic cultures in the first publication [96], while the authors reported similar results in individualistic and collectivist cultures in the second one [97]. Furthermore, Toda et al. [99] compared users' perceived importance of game elements in Brazilian and US citizens. The authors found a significant difference in the perceived importance of cooperation, but not competition, in the two populations. In particular, Brazilian participants deemed cooperation more important than the US sample.

## 3. Future steps

As stated in the introduction, from recent literature [4, 15, 20] it emerges that gamification frameworks are often lacking a modality section. Though, evidence shows how different levels of interdependence impact psychological and behavioral variables in participants, in traditional activities, video games, and even gamified systems [2, 27, 28, 32, 33, 51, 52, 53, 60]. Future works should follow two separate but interconnected pathways to fill the gap and further connect research on gamification with the design of gamified systems. As represented in **Figure 1**, on one hand (**column A**) researchers should further analyze the relationship between different modalities and the effects of gamification, considering the target's characteristics. This means: (1) considering the relationship between different modalities and interpersonal differences in the population, such as personality, (2) considering the relationship between different modalities and users' demographic categories, (3) considering the relationship between different modalities and cultural differences, and (4) considering the relationship between different modalities and other possible factors less studied so far, such as the context of the application and

the behaviors to be encouraged through gamification.



**Figure 1:** Reciprocal benefits between research in gamification and the development of a holistic framework, with the inclusion of a modality section.

Other than increasing the knowledge on the topic, understanding how modality moderates the effects of gamification can help in the definition of better gamification frameworks. On the other hand, gamification frameworks should include a modality section. Including a modality section in gamification, frameworks would have two implications (**column B**): (1) it would raise awareness in designers of how different modalities could impact their users' experience, and (2) it would drive designers to think about the interdependence between users, and possibly make the modality explicit in papers. The latter also helps the construction of a body of data about the modality adopted in gamified systems and the effects of gamification on people's psychological and behavioral variables, which can be used in future reviews and meta-analyses and further refine gamification frameworks.

### 3.1. Research agenda

To clarify the impact that modality may have on users, we present a research agenda that aims at exploring the relationship between modality and other meaningful aspects for the design of

gamified systems, such as differences between users, the context of the application, and the behavior to be encouraged.

**Agenda point 1)** Investigate the tailored gamification by considering the players' preferences, types, and personalities, in relation to game modality.

We can divide interpersonal differences into two main aspects: first, we can talk about personality (i.e., measured through the Big 5 or OCEAN model [75]), and second, we can also talk in terms of player types (i.e., measured through Bartle's taxonomy [68]). As presented in **Section 2.4**, Klock et al. systematic literature review [14] shows that interpersonal differences may play a role in the appreciation for different modalities. Both for personality and player type, though, there is still a lack of agreement on which game elements and modalities could be best suited based on these interpersonal differences. Therefore, more research is needed to shed light on the matter.

**Agenda point 2)** Investigate the tailored gamification by considering demographic differences, such as age and gender, in relation to game modality.

When talking about demographic differences we can mainly identify people in terms of age and gender. While for age little is known about the influence of modality on the user experience related to gamified systems, there is more evidence about the appreciation for different modalities based on gender (and the continuum femininity-masculinity) [14, 80, 84]. As for interpersonal differences, also data on the relationship between modality and demographic differences are scarce and often contradictory. Collecting more information about this relationship can represent valuable knowledge for designers with a specific target during the design phase.

**Agenda point 3)** Investigate the tailored gamification by considering cultural differences, such as the distinction between individualistic and collectivist cultures, in relation to game modality.

As presented in Oyibo et al. [96, 97], individualistic and collectivist cultures may show a preference for specific gamification features and modalities. The results as a whole are not clear, and no modality other than competition was taken into account by the authors. Given the differences between the two types of cultures [98], it is possible that different populations may have a preference for specific modalities. Therefore designers in different parts of the world may need

to pay attention to the target society in order to properly design a gamified system. To guide designers in this way, more research has to be done on the relationship between modality and individualistic and collectivist cultures.

**Agenda point 4)** *Investigate the tailored gamification by considering the different contexts of application in relation to game modality.*

Gamification can be applied in a vast number of contexts [3], and it is possible that users may prefer different modalities based on the context of the application. In a recent meta-analysis about gamification in education, for example, the authors summarized the effects of gamification on motivational, cognitive, and behavioral outcomes [100]. The results show a more positive impact of cooperative-competitive gamified systems over competitive gamification in terms of behavioral outcomes. The authors do not exclude that competition can have promising results, since some factors may have mediated the effects of competition, such as the design of the challenge (i.e., destructive competition, in which one player has to destroy other participants in order to prevail), and the lack of balance between participants' skills [100]. In a different field, in Morschheuser et al. [101] literature review, the authors summarized the finding on the application of gamification in crowd-sourcing, dedicating part of the manuscript to the effectiveness of different modalities. The authors underline how crowd-sourcing success is based on people's cooperation [101, 102, 103], and therefore adopting a cooperative modality may have positive outcomes [101]. Other evidence included in the review suggests that competition and leaderboard can represent another way to increase motivation and people's participation in gamified crowd-sourcing systems [104, 105]. Competition, though, can demotivate less skilled users to contribute [53, 63], especially when adopting long-term leaderboards [53, 63, 106]. In this perspective, the authors suggest using short-term leaderboards [101, 105]. The results on gamification in education, crowd-sourcing, and the evidence on the general population present some similarities, such as the effectiveness of the cooperative-competitive modality. It is still unclear if the fondness for a specific modality (i.e., cooperative-competitive) can be the result of a preference in the general population, or if this preference may also be influenced by the context of the application. Future research should deepen the knowledge of the interaction between the

context and the preference for a specific modality in gamification.

**Agenda point 5)** *Investigate the tailored gamification by considering the different desired behaviors in relation to game modality.*

As described in **Section 2.3**, in-game cooperation promotes cooperation also in the real world [54]. It is possible that some modalities are suited to promote and support some behaviors better than others. Including a modality that supports users in reaching their goals in terms of behavior and learning, can increase the effectiveness of gamification. Future research should explore this area, and understand the relationship between modalities and the behaviors encouraged through gamified systems.

**Agenda point 6)** Produce guidelines to help in the choice between game modalities during the design of gameful systems.

As can be seen from the previous sections, a proper guideline for managing game modality is necessary. The guideline should take into account all the abovementioned relationships and must be part of a design framework able to exploit an open-access database based on empirical data, indicating which elements are most appropriate for the use of a given game modality according to context, users, device, aim, and encouraged behaviors.

## 4. Conclusions

In this paper, we presented a review of the literature that highlights the importance of modality in gamification and presents evidence of its influence on social, behavioral, and psychological outcomes in traditional activities, video games, and gameful systems. Overall, the data suggest that game modality is often neglected during the definition of gamification frameworks. Evidence on gamification, though, suggests that the general population is affected differently by different modalities, and the effects can be mediated by demographic, and cultural factors. Other factors such as the context of the application, and the specific behaviors that designers want to encourage, may impact the effects of modality, even though data are scarce in this direction. To understand the relationship between modality and all these variables, we presented a research agenda and the necessity to include the modality in gamification design frameworks.

## 5. References

- [1] S. Deterding, D. Dixon, R. Khaled, L. Nacke, From game design elements to gamefulness: defining "gamification", in: Proceedings of the 15th international academic MindTrek conference: Envisioning future media environments, 2011, pp. 9–15.
- [2] B. Morschheuser, A. Maedche, D. Walter, Designing cooperative gamification: Conceptualization and prototypical implementation, in: Proceedings of the 2017 ACM Conference on Computer Supported Cooperative Work and Social Computing, 2017, pp. 2410–2421.
- [3] J. Koivisto, J. Hamari, The rise of motivational information systems: A review of gamification research, *International Journal of Information Management* 45 (2019) 191–210.
- [4] S. Bassanelli, N. Vasta, A. Bucchiarone, A. Marconi, Gamification for behavior change: A scientometric review, *Acta Psychologica* 228 (2022) 103657. URL: <https://www.sciencedirect.com/science/article/pii/S000169182200172X>.
- [5] L. Kotoun, Gamification apps for 2023, 2022. URL: <https://xperienify.com/gamification-apps/>.
- [6] Scavify, 10 best gamification apps for 2022, 2020. URL: <https://www.scavify.com/blog/gamification-app>.
- [7] G. F. Tondello, R. R. Wehbe, L. Diamond, M. Busch, A. Marczewski, L. E. Nacke, The gamification user types hexad scale, in: Proceedings of the 2016 annual symposium on computer-human interaction in play, 2016, pp. 229–243.
- [8] D. Codish, G. Ravid, Gender moderation in gamification: does one size fit all? (2017).
- [9] S. Bassanelli, A. Bucchiarone, Gamidoc: A tool for designing and evaluating gamified solutions, in: Extended Abstracts of the 2022 Annual Symposium on Computer-Human Interaction in Play, 2022, pp. 203–208.
- [10] W. Oliveira, J. Hamari, L. Shi, A. M. Toda, L. Rodrigues, P. T. Palomino, S. Isotani, Tailored gamification in education: A literature review and future agenda, *Education and Information Technologies* (2022) 1–34.
- [11] M. Böckle, I. Micheel, M. Bick, J. Novak, A design framework for adaptive gamification applications, in: Proceedings of the 51st Hawaii International Conference on System Sciences, 2018.
- [12] B. Kim, Designing gamification in the right way, *Library technology reports* 51 (2015) 29–35.
- [13] Y.-k. Chou, Actionable gamification: Beyond points, badges, and leaderboards, Packt Publishing Ltd, 2019.
- [14] A. C. T. Klock, I. Gasparini, M. S. Pimenta, J. Hamari, Tailored gamification: A review of literature, *International Journal of Human-Computer Studies* 144 (2020) 102495.
- [15] K. Kölln, Maybe we don't need a new gamification framework after all, in: Extended Abstracts of the 2022 Annual Symposium on Computer-Human Interaction in Play, 2022, pp. 384–387.
- [16] S. Hallifax, E. Lavoué, A. Serna, To tailor or not to tailor gamification? an analysis of the impact of tailored game elements on learners' behaviours and motivation, in: *International Conference on Artificial Intelligence in Education*, Springer, 2020, pp. 216–227.
- [17] J. F. Choi, J. Choi, Development of gamification model for flipped learning, *International Journal of Crisis & Safety* 6 (2021) 68–79.
- [18] B. Huang, K. F. Hew, Implementing a theorydriven gamification model in higher education flipped courses: Effects on out-of-class activity completion and quality of artifacts, *Computers & Education* 125 (2018) 254–272.
- [19] M. Rauschenberger, A. Willems, M. Ternieden, J. Thomaschewski, Towards the use of gamification frameworks in learning environments, *Journal of Interactive Learning Research* 30 (2019) 147–165.
- [20] A. Mora, D. Riera, C. González, J. Arnedo-Moreno, Gamification: a systematic review of design frameworks, *Journal of Computing in Higher Education* 29 (2017) 516–548.
- [21] D. W. Johnson, Social interdependence: interrelationships among theory, research, and practice., *American psychologist* 58 (2003) 934.
- [22] D. Liu, X. Li, R. Santhanam, Digital games and beyond: What happens when players compete?, *Mis Quarterly* (2013) 111–124.
- [23] M. Deutsch, A theory of co-operation and competition, *Human relations* 2 (1949) 129–152.



- [24] M. Deutsch, Field theory in social psychology, *The handbook of social psychology* 1 (1968) 412–487.
- [25] K. Lewin, *Resolving social conflicts; selected papers on group dynamics.* (1948).
- [26] K. Lewin, *Field theory in social science: selected theoretical papers* (edited by dorwin cartwright.). (1951).
- [27] D. W. Johnson, R. T. Johnson, *Cooperation and competition: Theory and research.*, Interaction Book Company, 1989.
- [28] D. W. Johnson, R. T. Johnson, *Training for cooperative group work*, MA, West, D., Tjosvold, KG Smith,(Eds.), *The essentials of teamworking: International perspectives* (2005) 131–147.
- [29] R. P. Bagozzi, U. M. Dholakia, *Open source software user communities: A study of participation in linux user groups*, *Management science* 52 (2006) 1099–1115.
- [30] D. W. Johnson, R. T. Johnson, *An educational psychology success story: Social interdependence theory and cooperative learning*, *Educational researcher* 38 (2009) 365–379.
- [31] W. M. Al-Rahmi, M. S. Othman, *Evaluating student’s satisfaction of using social media through collaborative learning in higher education*, *International Journal of advances in engineering & technology* 6 (2013) 1541.
- [32] J. M. Tauer, J. M. Harackiewicz, *The effects of cooperation and competition on intrinsic motivation and performance.*, *Journal of personality and social psychology* 86 (2004) 849.
- [33] I. Erev, G. Bornstein, R. Galili, *Constructive intergroup competition as a solution to the free rider problem: A field experiment*, *Journal of Experimental Social Psychology* 29 (1993) 463–478.
- [34] J. W. Julian, F. A. Perry, *Cooperation contrasted with intra-group and inter-group competition*, *Sociometry* (1967) 79–90.
- [35] R. Tuomela, *Collective and joint intention*, *Mind & Society* 1 (2000) 39–69.
- [36] R. Tuomela, *We-intentions revisited*, *Philosophical Studies* 125 (2005) 327–369.
- [37] M. A. Hogg, J. C. Turner, *Interpersonal attraction, social identification and psychological group formation*, *European journal of social psychology* 15 (1985) 51–66.
- [38] I. Cantador, J. M. Conde, *Effects of competition in education: A case study in an elearningenvironment* (2010).
- [39] T. Verhoeff, *The role of competitions in education*, *Future world: Educating for the 21st century* (1997) 1–10.
- [40] I. Fulu, *Enhancing learning through competitions.* school of infocomm technology, Ngee Ann Polytechnic (2007).
- [41] S.-f. Lam, P.-s. Yim, J. S. Law, R. W. Cheung, *The effects of classroom competition on achievement motivation.* (2001).
- [42] E. Vockell, *Educational psychology: A practical approach*, Purdue University (2004).
- [43] F.-Y. Yu, L.-J. Chang, Y.-H. Liu, T.-W. Chan, *Learning preferences towards computerised competitive modes*, *Journal of Computer Assisted Learning* 18 (2002) 341–350.
- [44] J. S. Thousand, R. A. Villa, A. I. Nevin, *Creativity and collaborative learning: The practical guide to empowering students, teachers, and families*, ERIC, 2002.
- [45] J. Shindler, *Transformative classroom management: Positive strategies to engage all students and promote a psychology of success*, John Wiley & Sons, 2009.
- [46] B. Reeves, J. L. Read, *Total engagement: How games and virtual worlds are changing the way people work and businesses compete*, Harvard Business Press, 2009.
- [47] N. Yee, *Motivations for play in online games*, *CyberPsychology & behavior* 9 (2006) 772–775.
- [48] B. Morschheuser, M. Riar, J. Hamari, A. Maedche, *How games induce cooperation? a study on the relationship between game features and we-intentions in an augmented reality game*, *Computers in human behavior* 77 (2017) 169–183.
- [49] J. Jung, C. Schneider, J. Valacich, *Enhancing the motivational affordance of information systems: The effects of real-time performance feedback and goal setting in group collaboration environments*, *Management science* 56 (2010) 724–742.
- [50] R. M. Ryan, C. S. Rigby, A. Przybylski, *The motivational pull of video games: A self-determination theory approach*, *Motivation and emotion* 30 (2006) 344–360.
- [51] C. Ames, D. W. Felker, *An examination of children’s attributions and achievement-related evaluations in competitive, cooperative, and individualistic reward structures.*, *Journal of Educational Psychology* 71 (1979) 413.

- [52] E. L. Deci, G. Betley, J. Kahle, L. Abrams, J. Porac, When trying to win: Competition and intrinsic motivation, *Personality and social psychology bulletin* 7 (1981) 79–83.
- [53] C. Preist, E. Massung, D. Coyle, Competing or aiming to be average? normification as a means of engaging digital volunteers, in: *Proceedings of the 17th ACM conference on Computer supported cooperative work & social computing*, 2014, pp. 1222–1233.
- [54] M. Seif El-Nasr, B. Aghabeigi, D. Milam, M. Erfani, B. Lameman, H. Maygoli, S. Mah, Understanding and evaluating cooperative games, in: *Proceedings of the SIGCHI conference on human factors in computing systems*, 2010, pp. 253–262.
- [55] J. Hamari, K. Huotari, J. Tolvanen, Gamification and economics, *The gameful world: Approaches, issues, applications* 139 (2015) 15.
- [56] C.-I. Teng, W.-W. Chen, Team participation and online gamer loyalty, *Electronic Commerce Research and Applications* 13 (2014) 24–31.
- [57] A. K. Przybylski, C. S. Rigby, R. M. Ryan, A motivational model of video game engagement, *Review of general psychology* 14 (2010) 154–166.
- [58] A. M. Marker, A. E. Staiano, Better together: outcomes of cooperation versus competition in social exergaming, *Games for health journal* 4 (2015) 25–30.
- [59] Y. Jia, Y. Liu, X. Yu, S. Voids, Designing leaderboards for gamification: Perceived differences based on user ranking, application domain, and personality traits, in: *Proceedings of the 2017 CHI conference on human factors in computing systems*, 2017, pp. 1949–1960.
- [60] J. Hamari, J. Koivisto, H. Sarsa, Does Gamification work?—a literature review of empirical studies on gamification, in: *2014 47th Hawaii international conference on system sciences*, Ieee, 2014, pp. 3025–3034.
- [61] D. Codish, G. Ravid, Personality based gamification-educational gamification for extroverts and introverts, in: *Proceedings of the 9th CHAIS Conference for the Study of Innovation and Learning Technologies: Learning in the Technological Era*, volume 1, The Open University of Israel Ra’anana, 2014, pp. 36–44.
- [62] J. Hamari, Transforming homo economicus into homo ludens: A field experiment on gamification in a utilitarian peer-to-peer trading service, *Electronic commerce research and applications* 12 (2013) 236–245.
- [63] E. Massung, D. Coyle, K. F. Cater, M. Jay, C. Preist, Using crowdsourcing to support proenvironmental community activism, in: *Proceedings of the SIGCHI Conference on human factors in Computing systems*, 2013, pp. 371–380.
- [64] R. N. Landers, K. N. Bauer, R. C. Callan, Gamification of task performance with leaderboards: A goal setting experiment, *Computers in Human Behavior* 71 (2017) 508–515.
- [65] V. Gabrielle, The dark side of gamifying work, *Fast Company* 1 (2018) 2018.
- [66] Y. Chen, P. Pu, Healthytogether: exploring social incentives for mobile fitness applications, in: *Proceedings of the second international symposium of chinese chi*, 2014, pp. 25–34.
- [67] B. Morschheuser, J. Hamari, A. Maedche, Cooperation or competition—when do people contribute more? a field experiment on gamification of crowdsourcing, *International Journal of HumanComputer Studies* 127 (2019) 7–24.
- [68] R. Bartle, Hearts, clubs, diamonds, spades: Players who suit muds, *Journal of MUD research* 1 (1996) 19.
- [69] M. AL-Smadi, Gameducation: using gamification techniques to engage learners in online learning, *European Summit on Immersive Education* (2014) 85–97.
- [70] C. Fuß, T. Steuer, K. Noll, A. Miede, Teaching the achiever, explorer, socializer, and killer—gamification in university education, in: *International Conference on Serious Games*, Springer, 2014, pp. 92–99.
- [71] H. Akasaki, S. Suzuki, K. Nakajima, K. Yamabe, M. Sakamoto, T. Alexandrova, T. Nakajima, One size does not fit all: Applying the right game concepts for the right persons to encourage non-game activities, in: *International Conference on Human Interface and the Management of Information*, Springer, 2016, pp. 103–114.
- [72] B. Taspinar, W. Schmidt, H. Schuhbauer, Gamification in education: A board game approach to knowledge acquisition, *Procedia Computer Science* 99 (2016) 101–116.
- [73] F. T. Fernandes, P. T. A. Junior, Gamification aspects in the context of electronic government and education: A case study, in: *International Conference on HCI in*

- Business, Government, and Organizations, Springer, 2016, pp. 140–150.
- [74] A. Marczewski, User types, Even ninja monkeys like to play: Gamification, game thinking and motivational design 1 (2015) 65–80.
- [75] L. R. Goldberg, The structure of phenotypic personality traits., *American psychologist* 48 (1993) 26.
- [76] S. Roccas, L. Sagiv, S. H. Schwartz, A. Knafo, The big five personality factors and personal values, *Personality and social psychology bulletin* 28 (2002) 789–801.
- [77] A. Pakinee, K. Puritat, Designing a gamified elearning environment for teaching undergraduate erp course based on big five personality traits, *Education and Information Technologies* 26 (2021) 4049–4067.
- [78] Y. Jia, B. Xu, Y. Karanam, S. Voids, Personalitytargeted gamification: a survey study on personality traits and motivational affordances, in: *Proceedings of the 2016 CHI Conference on Human Factors in Computing Systems*, 2016, pp. 2001–2013.
- [79] R. Orji, L. E. Nacke, C. Di Marco, Towards personality-driven persuasive health games and gamified systems, in: *Proceedings of the 2017 CHI conference on human factors in computing systems*, 2017, pp. 1015–1027.
- [80] J. Koivisto, J. Hamari, Demographic differences in perceived benefits from gamification, *Computers in Human Behavior* 35 (2014) 179–188.
- [81] G. F. Tondello, A. Mora, L. E. Nacke, Elements of gameful design emerging from user preferences, in: *Proceedings of the annual symposium on computer-human interaction in play*, 2017, pp. 129–142.
- [82] M. Denden, A. Tlili, F. Essalmi, M. Jemni, An investigation of the factors affecting the perception of gamification and game elements, in: *2017 6th international conference on Information and Communication Technology and Accessibility (ICTA)*, IEEE, 2017, pp. 1–6.
- [83] R. Orji, J. Vassileva, R. L. Mandryk, Modeling the efficacy of persuasive strategies for different gamer types in serious games for health, *User Modeling and User-Adapted Interaction* 24 (2014) 453–498.
- [84] M. Busch, E. Mattheiss, M. Reisinger, R. Orji, Fröhlich, M. Tscheligi, More than sex: The role of femininity and masculinity in the design of personalized persuasive games, in: *International Conference on Persuasive Technology*, Springer, 2016, pp. 219–229.
- [85] T. Itoko, S. Arita, M. Kobayashi, H. Takagi, Involving senior workers in crowdsourced proofreading, in: *International Conference on Universal Access in Human-Computer Interaction*, Springer, 2014, pp. 106–117.
- [86] B. Tylor Edward, *Primitive culture*, vol. 1, Henry Holt, New York (1871).
- [87] L. T. Wright, C. Nancarrow, P. M. Kwok, Food taste preferences and cultural influences on consumption, *British Food Journal* (2001).
- [88] A. Miyahara, Toward theorizing japanese interpersonal communication competence from a nonwestern perspective, *Intercultural communication: A global reader* (2004) 279–292.
- [89] L. Zahedi, J. Batten, M. Ross, G. Potvin, S. Damas, P. Clarke, D. Davis, Gamification in education: A mixed-methods study of gender on computer science students' academic performance and identity development, *Journal of Computing in Higher Education* 33 (2021) 441–474.
- [90] L. Hassan, J. Hamari, Gameful civic engagement: A review of the literature on gamification of eparticipation, *Government Information Quarterly* 37 (2020) 101461.
- [91] S.-K. Thiel, M. Reisinger, K. Röderer, "i'm too old for this!" influence of age on perception of gamified public participation, in: *Proceedings of the 15th International Conference on Mobile and Ubiquitous Multimedia*, 2016, pp. 343–346.
- [92] T. Hanghøj, A. Lieberoth, M. Misfeldt, Can cooperative video games encourage social and motivational inclusion of at-risk students?, *British Journal of Educational Technology* 49 (2018) 775–799.
- [93] A. Bucchiarone, A. Cicchetti, S. Bassanelli, A. Marconi, How to merge gamification efforts for programming and modelling: a tool implementation perspective, in: *2021 acm/ieee international conference on model driven engineering languages and systems companion (models-c)*, IEEE, 2021, pp. 721–726.
- [94] J. Quintero, S. Baldiris, J. Cerón, J. Garzón, D. Burgos, G. Vélez, Gamification as support for educational inclusion: The case of ar-robot, in: *2022 International Conference on Advanced Learning Technologies (ICALT)*, IEEE, 2022, pp. 269–273.

- [95] D. Ortega Sánchez, I. M. Gómez Trigueros, Gamification, social problems, and gender in the teaching of social sciences: Representations and discourse of trainee teachers, *Plos one* 14 (2019) e0218869.
- [96] K. Oyibo, R. Orji, J. Vassileva, The influence of culture in the effect of age and gender on social influence in persuasive technology, in: Adjunct publication of the 25th conference on user modeling, adaptation and personalization, 2017, pp. 47–52.
- [97] K. Oyibo, R. Orji, J. Vassileva, Investigation of the social predictors of competitive behavior and the moderating effect of culture, in: Adjunct publication of the 25th conference on user modeling, adaptation and personalization, 2017, pp. 419–424.
- [98] E. Rhee, J. S. Uleman, H. K. Lee, R. J. Roman, Spontaneous self-descriptions and ethnic identities in individualistic and collectivistic cultures., *Journal of personality and social psychology* 69 (1995) 142.
- [99] A. Toda, A. Klock, F. D. Pereira, L. A. Rodrigues, T. Palomino, V. Lopes, C. Stewart, E. H. Oliveira, I. Gasparini, S. Isotani, et al., Towards the understanding of cultural differences in between gamification preferences: A data-driven comparison between the us and brazil, in: *Proceedings of the 15th International Conference on Educational Data Mining*, 2022, p. 560.
- [100] M. Sailer, L. Homner, The gamification of learning: A meta-analysis, *Educational Psychology Review* 32 (2020) 77–112.
- [101] B. Morschheuser, J. Hamari, J. Koivisto, A. Maedche, Gamified crowdsourcing: Conceptualization, literature review, and future agenda, *International Journal of Human-Computer Studies* 106 (2017) 26–43.
- [102] I. Blohm, U. Bretschneider, J. M. Leimeister, H. Krcmar, Does collaboration among participants lead to better ideas in it-based idea competitions? an empirical investigation, *International Journal of Networking and Virtual Organisations* 9 (2011) 106–122.
- [103] A. C. Bullinger, A.-K. Neyer, M. Rass, K. M. Moeslein, Community-based innovation contests: Where competition meets cooperation, *Creativity and innovation management* 19 (2010) 290–303.
- [104] T. Y. Lee, C. Dugan, W. Geyer, T. Ratchford, J. Rasmussen, N. S. Shami, S. Lupushor, Experiments on motivational feedback for crowdsourced workers, in: *Proceedings of the International AAAI Conference on Web and Social Media*, volume 7, 2013, pp. 341–350.
- [105] P. G. Ipeirotis, E. Gabrilovich, Quizz: targeted crowdsourcing with a billion (potential) users, in: *Proceedings of the 23rd international conference on World wide web*, 2014, pp. 143–154.
- [106] T. Straub, H. Gimpel, F. Teschner, C. Weinhardt, How (not) to incent crowd workers, *Business & Information Systems Engineering* 57 (2015) 167–179.