

Towards Identifying Social Gamification Techniques Applicable to Groups, Applied to On-Demand Shared Transportation

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Abstract. *The paper explores applying gamification techniques to improve on-demand shared transportation systems by influencing group decision-making processes. Gamification, typically applied to individual users, is extended to scenarios involving multiple users to optimise resource usage in transportation. The study identifies key gamification elements such as avatars, badges, leaderboards, and challenges and examines their effectiveness in fostering user cooperation and competition. The research suggests combining cooperative and competitive gamification strategies can enhance user engagement, motivation, and overall system efficiency.*

Keywords. gamification, group dynamics, transportation, cooperation, competition

1 Introduction

Gamification is described as applying game-specific techniques and methods to non-game contexts to increase participants' engagement and motivation levels.

One of the fields of gamification applications that could benefit considerably from gamification is the transport of people. The transport systems offer travel to groups of users according to their needs. Those that are more flexible, such as a taxi or transport service that can be adapted to demand, adapt their operation to the travel requests of users. The introduction of gamification techniques in this area seeks to motivate users to

make 'better use' of the transport system. This best use refers to a travel demand that is properly adapted to the available resources of the transport system at any given time. Consequently, this is achieved by motivating users to change the location at which their journey begins or ends and the time at which they wish to travel whenever these attributes represent conflicts with system resources.

Gamification techniques applied to shared transportation present a complex challenge. The scroll request attributes that should be modified now depend on a set of users instead of a single one. For the modification to be successful, all users in the group must reach the same decision. In this paper, we explore gamification techniques applied to groups of people based on the example of shared transportation. Next, we explore the different situations that occur during group decision-making and discuss the problems that could entail applying gamification techniques.

2 Related Work

This section provides topic progression from general gamification towards social and cooperative gamification, introducing concepts relevant to this paper.

2.1 Defining Gamification

As mentioned earlier, the generally accepted definition of gamification concerns using game-specific mechan-

ics, techniques, and methods in non-game contexts. The main goal of this process is usually to boost the users' engagement and motivation levels. Some of the earliest use of the concept of gamification as we know it can be traced to 2008 (Dar et al., 2022; Deterding, Dixon, Khaled and L. E. Nacke, 2011). Since the generally accepted definition mentioned earlier is extremely adaptable, some authors, such as Edwards et al. (2016), constrain their research by providing a more specific definition. For example, Edwards et al. (2016) consider a system to be gamified if it utilises at least one of the techniques in a set of recognised fundamental gamification techniques that comprises the following: avatars, badges, challenges, competitions, leaderboards, prizes, and rewards. The fundamental concepts often related to gamification are points, badges, and leaderboards. More advanced concepts that can be included in a gamified system follow the principles of game design (Manzano-León et al., 2021).

Various authors propose different key building blocks of a game design process. Schell (2019) describes games using the four basic elements of games: 1. mechanics (procedures and rules of a game), 2. story (the sequence of events that progresses the game), 3. aesthetics (the way the game is designed, caters to all of the human senses), 4. technology (how the game is implemented, e.g. pen and paper, computer system, etc.). One of the most studied systems of game design elements, according to Manzano-León et al. (2021), the MDE system (Hunicke et al., 2004; Yamani, 2021), consists of the following elements: 1. mechanics, 2. dynamics, 3. aesthetics. Mechanics encompass rules, actions, and control mechanisms made accessible to the player. Dynamics comprises the behaviours that stem from mechanics and depend on them and their execution. Aesthetics is the concept that elicits the wanted emotional response and works on evoking it in the player.

It should be noted here that gamification uses the concepts of games, but the system using such concepts is not necessarily a game. Furthermore, learning supported by gamification does not necessarily entail game-based learning, according to Yamani (2021). The main goal of a game is to elicit a positive emotional response and to have fun within the constraints of a given game's collection of rules (Avedon and Sutton-Smith, 1971; Schell, 2019; Yamani, 2021). Furthermore, taking part in a game is voluntary. On the other hand, gamification focuses on motivating users to engage with the contents of the gamified system without necessarily transforming the content itself, making the interaction easier and less expensive than developing full-fledged educational games. Game-based learning and gamification aim to enhance the experience of interaction, for example, the experience of learning. Ultimately, while game-based learning makes the learning process a core part of the gameplay, gamification en-

hances existing educational tasks by integrating game mechanics.

Having fun while interacting with different activities and enjoying the process is something people often like (Dindar et al., 2021). Moreover, a number of studies have found that indulging in games and related concepts can positively influence prosocial behaviour in players (Riar, Morschheuser, Hamari and Zarnekow, 2020). Applied gamification mechanics are shown to induce intrinsic and extrinsic motivation in users (Feng et al., 2022). Therefore, it is unsurprising that gamification is becoming increasingly important (Fonseca et al., 2023). However, even though gamification has often been shown to foster motivation, boost engagement, and, for example, improve learning, there are challenges to the use and implementation of gamification techniques in various contexts, such as the long-term viability of the effects of gamification to the users (Sardi et al., 2017). Furthermore, the published research on gamification lacks a generalised approach, as it is often observed in a domain-specific context (Dindar et al., 2021). Another point to emphasise is the lack, and impossible existence, of a definitive list of possible gamification elements because choosing those is a process akin to game design, which is, by definition, experimental (Bakhanova et al., 2023).

2.1.1 Gamification Design Frameworks

The above briefly described MDE model can be considered a methodology or a framework that is used in the process of designing video games. The main goal of using that particular methodology is to ease establishing connections between (Manzano-León et al., 2021): rules–mechanics, game–dynamics, and fun–aesthetics. A similar approach can be applied to gamification systems. Mechanics can be translated into gamification concepts such as trading, competing, collecting cards, etc. Dynamics can be observed in socialising and status marking; aesthetics can be recognised in e.g. the narrative, challenges, or entertainment.

The MDE model is not the only gamification framework that has been published recently. In fact, many gamification design frameworks can be found in the published literature, as presented by Mora et al. (2017) in their overview of 40 such frameworks that were published up to October 2015. Two more gamification design frameworks are presented in this paper: 1. the toolkit of gamification elements presented by Werbach and Hunter (2015) and 2. the Octalysis gamification framework by Chou (2015).

The gamification design framework of Werbach and Hunter (2015) is based on the hierarchy of three fundamental game elements: 1. dynamics, 2. mechanics, 3. components. The concepts of dynamics provide motivation to the user and can be observed in the available in-game choices, social interaction, or ways of eliciting specific emotional responses from players. Dynamics can be observed as being a part of one of the follow-

ing categories: constraints, emotions, narrative, progression, and relationships. Akin to the MDE model described above, mechanics are the concepts that include the player and drive their involvement, generate engagement and motivate them to move forward in the game, such as turns, rewards, or types of relationship implementations. Mechanics can be understood as instances of the concepts in dynamics and as ‘verbs of a game.’ (Werbach and Hunter, 2015) Components comprise the specific actionable elements and objects that implement concepts of dynamics and mechanics, e.g. quests that progress narrative or force social interaction, points that implement one of the aspects of rewards, etc.

The Octalysis gamification design framework, developed and presented by Chou (2015), is a comprehensive model for analysing and designing gamified experiences based on human motivation. This framework’s approach to designing gamification differs from the two described above. It identifies the following eight core drives that influence human behaviour and engagement: 1. epic meaning and calling 2. development and accomplishment 3. empowerment of creativity and feedback 4. ownership and possession 5. social influence and relatedness 6. scarcity and impatience 7. unpredictability and curiosity 8. loss and avoidance. By understanding and leveraging these drives, Chou (2015) argues that designers can create experiences that motivate and engage users more effectively. Furthermore, the core drives are divided with more classification bases in mind. For example, some of the core drives are more associated with creativity, and some are more focused on analytic thought and ownership. Furthermore, Chou (2015) classifies some of the core drives as positive and negative regarding how manipulative they are or how good the user feels when they encounter the applicable core drive. The empowerment of creativity and feedback core drive encourages users to express their creativity and solve problems while receiving immediate feedback. An example of this can be found in sandbox games like Minecraft, where players can build and create within the game world while receiving instant feedback on their creations. By incorporating these and other core drives from the Octalysis Framework, designers can craft engaging and motivating experiences tailored to their audience’s intrinsic and extrinsic motivations.

2.2 Select Application Domains

Gamification has been applied across various domains (Schatten et al., 2017), each leveraging game mechanics to improve user engagement, motivation, and performance. In the requirements elicitation field, gamification involves and engages users, thereby enhancing the process of gathering requirements (Dar et al., 2022). In education, gamification methods aim to foster active learning, which motivates students and

strengthens their connection to the lessons (Chi and Wylie, 2014; Dereli and Kahraman, 2024). Specifically, gamified flipped classrooms have been shown to enhance nursing students’ skill knowledge and self-confidence during clinical practice. Research consistently indicates that educational gamification positively impacts student motivation, engagement, and academic performance across various educational levels, suggesting it is an effective strategy for improving academic outcomes (Manzano-León et al., 2021; Mora et al., 2017).

In health-related applications, incorporating game design elements like earning points, collecting badges, and interacting with virtual agents has significantly enhanced user experience and motivation, encouraging sustained usage (Priesterroth et al., 2019). The positive effects of gamification also extend to e-learning, where elements such as points, leaderboards, rewards, and challenges enhance student motivation and engagement with classroom content (Saleem et al., 2022). Gamification also plays a crucial role in e-health solutions by ensuring regular user engagement and increasing immersion (Sardi et al., 2017). In collaborative knowledge crowdsourcing, gamification mechanics related to immersion, social interaction, and achievement foster a sense of self-worth and competence among solvers, boosting their participation and contribution (Feng et al., 2022). Additionally, gamification strategies incorporating competition, cooperation, and team dynamics have positively affected students’ learning curves (Mohammadi et al., 2023). In the university context, gamification-based cooperative play strategies can enhance students’ emotional intelligence, life goals, and learning strategies, thereby increasing academic motivation and reducing dropout rates (Redondo-Rodríguez et al., 2023). Gamification also supports zero-waste practices by encouraging cooperative efforts towards reducing waste (Imani et al., 2021).

2.3 Frequently Used Gamification Mechanics

As extensively discussed in the available literature, gamification involves various concepts that enhance user engagement and motivation across different domains. Common gamification forms include badges and leadership boards, frequently used to foster a sense of achievement and competition among users (Dindar et al., 2021; Looyestyn et al., 2017). Moreover, Dar et al. (2022) highlight ten essential ingredients of great games (Deterding, Dixon, Khaled and L. Nacke, 2011), such as avatars, 3D environments, ranks, levels, reputation, feedback, economies, rule-based competition, teams, configurable communication systems, and time pressure, along with other elements like scores, points, badges, awards, and quests. These elements, particularly points, leaderboards, and badges, are frequently

used in requirements elicitation, illustrating their effectiveness in engaging users.

The application of gamification in education and health also showcases the versatility of game mechanics. For instance, Manzano-León et al. (2021) uses the MDE model presented above and describes game mechanics as actions and controls within a game, such as drawing cards or competing, while dynamics refer to behaviours like socialising or reflecting during gameplay. Aesthetics evoke emotional responses in players, enhancing their engagement. Feng et al. (2022) classifies gamification elements into three categories: immersion (e.g., storytelling and avatars), social (e.g., chats and peer ratings), and achievement (e.g., points and badges). These classifications are evident in the diverse applications of gamification methods, including educational escape rooms, board games, and online quizzes in physiotherapy and rehabilitation education (Dereli and Kahraman, 2024). Virtual reality games and gamified websites further illustrate the innovative use of gamification techniques in educational contexts, with leaderboards being particularly motivating as they visualise progress.

The analysed studies consistently report various gamification elements contributing to enhanced user experiences. Feedback, rewards, progress bars, social connections, challenges, and quests are commonly used across applications (Saleem et al., 2022; Sardi et al., 2017). Feedback, in particular, stands out as a widely used technique, often accompanied by parallel communication systems and digital rewards, which can include virtual coins, badges, or other in-game items (Priesterroth et al., 2019). Manzano-León et al. (2021) enumerate a comprehensive list of gamification elements, including challenge, reward, narrative, achievements, points, levels, badges, ranking, mastery, and feedback, underscoring the multifaceted nature of gamification strategies. These elements enhance motivation and engagement and facilitate active learning and behavioural change, proving the efficacy of gamification in various fields.

2.4 Social Gamification, Cooperation, and Competition

Social gamification involves transforming individual-based tasks into social events by incorporating elements of interaction and cooperation, thereby creating more immersive experiences for users. Gamification elements are classified into four categories based on social dependence: 1. individual 2. competitive 3. cooperative 4. and competitive-cooperative. Cooperative game elements often include design patterns that encourage teamwork, such as complementarity, synergies between roles, shared goals, and special rules for team members (Imani et al., 2021; Morschheuser et al., 2017). Research indicates that cooperation in gamification fosters better socialisation and psychological

health compared to competition. Cooperative settings lead to higher group participation and greater intimacy among group members, making gamified cooperation more effective in developing feelings of belonging and attachment among learners. Both gamified competition and cooperation can sustain task effort and improve learning outcomes, but they engage different psychological processes (Dindar et al., 2021).

Social gamification plays a significant role in creating a sense of belonging by enhancing individual tasks and enabling users to engage with others. It transforms activities such as exercise into social events, fostering a sense of immersion and interaction that is distinct from individualistic gamification. Interaction with cooperative game design features can promote altruism, as players find intrinsic fulfilment and enjoyment in contributing to the welfare of others. Altruistic behaviours are especially prominent within groups where individuals identify with each other, creating a "we"-perspective (Riar, Morschheuser, Hamari and Zarnekow, 2020; Zhang et al., 2023). Cooperative learning further emphasises the importance of working towards shared goals, facilitating participants' support and reinforcing gamification's social aspects (Fonseca et al., 2023).

Designing systems to achieve full cooperation involves addressing individuals' altruistic motivations and group intentions rather than relying solely on individual motives. Social interdependence theory (SIT) explains how social interactions influence people's goals, highlighting positive interdependence in cooperative environments where mutual goals are shared and negative interdependence in competitive settings where one's success depends on others' failure. Individualistic gamification lacks these elements but can be transformed into social gamification by integrating competitive or cooperative mechanisms. Cooperation and interpersonal competition can coexist, but intergroup competition inherently involves cooperation among team members (Zhang et al., 2023).

The concept of cooptation, which combines competition and cooperation, offers a promising approach to designing social gamification (Liu et al., 2017). It opens up new avenues for enhancing engagement and motivation by leveraging the strengths of both competitive and cooperative dynamics (Zhang et al., 2023). Competition is categorised by Zhang et al. (2023) into interpersonal (among individuals) and intergroup (among groups), leading to various forms of cooptation. These include interpersonal cooptation, intergroup cooptation, and hybrid cooptation, each involving different combinations of cooperation and competition. Studies suggest that cooptation can enhance engagement and motivation, offering a fresh perspective on the design of social gamification systems.

The meta-analysis of 148 studies on SIT performed by Roseth et al. (2008) indicates that cooperative goal structures generally outperform competitive ones in

offline tasks (Zhang et al., 2023). This finding supports the effectiveness of cooperative environments in promoting better outcomes. Intergroup cooperation, which integrates cooperation with intergroup competition, has increased game engagement and physical activity, such as daily steps. This approach induces group cohesiveness, leading to more constructive cooperation among teammates and overall enhanced engagement.

Social gamification leverages cooperative and competitive elements to enhance user engagement and motivation. Fostering social interactions and creating a sense of belonging transforms individual tasks into collective activities, promoting psychological well-being and effective learning outcomes. Cooperative game elements, social interdependence, and competition strategies are central to designing effective social gamification systems, ultimately leading to higher engagement and better performance (Riar, Morschheuser, Zarnekow and Hamari, 2022). Furthermore, Riar, Morschheuser, Zarnekow and Hamari (2022) argue that designing cooperative gamification brings several advantages, including fostering social identity, team cohesion, and interpersonal ties.

3 Example Use Case

This section describes the on-demand shared transportation example used here to showcase how gamification can be used to improve the use of a transportation system and then lists considerations for applying gamification techniques to groups of people.

3.1 System Description

We consider the user of the transport system i , represented by his travel request $p_i(O_i, D_i, T_i)$. The request describes the origin of the trip O_i , the destination D_i , and the time the user wants to travel T_i . The request will be fulfilled once the user who issued it is picked up by a transport at O_i at a time later than or equal to T_i and finally moved to D_i . If the transport operator detects that this request is too expensive for the system to fulfil or simply impossible, the gamification system is activated to motivate the user to modify it. This modification may include an alternative location of origin or destination and a travel time before or after the one entered by the user. The system will calculate the possible modifications and present them to the user together with a reward that motivates them to accept a suggested modification. The reward can represent various benefits depending on the gamification system being implemented. For example, it could be a score on a public scoreboard or a discount on the price of the user's trip. The user will, therefore, have the freedom to accept or reject the modifications offered to them and will be rewarded whenever their decision cuts the costs of the transport system.

3.2 Group Decision Making

In the previous section, we described how gamification techniques can be used to improve a transport system. The dynamic described, however, has considered the interaction with a single user. After all, a real system has several users requesting trips simultaneously, so the gamification system must adapt to this situation. Below, we list different considerations that must be considered to make this adaptation.

Grouping of the decision. In certain cases, the system may require that each of the group's users accept the same modification on their journey since if they do not all, the benefit for the system would be non-existent. In these cases, a partial commitment process is carried out. Users are informed of the number of participants in the process and are given a maximum time to make their individual decisions. If all participants' decisions are not unanimous when the given time ends, the trip modification is considered rejected, and no user is rewarded.

Rejection penalty. Given a modification to the journey of a group of users, the system may partially benefit if most users accept it. The benefit, however, will be less than if the acceptance were unanimous. To motivate this unanimous acceptance, the minority of users who have chosen to reject the modification may be penalised. However, this type of more aggressive technique must be applied very carefully to avoid the appearance of negative feelings in the user regarding the transport system.

Negotiation between users. The last case we consider contemplates the negotiation between the group's users, who must make the decision. Given a specific travel modification, each user can propose changes to the modification, thus making it more attractive to them. This negotiation process takes place in turns, during which users make proposals. Once the final round is reached, the group's decision must be unanimous, either accepting or rejecting the negotiated modification.

3.3 Proposed Group Gamification Approach

The approach described above, in Sec. 3, is geared towards the individual and their role in a group. Due to the constraints of the used example, this group consists of other commuters, i.e. other users of the on-demand shared transportation system. It may be observed that all the people in the same group share a common goal – the aim of their interaction is to lower their fare as much as possible by utilising the system and the rewards it offers them. The concept of a reward is used very freely in this particular example, with no specified features at the moment other than bringing benefit to the users if they all agree to reach the same decision.

Following the content presented in Sec. 2.4, the gamified system is expected to be more effective in a

cooperative context. Even so, to further enhance the users' motivation and eagerness to interact with the system and each other, we propose the combined approach of cooperation and competition here.

One suggestion following the recent guidelines on social and cooperative gamification outlined in Sec. 2.4 combines cooperation and competition on different levels of social interaction. We propose a mechanic of individual players grouped into long-term groups (named herein guilds). When faced with a challenge or a task, such individual players are, due to the described nature of the example on-demand shared transportation system in Sec. 3, grouped into small short-term temporary groups (named herein parties). In such a setting: i) The individual players can behave following the interpersonal competition, at the very least collecting green points for helping the transportation system spend fewer resources, showcase those on a leaderboard, customise their avatars, socialise with other users, etc. ii) Guilds can act according to intergroup competition, for example, visually spreading their influence showcased as a real-world map overlay, based on the number of members or the number of members following the rules of the group and successfully achieving individual or group objectives and accepting modifications proposed by the system. iii) Individual players within their chosen guilds can behave cooperatively, driven by the common group goals and the aim of strengthening their guild. Furthermore, the social benefits of being a part of the group may include ways of providing a helping hand to fellow guild members. iv) Individual players within the temporary grouping (a party) would also be advised to act cooperatively. All of the members of a party receive the greatest benefits only if they cooperate.

The described system utilises various gamification elements that cater to both the individual and the group levels. The latter being the more important for this paper, it should be noted here that providing challenges on a group level is argued here to be one of the ways of influencing the behaviour of the group members. Providing visual feedback on the strength of the group, as opposed to providing feedback only on the strength of the individual user, is argued here to be beneficial for fostering group behaviour. Further discussion on the effect of the proposed system and further possible gamification elements and their effects in this particular application domain is presented in the following section.

4 Discussion

The suggestion of individual competition combined with intra-guild and -party cooperation, and inter-guild competition, might seem to oppose the intergroup competition on the guild level, yet this dichotomy of the source of individual's power and competitive advantage over other users creates a complex social dynamic

that may mitigate the possible stagnancy of motivation to follow the gamified system's rules, suggestions, and modification requests.

The proposed approach to interpersonal competition ties in with the described example system's goal of minimising the number of users who are ready to reject the suggested journey modification. Since one of the users' goals is to accumulate as many rewards and benefits as possible, thus winning over the competition posed by other users, it is expected to be natural for users to avoid receiving penalties or not receiving rewards. Further motivation and engagement enhancement is expected to be driven by other available gamification techniques, such as attractive narrative and graphically customised visual representation of the real world, providing emphasis on the effect generated by single user's decisions to accept the system-provided journey modifications in terms of environmental and similar changes, individual and group-based challenges, time-limited journey modification offers, customised reward system that chooses the best award from a predefined set based on the user's profile thus enticing curiosity and unpredictability.

The proposed temporary grouping mechanic described in Sec. 3.3 provides a gamified approach to the decision grouping and interpersonal negotiation stages of the dynamic described in Sec. 3.2. Since the users compete with each other, they are expected to aim to maximise their rewards and benefits. On the other hand, the largest benefit from an intra-party interaction can be achieved by cooperation. Therefore, users in a party are competitors by default, who are put into a situation that demands cooperation. To further foster the efficiency of intra-party cooperation, party actions could have greater weight on the user's individual contribution to their guild's standings.

Finally, the long-term grouping mechanic proposed in Sec. 3.3 is argued here to be able to foster the engagement of users in general. Behaving socially benefits the user's engagement with the system and the game, according to many authors in 2. Cooperative inter-guild behaviour incentivises users' inclusion and sense of belonging, for every journey modification they accept provides benefits for their guild. On the other hand, individual users are expected to accept journey modification more eagerly since it would reward them (benefit for the interpersonal competition) and their guild (benefit for the intra-guild cooperation and inter-guild competition).

5 Conclusions

This paper has opened a line of research based on applying gamification techniques to improve transport, specifically on-demand shared transportation. As the text demonstrates, applying these techniques to influence the decision of groups of people is not trivial, and,

therefore, the case described must be carefully considered before the approach of a real system.

Regarding future work, we are currently developing the implementation of a transport simulator that allows us to run different experiments with various gamification techniques. The results of these tests will provide relevant information so that both transport operators and researchers can correctly choose the gamification techniques to apply to specific types of transport.

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