# 143 km

**The teleportation of entanglement travelling this distance proves the feasibility of a quantum repeater in a space- and ground-based worldwide quantum Internet.**

Image by Graeme Paterson

# An Introduction to Gamification in Human-Computer Interaction

**Improving user experience through game play.**

*By Gustavo Fortes Tondello*

User experience (UX) is a field within human-computer interaction (HCI) that studies the whole experience of a user with a product, system, or service. UX focuses on issues such as usability, ergonomics, cognitive load, and affective experiences. However, in the last few years, there has been a growing interest in understanding users' motivation to use a product, system, or service. This interest

is spawned by observable low engagement rates: It is not enough to have a useful system, one needs to also motivate and engage users in it. One possible solution to this comes from a field of study called gamification or gameful design.[1] Its main inspiration comes from understanding the factors that make games fun and motivate people to play them voluntarily with so much engagement.

Gamification is defined in HCI as "the use of game design elements in non-game contexts" [1]. There are two important concepts embedded in this definition:

▶ *Game design elements:* The parts used to build games. In this context, we refer to the parts that afford the gameful experience, instead of the technologies involved in creating the game. Thus, we are not interested in things like graphics and audio. Instead, gamification focuses on elements such as challenges, levels, avatars, points, achievements, stories, and leaderboards.

▶ *Non-game contexts:* Those applications whose main purpose goes beyond pure entertainment. Examples of contexts where gamification has been applied include: business, marketing, education, and health.

Deterding et al.'s definition [1] also suggests gamification consists of using game elements in a system that is not a full game. This is different from serious games, which are also used in non-game contexts but with a different approach. Gameful design also differs from playful design because the former focuses on activities that are oriented to goals and structured by rules, while the latter focuses on free-form and improvisational activities (although both gameful and playful design can be applied together to the same product). Figure 1 situates gameful design between the poles of games and play, parts and whole.

Most gamification researchers have been seeking to understand users' motivations to interact with a product or system by means of the self-determination theory (SDT) [2]. SDT posits human beings can be intrinsically or extrinsically motivated to engage with any task. Intrinsic motivation refers to wanting to do something just because the task itself is enjoyable. Extrinsic motivation refers to doing something because there is a possibility of achievement, some additional outcome, such as earning a reward or fulfilling an obligation. Furthermore, SDT posits intrinsic

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1 There have been a few different definitions of gamification and gameful design from different fields and authors. We have also seen some heated discussions attributing slight different meanings to these terms and arguing in favor of one or the other. However, we use both terms here from the point of view of HCI research and attribute them both the same meaning.

motivation is supported by activities that fulfill three psychological needs: competence (feeling capable of doing something), autonomy (feeling free to choose how to do something), and relatedness (feeling connected with other people). SDT researchers have demonstrated the fulfillment of these three psychological needs can explain why players enjoy games so much [2]. For example, completing quests or beating a difficult boss in a game makes the player feel

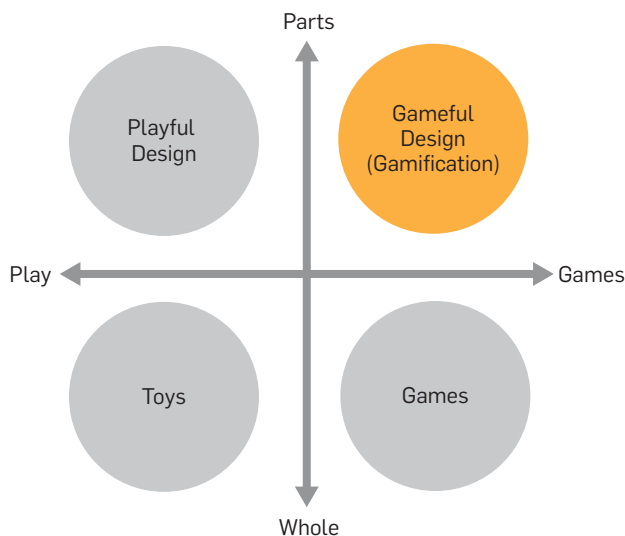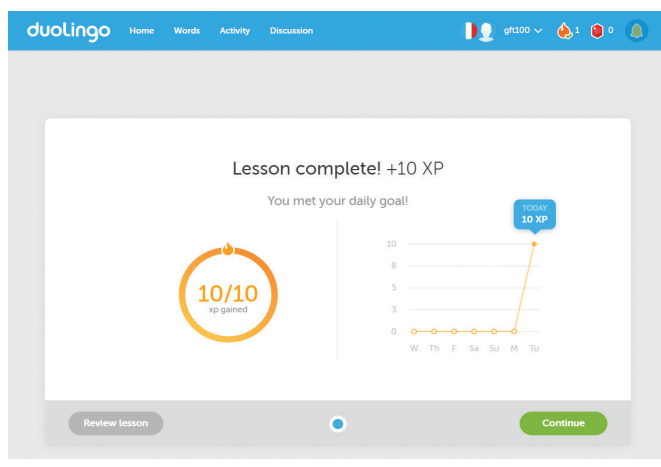**Figure 1. Gamification between games and play, parts and whole.**



**Figure 2. Gameful elements after my first completed lesson at Duolingo.**



competent. Being able to choose different paths or to create different things makes the player feel autonomous. Finally, playing with other people (in cooperation or competition) makes the player feel related. Thus, these insights have often been applied to gamification by selecting and using game design elements that can lead users to feel the same kind of motivation when interacting with any system.

An example is the language-learning site Duolingo. Figure 2 shows how Duolingo used gameful design elements after I completed my first French lesson. Before I began, the application allowed me to choose the language I wanted to learn, how much time I wanted to study per day, and if I wanted to begin at the basic or the advanced level. These choices helped me feel autonomous. While doing the first lesson, a progress bar was always visible showing me I was getting closer to achieving my goal. After I completed the lesson, I was informed I had completed my daily goal and earned experience points. All of this helped me feel competent. The daily streak counter (the fire icon at the top right) also motivated me to engage with the application every day. Finally, it is possible to connect with other users inside the platform, helping me feel related with others. Duolingo has been cited as an interesting example of gamification, and its learning effectiveness has been independently studied (https://www.duolingo.com/research).

In HCI, the study of gamification has often been part of the sub-domains of player-computer interaction (PCI) and player experience (PX), which study the experience of players interacting with games. Research focused on games with a purpose (serious games) and gamification has been increasingly popular at the ACM CHI conference, as well as the recently created ACM CHI PLAY Conference, which is focused on the PCI sub-domain. Furthermore, Gamification 2013 was a focused conference held at the University of Waterloo that put together scholars interested in gameful design research and applications.

Despite its popularity, gamification research is still an emergent field and much remains to be done. A review by Seaborn and Fels in 2015 [3] noted usage of the term gamification remains inconsistent; more empirical, mixed-method research that reports statistical analysis and effect sizes are needed to substantiate the initial positive effects reported. Furthermore comparative studies with controls are needed to ascertain what effects gamification has beyond other approaches. Another review by Hamari et al. in 2014 [4] suggested gamification does work, but some caveats exist as most quantitative studies reported only partially positive results. The reasons for this still need to be further investigated.

A quantum computer could easily crack a security code that would otherwise take thousands of years using the most powerful supercomputers.

Besides additional investigation regarding the results of gameful design implementations, more research is also needed regarding gameful design methods. Many design methods have been described by industry practitioners, but these often lack a solid theoretical foundation and proven empirical results. Seeking to fill this gap, Deterding has reviewed several industrial and academic gameful design methods and proposed the "lens of intrinsic skill atoms" [5]. This is a design method backed by scientific research on motivation and game design, and has been applied in several case studies. Deterding's method focuses on identifying the underlying challenges of the activity and helping the user reframe them as gameful challenges, with help of motivational design lenses. Nicholson introduced the term "meaningful gamification" [6], which aims to help a user find personal connections that motivate engagement with a specific context for long-term change. This is achieved by employing six new concepts in gameful design instead of a reward-based design: reflection, exposition, choice, information, play, and engagement. Kappen and Nacke introduced the "kaleidoscope of effective gamification" (KEG), which describes several design layers that need to be applied to a gameful system to achieve effectiveness—in this context this is described as "the successful engagement of a player through effective game design" [7]. KEG describes four layers: the motivated behavior layer, the game experience layer, the game design process layer, and the perceived layer of fun.

Finally, another topic that has been recently receiving attention is the personalization of gameful applications. Several studies have suggested different people respond differently to gameful applications; thus, a personalized approach seems to be more engaging than a one-size-fits-all approach. This topic was investigated in the Workshop on Personalization in Serious and Persuasive Games and Gamified Interactions" (http://personalizedgames.

tech-experience.at/) held during ACM CHI PLAY 2015. One approach for personalization in gameful design is understanding and tailoring the design to a particular user's motivations and personality. Among the diversity of player and user type models in the literature, there are two recent research-based models that can be used for this approach. One of them is the BrainHex model [8], which is based on neurobiological research and describes seven types of players according to motivation: achievers, conquerors, daredevils, masterminds, seekers, socialisers, and survivors. Another is the gamification user types Hexad [9], which is based on the theories of intrinsic and extrinsic motivation and describes six types of users in gameful systems: achievers, free spirits, philanthropists, socialisers, players, and disruptors.

Gamification is an interesting and exciting research topic in HCI. Initial results have shown it carries great potential for improving engagement in user experience and positively helping people and businesses achieve their goals. Nevertheless, there are still open research questions to be explored. Uncountable practical applications are being implemented all the time and reporting favorable results, despite often lacking scientific validation. Because of all these factors, we expect to see many valuable results from gamification research for the following years. Stay tuned!

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**Completing quests or beating a difficult boss in a game makes the player feel competent. Being able to choose different paths or to create different things makes the player feel autonomous.**

**Biography**

Gustavo Fortes Tondello is a Ph.D. student in computer science at the University of Waterloo, Canada.His main interests include gamification and games for health and learning. His research focuses on the design of gameful applications.