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Analysing the effectiveness of gamification: a strategy to create engaging, motivating and enjoyable user experiences

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ANALYSING THE EFFECTIVENESS OF GAMIFICATION: A STRATEGY TO CREATE ENGAGING, MOTIVATING AND ENJOYABLE USER EXPERIENCES

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DOCTORAL DISSERTATION

ANALYSING THE EFFECTIVENESS OF GAMIFICATION: A STRATEGY TO CREATE ENGAGING, MOTIVATING AND ENJOYABLE USER EXPERIENCES

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A mis padres, Andrés y María Luisa,
por apoyarme y creer siempre en mí

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CHAPTER I

INTRODUCTION

1.1. MOTIVATION

In recent decades, the advances in technology, in general, and mobile technology, in particular, have changed the way humans interact, make purchases, manage their finances, or receive educational content (Grewal et al., 2020; MobileAppDaily, 2022). Technological development has also affected internal organizational processes, including human resource management, such as the way companies attract and recruit new talent, or motivate, train and retain employees (Stone et al., 2015; Vrontis et al., 2022).

The outbreak of the Covid-19 pandemic has accelerated the digital transformation and changed the way people and organizations live and work (De' et al., 2020). During the spread of the pandemic, social distancing norms were imposed and, therefore, people had to shift their daily activities to a remote environment.

In the second quarter of 2020, mobile app downloads, usage and consumer spending hit all-time records (TechCrunch, 2020). Driven by social distancing and lockdown measures, worldwide mobile app usage grew 40% year-over-year in the second quarter of 2020, reaching a monthly record high of over 200 billion hours during the month of April 2020 (Data.ai, 2020). An all-time high for app downloads was also reached with 35 billion new downloads during the second quarter of 2020 (TechCrunch, 2020). Mobile apps of different categories saw a boost from the Covid-19 pandemic. For instance, the Covid-19 pandemic caused a transition from traditional gym consumers to virtual fitness users (Grand View Research, 2023) and data shows how the total number of mobile health and fitness app downloads worldwide grew from 565 million to 811 million during second quarter of 2020 (Data.ai, 2022). Similarly, the number of people who used for the first time digital services skyrocketed (McKinsey & Company, 2021).

Furthermore, the Covid-19 pandemic lead companies to adopt work-from-home policies. Employees had to adapt to sudden changes, such as virtual meetings, whereas companies had to invest on information technology, such as cloud-enabled tools and technologies, digital collaboration tools, productivity management tools, remote monitoring technologies and learning and training tools to support remote work (Statista, 2022).

In this digitized economy, where organizations are looking for new ways to provide engaging experiences to their customers and employees (Robson et al., 2016), gamification has become a fundamental aspect of any user interface and user experience design (Klock et al., 2020). But, what is gamification? Briefly, gamification involves the application of game design elements (e.g., points, rules, challenges, rewards, competition) in non-game contexts (Deterding et al., 2011) to harness the motivational and attractive power of games and, as a consequence, get people to achieve higher levels of motivation. On the one hand, gamification is a basic tool for companies involved in digital markets that deal with consumers who are constantly connected to the Internet and their smartphones (Tobon et al., 2020). On the other hand, as business processes are increasingly carried out in digital contexts and employees become more digital native, companies need to implement new tools and strategies, such as gamification, in human resources management to increase employees' engagement (Silic et al., 2020). In sum, gamification appears to be a powerful strategy that can increase the motivation and engagement of both consumers and employees.

Gamification has rapidly gained interest from both practitioners and scholars (Huotari & Hamari, 2017; Koivisto & Hamari, 2019; Wünderlich et al., 2020). The global gamification market size was estimated at $10.5 billion in 2021 and it is expected to reach around $96.8 billion by 2030; that is, it is expected to increase at a compound annual growth rate of 27.99% during this period (Precedence Research, 2023). Many organizations have shown an increased interest in using game elements to motivate people to behave in certain ways (Koivisto & Hamari, 2019). In this sense, there are many examples of the use of gamification in the business area. For instance, mobile apps related to health and physical activity, such as Fitbit, Strava or Runtastic, use game elements to motivate users to continuously use them and do sport. Similarly, mobiles apps in the financial context, such as Mint, Personal Capital or You Need a Budget, include game elements (e.g., challenges, points) to enhance personal finance management. Some organizations have also applied gamification in their internal processes. Companies such as McKinsey & Company make use of technologies to offer new personnel recruitment formats under gamified environments in which applicants from different backgrounds have to face different challenges and reach a solution. Likewise, Ernst & Young (EY) uses gamified platforms to attract and recruit talented employees, whereas Deloitte uses gamified approaches in the form of escape room games to train their employees. In all

these contexts, gamification makes it possible to assess different cognitive skills, provides insights beyond the resume or the traditional interview, and makes the recruitment process more attractive, increasing applicants' satisfaction, organizational attractiveness and attracting new applicants (Buil et al., 2020).

In addition to this notable increase in its use in the business context, gamification has become a research line of great importance for academics (Huotari & Hamari, 2017; Koivisto & Hamari, 2019; Wünderlich et al., 2020). Since the term gamification emerged in the early 2000s (Sailer et al., 2017), its use has gained popularity in a variety of contexts (Seaborn & Fels, 2015). The increasing number of literature reviews published around this concept, in general (e.g., Hamari et al., 2014; Kasurinen & Knutas, 2018; Koivisto & Hamari, 2019; Krath et al., 2021; Rapp et al., 2019; Seaborn & Fels, 2015), and specific fields, such as education (e.g., Khaldi et al., 2023; Metwally et al., 2021; Zainuddin et al., 2020), manufacturing (e.g., Keepers et al., 2022), the Internet of Things (e.g., Xiao et al., 2022), e-participation (e.g., Hassan & Hamari, 2020), cooperation activities (e.g., Riar et al., 2022), corporate training (e.g., Larson, 2020), production and logistics operations (e.g., Klock et al., 2021; Warmelink et al., 2020) or tourism (e.g., Pasca et al., 2021), in particular, shows its importance in academia.

1.2. GAMIFICATION: AN OVERVIEW

Although it was in 2002 when Nick Pelling, a computer programmer, first mentioned the term gamification, it became popular around 2010. One of the first definitions was proposed by Deterding et al. (2011, p. 9), who define it as *"the use of game design elements in non-game contexts"*. These authors differentiate the term gamification from other related concepts, such as (serious) games, toys and playful design, based on two dimensions: playing/gaming and parts/whole. That is, their classification takes into account the entertainment purpose of the product and the design scope (Kasurinen & Knutas, 2018). Briefly, games or serious games are fully-developed games for entertainment purposes (i.e., games) or not-entertainment purposes (i.e., serious games), whereas gamification merely incorporates game elements into the system or activity which has not entertainment purposes. On the other hand, gamification differs from playful design and toys in the playing/gaming dimension. Gamification is related to

gaming, which means playing structured by rules and towards goals (Deterding et al., 2011). Conversely, playful design and toys are related to playing, that is, a free-form, expressive, improvisational recombination of behaviours and meanings (Deterding et al., 2011). In addition, while playful design refers to systems designed with playful elements, but with a non-playful purpose in real-life, toys refer to products fully developed for playing and with an entertainment purpose (Deterding et al., 2011; Kasurinen & Knutas, 2018).

Based on the definition of Deterding et al. (2011), other definitions have been proposed later. For instance, Seaborn and Fels (2015, p. 17) underline the intentionality of gamification and define the term as *"the intentional use of game elements for a gameful experience of non-game tasks and contexts"*, while Sailer et al. (2017, p. 372) emphasize the users' experiences and define it as *"the process of making activities in non-game contexts more game-like by using game design elements"*.

Other authors have defined the term gamification based on the benefits for the user. In this sense, Robson et al. (2015, p. 2) focus on the design principles to change user behaviours and achieve desired goals and posit that gamification refers to *"the application of lessons from the gaming domain to change behaviours in non-game situations"*. Similarly, Zichermann and Cunningham (2011) argue that gamification generates benefits such as engaging users and solving problems.

Finally, gamification has also been defined from the perspective of service marketing. In this sense, focusing on the experiences that gamification can invoke, Hofacker et al. (2016, p. 2) define it as *"the use of game design elements to enhance non-game goods and services by increasing customer value and encouraging value-creating behaviours such as increased consumption, greater loyalty, engagement, or product advocacy"*. In a similar vein, Huotari and Hamari (2017, p. 25) define this concept as *"a process of enhancing a service with affordances for gameful experiences in order to support user's overall value creation"*.

All definitions share two important features: the use of game design elements or affordances and the fact that gamification can be used in different non-game contexts. These two issues are briefly discussed next.

Gamification has the potential to reshape tasks and activities by using game elements (Koivisto & Hamari, 2019). However, when referring to the game elements, different terminologies and classifications are found in the literature, as authors use different levels of abstraction (Klock et al., 2020).

Werbach and Hunter (2012) establish three categories of game elements organized according to the order of abstraction: game dynamics, game mechanics and game components. Dynamics correspond to the highest level of abstraction and include elements such as constraints, emotions, narrative, and progression. At the next level are the mechanics, which correspond to those that promote action, for example challenges, competition, cooperation, feedback, etc. Finally, as more specific forms, there are the components, such as achievements, avatars, badges, points, levels, etc.

The MDE framework (Mechanics-Dynamics-Emotions), developed by Robson et al. (2015), is also a well-known approach to analyse game elements in the business context. This proposal is based on the MDA framework (Mechanics-Dynamics-Aesthetics) developed by Hunicke et al. (2004) in an attempt to explain and better understand game designs. In the MDE framework, mechanics are established by the gamified system designer. Mechanics set the goals, rules, setting, context, types of interactions, and boundaries of the situation; therefore, they remain constant across players. By contrast, dynamics, which refer to player behaviours during the experience, depend on the way in which players interact with the mechanics. Finally, emotions refer to affective mental states during a gamified experience and depend on the way in which players follow the mechanics and create the dynamics.

More recently, Koivisto and Hamari (2019, p. 193) use the term affordance to refer to *"the various elements and mechanics that structure games and aid in inducing gameful experiences within the systems"*. The concept of affordance, introduced by Gibson (1977), has been the basis for many studies into gamification (e.g., Du et al., 2020; Suh et al., 2017, 2018). In particular, Koivisto and Hamari (2019) differentiate between three categories: achievement and progression-oriented affordances, which include elements such as badges/medals, points, leaderboards/rankings, progress bars and increasingly difficult levels; social-oriented affordances, which include elements such as cooperation, competition with others, social networking features and teammates; and immersion-oriented affordances, which include elements such as avatars or profiles,

narrative or meaningful stories and customisation. As noted by Koivisto and Hamari (2019), the achievement and progression-oriented elements are the most common in gamified systems, followed by social-oriented elements and immersion-oriented elements.

In relation to the contexts, the definitions agree that gamification can be applied in a wide range of non-game contexts. Indeed, gamification outcomes highly depend on these contexts and on the individuals who interact with the gamified system (Hamari et al., 2014). Gamification has been applied and studied in a variety of fields, such as education (e.g., Bouchrika et al., 2021; Buil et al., 2019; Da Rocha Seixas et al., 2016; Huang et al., 2019; Piteira et al., 2018), sports (e.g, Hamari & Koivisto, 2015; Hassan et al., 2020; Kim et al., 2022), health (e.g., Biduski et al., 2020; Hydari et al., 2022), finance (e.g., Nasirzadeh & Fathian, 2020; Rodrigues et al., 2016), marketing activities (e.g., Eisingerich et al., 2019; Hsu & Chen, 2018; Hwang & Choi, 2020; Jang et al., 2018), human resources (e.g., Buil et al., 2020; Hammedi et al., 2021; Mitchell et al., 2020), or tourism (e.g., Bravo et al., 2021; Trigo-De la Cuadra et al., 2020; Moro et al., 2019; Xu et al., 2017), among others.

Focusing on the target group of gamification, Werbach and Hunter (2012) propose that gamification can be divided into three categories: internal gamification, which is applied into organizations; external gamification, which supports communication exchange between firms and customers; and gamification towards behavioural change, which is focused on obtaining positive results for a person or/and the whole society, such as promoting healthier lifestyles or more sustainable behaviours.

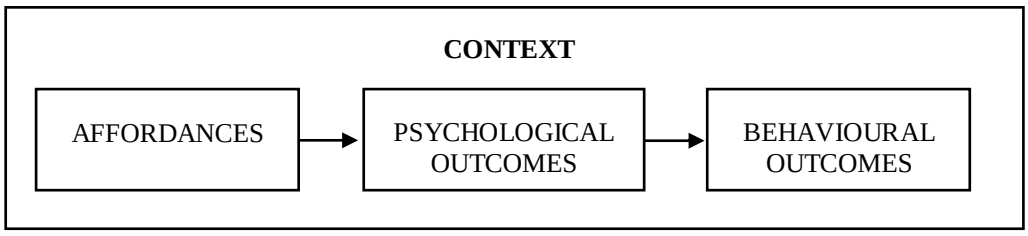
From a similar perspective, Wünderlich et al. (2020) suggest that gamification has the potential to impact on four levels: in-game, intra-organizational, customer and transformative. At the in-game level, gamification has the potential to enhance the user's experience by increasing his/her effort and persistence (Gutt et al., 2020) and his/her usage intention (Höllig et al., 2020). At the intra-organizational level, gamification has shown great potential to motivate employees (Friedrich et al., 2020; Mitchell et al., 2020) and enhance employee productivity (Oprescu et al., 2014). At the customer level, previous studies have found support for the role of gamification in customer relationship management, especially in loyalty programs, where it has been shown to increase customer loyalty, participation and intention to download apps (Hwang & Choi, 2020).

Moreover, gamification has been shown to increase marketing effectiveness by promoting user commitment, willingness to pay and customer referrals (Wolf et al., 2020), adoption of product innovations (Müller-Stewens et al., 2017), the use of e-commerce platforms (Aparicio et al., 2021) and perceptions of brand equity (Xi & Hamari, 2020). Finally, at the transformative level, gamification has been shown to be a highly effective means of promoting health (Sardi et al., 2017), exercise (Jang et al., 2018; Matallaoui et al., 2017) and sustainable energy consumption (Mulcahy et al., 2020; Oppong-Tawiah et al., 2020).

1.3. GENERAL FRAMEWORK AND THEORETICAL BACKGROUND

This doctoral dissertation follows the overall conceptualization of gamification proposed by Koivisto and Hamari (2019), based on the works of Hamari et al. (2014), Huotari and Hamari (2017) and Deterding (2015). These authors posit that on an overarching level, gamification is made up of three main components: 1) the motivational affordances implemented to a system or service, 2) the psychological outcomes derived from these motivational affordances, and 3) the further behavioural outcomes. According to Koivisto and Hamari (2019), these three interrelated components are situated within a specific context (Deterding, 2015; Hamari et al., 2014; Huotari & Hamari, 2017) (see Figure 1.1).

Figure 1.1. Overall conceptualization of gamification



Source: Koivisto & Hamari (2019)

The first component includes the affordances. As explained earlier, Koivisto and Hamari (2019) classify the affordances into three groups: achievement and progression-oriented affordances, social-oriented affordances and immersion-oriented affordances. The first group, achievement and progression-oriented affordances, includes elements such as badges/medals, points, leaderboards/rankings, progress bars and increasingly

difficult levels. The second group, social-oriented affordances, includes elements such as cooperation, competition with others, social networking features and teammates. Finally, the third group, immersion-oriented affordances, includes elements such as avatars or profiles, narrative or meaningful stories and customisation.

The second component refers to the psychological outcomes that both games and gamification seek to promote. As noted by Koivisto and Hamari (2019), these psychological outcomes include a great variety of psychological experiences, such as competence, autonomy, relatedness, enjoyment and engagement.

Finally, the third component of the overall conceptualization proposed by Koivisto and Hamari (2019) corresponds to the behavioural outcomes that gamification attempt to encourage, such as intention to use or better learning results.

There are different theories in the literature that are used to explain, design and evaluate the effects of gamification (Krath et al., 2021). Although as recently noted by Krath et al. (2021, p. 3), there is still a *"controversy and lack of an overview of the theories that are used as a basis for scientific research on gamification in different contexts"*, some theoretical foundations are especially popular. As explained in the following chapters, this doctoral dissertation focuses on four theories to explain the underlying mechanisms that explain the gamification effects: the self-determination theory (SDT; Deci, 1975), the self-system model of motivational development (SSMMD; Connell, 1990; Connell & Wellborn, 1991; Skinner et al., 2008), the technology acceptance model (TAM; Davis, 1989), and the information system success theory (DeLone & McLean, 1992, 2003; Seddon, 1997; Seddon & Kiew, 1996). A brief description of each of them is provided below and in the following chapters we will delve into each one in more detail.

The self-determination theory (SDT; Deci & Ryan, 2000) is of great importance to understand the motivational power of games (Ryan et al., 2006). Therefore, it has become a key framework to explain how gamification works (Tobon et al., 2020). This theory distinguishes different types of motivation according to the degree to which they are autonomous (i.e., intrinsic motivation, integrated regulation and identified regulation) or controlled (i.e., introjected regulation and external regulation). Between these two broad types of motivation, to achieve the best outcomes from any activity or task, it is

preferable for individuals to be autonomously motivated, as this means that they find the activities important and enjoy them, rather than controlled, which would imply doing them by obligation or external pressure (Deci & Ryan, 2015). In addition, the SDT and, in particular, the cognitive evaluation theory (Ryan & Deci, 2000), a sub-theory within SDT, states that the satisfaction of the individual's basic psychological needs for competence, autonomy and relatedness fosters greater autonomous motivation (Deci & Ryan, 2000).

Gamification may also enhance psychological processes such as engagement (Koivisto & Hamari, 2019; Suh et al., 2018). In this sense, the self-system model of motivational development (SSMMD; Connell, 1990; Connell & Wellborn, 1991; Skinner et al., 2008), which is based on the SDT (Deci, 1975), explains the role that social contextual factors play in the development of individuals' self-system processes and how they promote or undermine individuals' engagement. In line with the SDT, the SSMMD states that engagement arises when the psychological needs for competence, autonomy and relatedness are satisfied. On the contrary, individuals experience disaffection when these psychological needs are not met (Connell & Wellborn, 1991).

Another common theoretical framework used to explain the effectiveness of gamification is the technology acceptance model (Tobon et al., 2020). The technology acceptance model (TAM), proposed by Davis (1989), suggests that individuals' attitudes towards specific technologies are predicted by two beliefs, their perceived usefulness, that is, the individual's belief that using a system will boost his/her performance, and their ease of use, that is, the individual's belief that interacting with the system will not demand additional effort (Davis, 1989).

As gamification is an information system phenomenon (Koivisto & Hamari, 2019), information system success theories (DeLone & McLean, 1992, 2003; Seddon, 1997; Seddon & Kiew, 1996) may also help to explain gamification effectiveness. The model proposed by DeLone and McLean (1992) has been largely used to examine information system success. This model includes six dimensions: system quality, information quality, use, user satisfaction, individual impact and organisational impact. Furthermore, alternative models have been proposed based on DeLone and McLean (1992)'s model. In particular, the information system success model proposed by Seddon (1997) shows how information quality and system quality influence perceived usefulness of a system and user satisfaction, as well as how perceived usefulness influences user

satisfaction. The model also suggests that net benefits for individuals, organizations and society may influence perceived usefulness and user satisfaction.

In sum, these theoretical frameworks can help understand why, and how, including game affordances or elements into non-game contexts may enhance individuals' experience and promote favourable psychological outcomes and the desired behaviours, as well as under which circumstances they work best.

1.4. RESEARCH GAPS

Despite the growing interest in gamification, prior research on this subject faces several challenges (Koivisto & Hamari, 2019; Rapp et al., 2019). According to Koivisto and Hamari (2019), gamification literature should move forward in three directions: thematic, theoretical and methodological.

Regarding to the thematic agenda, empirical research on gamification is mainly focused on the education domain. Therefore, it should broaden the study areas in order to analyse how gamification impacts other contexts. Similarly, a better understanding of the gamification effect on various stakeholder groups such as users, customers or employees is needed (Wünderlich et al., 2020). In addition, it is necessary to investigate the individual effect of motivational affordances/game elements, since most of previous research analyses gamification as a uniform concept (Sailer et al., 2017) or focuses on few elements, such as the PBL triad (points, badges, and leaderboards) (Werbach & Hunter, 2012) or customization and badges (Klock et al., 2020).

As mentioned in the previous section, gamification is conceptualized as a process consisting of three interrelated components: motivational affordances, psychological outcomes and behavioural outcomes. However, few studies carry out a complete analysis of the effects of gamification on these different components (Hamari et al., 2014; Koivisto & Hamari, 2019). Therefore, from a theoretical point of view, more studies should examine the underlying mechanisms through which gamification, in general, and game elements, in particular, influence the affective and attitudinal responses of individuals, and these, in turn, influence the behavioural responses. Although there are

several theories that may support the understanding and explanation of gamification effectiveness, many studies are not based on a theoretical framework (Seaborn & Fels, 2015). Therefore, there is a need to advance in the study of the gamification phenomenon by drawing on different theoretical approaches (Rapp et al., 2019).

Finally, from a methodological point of view, future research should include larger samples, validated measures, and more comprehensive analyses, beyond descriptive statistics (Hamari et al., 2014; Koivisto & Hamari, 2019; Seaborn & Fels, 2015).

1.5. RESEARCH OBJECTIVES

Taking into account the potential of gamification, as well as the challenges and gaps identified in the literature, this doctoral dissertation seeks to understand the underlying mechanisms through which gamification influences the attitudes and behaviours of individuals. By doing this, this doctoral dissertation advances the knowledge of gamification as a tool to create more motivating, engaging and enjoyable experiences and to influence individuals' attitudes and behaviours.

This general research objective can be divided into the following specific objectives:

1. To provide a broader understanding of the effects of gamification by analysing their use in different application contexts and directed to different users. In particular, both external gamification –directed towards customers– and internal gamification –which takes place within the organizations and is directed towards current and potential employees– are analysed.

2. To provide a theoretical foundation to explain how and why gamification works and produces positive effects. More specifically, this doctoral dissertation draws on four theoretical approaches –i.e., the self-system model of motivational development, the self-determination theory, the

technology acceptance model, and the information system success theory– to offer a theoretical basis to better understand the effects of gamification on the attitudes and behaviours of individuals.

3. To investigate the effects of different individual motivational affordances (i.e., game elements) implemented in the gamified systems to offer a more detailed analysis of their efficacy.

4. To explain the underlying mechanisms through which the motivational affordances (i.e., game elements) affect the psychological and behavioural responses of individuals. By doing this, we seek to provide a comprehensive view of the effects of gamification.

To respond to these research goals, the doctoral dissertation is divided into the following chapters, which correspond to three empirical investigations.

Chapter II focuses on external gamification and investigates the mechanisms that facilitate user engagement with gamified mobile apps and its consequences. Specifically, drawing on the self-system model of motivational development (SSMMD; Connell & Wellborn, 1991), this chapter analyses how the motivational affordances embedded in mobile gamified apps (i.e., achievement and progression-oriented elements, social-oriented elements and immersion-oriented elements) satisfy individuals' psychological needs for competence, autonomy and relatedness. Furthermore, it examines how these psychological needs increase user engagement with mobile apps and the effect of user engagement on individuals' continued use intention, WOM intention and ratings of apps.

Chapter III also focuses on external gamification and analyses the role of gamification in increasing users' motivation and intention to use gamified apps and facilitating their adoption. Specifically, it focuses on the financial industry and the personal financial management (PFM) apps. In particular, this chapter integrates the self-determination theory (SDT; Deci, 1975) and the technology acceptance model (TAM; Davis, 1989) to examine the effects of motivational affordances on motivational factors, such as perceived competence, perceived autonomy and autonomous motivation, and their subsequent effects on technology acceptance variables, such as perceived ease of use

and perceived usefulness. An exploration is then made of users' attitudes towards gamified PFM apps and their intention to use them.

Chapter IV focuses on internal gamification and examines the effectiveness of gamified e-trainings by analysing employees' attitudes and behaviours across two studies. Study 1 draws on the information systems success literature (DeLone & McLean, 1992, 2003; Seddon, 1997; Seddon & Kiew, 1996) and explores how the motivational affordances embedded in gamified e-training systems on information security increase their success and enhance employees' perceptions of security self-efficacy. In particular, it investigates how the motivational affordances improve information quality and system quality, and how it fosters enjoyment when using gamified e-training systems. Furthermore, it analyses the influence of information quality, system quality and enjoyment on perceived usefulness and employee satisfaction. Finally, it examines how perceived usefulness enhances employee satisfaction and how these factors improve employees' perceptions of security self-efficacy. Study 2 investigates employees' behaviours by analysing their response to a phishing attack.

Finally, chapter V presents the main conclusions resulting from this doctoral dissertation, as well as the theoretical and practical contributions. Limitations and directions for future research avenues are also discussed.

Table 1.1 exhibits a summary of the empirical investigations included in each chapter. In particular, it displays the research objectives, the study context, the theory and the methodology applied, the variables included in the research model and the most important findings.

Table 1.1. Summary of the chapters of the doctoral dissertation

Chapter	Research objective	Study context	Theory	Methodology	Variables studied	Key findings
Chapter II	To investigate how gamification may foster user engagement and positive marketing outcomes (i.e., intention to use, intention to recommend, app rating)	External gamification: mobile apps users	The self-system model of motivational development (SSMMD)	Empirical / Quantitative (survey) Structural equation modelling Sample: 276 users of a gamified fitness app	Motivational affordances (Achievement/ progression elements, Social elements, Immersion elements), Competence, Autonomy, Relatedness, User engagement, Continued use intention, WOM intention, App rating	Gamification increases user engagement through satisfaction of the needs for competence, autonomy and relatedness. User engagement, in turn, leads to greater intention to use, disseminate WOM about, and to positively rate, the app
Chapter III	To explore how gamification increases users' motivation and intention to use personal financial management (PFM) apps, and how it facilitates their adoption	External gamification: mobile apps users	The self-determination theory (SDT) and the technology acceptance model (TAM)	Empirical / Quantitative (survey) Structural equation modelling Sample: 208 users of a gamified personal financial management app	Motivational affordances, Competence, Autonomy, Autonomous motivation, Perceived ease of use, Perceived usefulness, Attitude, Behavioural intention	Gamifying PFM apps satisfies users' needs for competence and autonomy and enhances their autonomous motivation to use them. Users' motivation increases their perceptions of ease of use and usefulness of the apps and causes them to develop more favorable attitudes towards them. The findings also confirm a relationship between users' attitudes towards PFM apps and the behavioural intention to use them

Table 1.1. Summary of the chapters of the doctoral dissertation (continued)

Chapter	Research objective	Study context	Theory	Methodology	Variables studied	Key findings
Chapter IV	To explore how gamification increases the success of e-training systems and employees' perceptions of security self-efficacy, as well as to investigate employees' behaviours by analysing their response to phishing attack	Internal gamification: employees	The information system success theory	Empirical / Quantitative Study 1: Survey (subjective perceptions) Structural equation modelling Sample: 1,178 employees Study 2: Phishing campaign (objective behaviours) Variation in the percentage of click rate and the number of phishing e-mails reported to supervisors Sample: 13,452 phishing e-mails (first wave) and 13,714 phishing emails (second wave)	Motivational affordances (Challenge, Feedback, Clear goals, Narrative), Information quality, System quality, Enjoyment, Perceived usefulness, Satisfaction, Security self-efficacy	Gamification significantly influences information quality, system quality and enjoyment which, in turn, increase perceived usefulness and satisfaction. Perceived usefulness also enhances satisfaction, and both variables improve employees' security self-efficacy. Furthermore, gamified e-training systems are effective for improving employees' security behaviours (i.e., employees' response to a phishing attack)

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CHAPTER II

ENHANCING USER ENGAGEMENT: THE ROLE OF GAMIFICATION IN MOBILE APPS

2.1. INTRODUCTION

Over the last few years there has been an increasing trend to use mobile apps. This is reflected in the number of mobile app downloads, which grew worldwide from 194 billion in 2018 to 255 billion in 2022 (Statista, 2023). While the use of mobile apps is widespread, only 32% of users employ any one app more than 10 times. Similarly, 25% of mobile apps are used only once after being downloaded (Localytics, 2019). As these numbers suggest, user engagement with mobile apps is weak. Therefore, one of the most important challenges faced by organizations operating these applications is to keep the user engaged (Cechetti et al., 2019).

Gamification is a promising avenue for enhancing user engagement. Consequently, an increasing number of mobile app developers are incorporating gamification into their apps to enhance the user experience (Hofacker et al., 2016). Through the user's voluntary interaction with the system and its affordances –that is, the "*various elements and mechanics that structure games and aid in inducing gameful experiences within the systems*" (Koivisto & Hamari, 2019, p. 193)–, gamification promotes in him/her a series of psychological outcomes, such as enhanced motivation and engagement, with the final aim of shaping his/her behaviours (Koivisto & Hamari, 2019).

While mobile apps have become part of individuals' everyday lives, with some exceptions (e.g., Cechetti et al., 2019; Featherstone & Habgood, 2019; Kamboj et al., 2020), empirical research into how gamification affects user engagement with mobile apps is still limited. Indeed, recent studies have called for deeper understanding of engagement with mobile apps, and its antecedents and consequences (e.g., Fang et al., 2017; Ho & Chung, 2020). In addition, although useful, the prior literature is limited in that many studies discuss gamification only as a research context (e.g., Kamboj et al., 2020), and do not establish any links to extant theories to explain the motivational processes driven by the individual elements of gamification (see Suh et al., 2018 as an exception). Moreover, most studies examine a limited set of game elements (e.g., competition and leaderboards in Featherstone & Habgood, 2019; scoring systems, progress bars and levels, leaderboards and feedback in Cechetti et al., 2019), and do not measure users' interactions with the individual game elements, as advocated elsewhere

in the literature (Xi & Hamari, 2020). Finally, most studies analyse models by employing user engagement as the dependent variable. Thus, there is a need to understand better the mechanisms that explain how gamification can increase user engagement in this context, and how user engagement might foster positive outcomes.

Addressing these gaps, the present study draws on the self-system model of motivational development (SSMMD; Connell & Wellborn, 1991), which proposes that contexts that satisfy individuals' basic psychological needs promote engagement, to investigate how gamification might foster user engagement with mobile apps and positive marketing outcomes. Specifically, this study proposes a model to analyse how three game element categories embedded in mobile gamified apps (i.e., achievement and progression-oriented elements, social-oriented elements and immersion-oriented elements) contribute to the satisfaction of individuals' psychological needs for competence, autonomy and relatedness. In turn, it investigates the influence of these psychological needs on user engagement with mobile apps. Finally, the impact of user engagement on individuals' continued use intention, WOM intention and ratings of apps is analysed.

The study contributes to the literature and practice in a number of ways. It offers valuable insights into the user engagement literature. First, engagement is an abstract and context-specific construct. However, research related to engagement with mobile apps and its consequences "*still awaits development*" (Ho & Chung, 2020, p. 13). Indeed, as many scholars have noted (e.g., Fang et al., 2017; Kim & Baek, 2018; Tarute et al., 2017), only limited research has explored user engagement in the mobile environment. In addition, those works that have studied user engagement with mobile apps have focused on identifying the specific features or attributes of the apps (e.g., functionality, ease of use, privacy and security, interactivity) that drive user engagement (e.g., Fang et al., 2017; Kim & Baek, 2018). In contrast, few studies have investigated the influence of gamification. Therefore, this study advances previous research by examining gamified mobile apps and investigating how different game element categories might improve user engagement. Second, many previous studies have used performance indicators to measure user engagement (e.g., Featherstone & Habgood, 2019; Feng et al., 2020; Liu et al., 2020). Although useful, these measures do not address why users behave in specific ways (O'Brien & Toms, 2010). The present

study uses a self-report measure, the user engagement scale short form (UES-SF) (O'Brien et al., 2018), and contributes to a greater understanding of the measurement of user engagement by examining the use of this scale in the context of gamified mobile apps. Finally, by adopting a holistic view of user engagement to understand the phenomenon, this study explores its antecedents and consequences and provides a guide for commercial mobile app developers and operators.

The study also provides valuable insights into the gamification literature. First, the underlying mechanisms that explain how gamification engages users, in general, and mobile app users, in particular, are not yet fully understood; there has been little empirical research in the field and those studies that have been undertaken have important limitations (Rapp et al., 2019). Specifically, few studies have drawn on well-grounded theoretical models to explain the effects of gamification features (Seaborn & Fels, 2015). Our theory-driven study, based on the SSMMD (Connell & Wellborn, 1991), advances knowledge about the mechanisms through which gamification impacts on user engagement in the context of mobile apps, and provides useful insights into the use of gamification. Second, recent literature reviews (e.g., Koivisto & Hamari, 2019; Rapp et al., 2019; Tobon et al., 2020) have noted that there is a lack of research into the specific effects of game elements, as many studies investigate gamification only as a research context and/or focus on just a small set of elements. This study responds to these calls for more research into the influence of the different motivational affordances (i.e., game elements), and sheds new light on their effects. Finally, the study overcomes the methodological limitations of prior works, many of which are descriptive and use small samples and unvalidated measures (Hamari et al., 2014; Koivisto & Hamari, 2019; Seaborn & Fels, 2015)

This chapter is structured as follows. First, in section 2.2 the most relevant studies on gamification and engagement are discussed. Section 2.3 presents the theoretical background and proposes the research hypotheses. Section 2.4 describes the methodology and Section 2.5 exhibits the results. Finally, Section 2.6 discusses the findings and presents the theoretical and managerial implications of the study, as well as the limitations and future research directions.

2.2. PREVIOUS RESEARCH ON GAMIFICATION AND ENGAGEMENT

As noted by Syrjälä et al. (2020, p. 3), "*gamification research typically takes engagement as a given concept*". However, as shown in theoretical discussions about the construct in fields such as organizational behaviour (e.g., Bakker et al., 2008; Macey & Schneider, 2008), marketing (e.g., Brodie et al., 2011; Hollebeek, 2011; Verhoef et al., 2010), education (e.g., Appleton et al., 2006; Fredricks et al., 2004) and human-computer interaction (e.g., O'Brien & Toms, 2008, 2010), the definition and operationalization of engagement is not simple. Different meanings of engagement have been proposed across various academic disciplines (Pansari & Kumar, 2017), and numerous terms have been used to describe different engagement subjects and objects (e.g., customer engagement, brand engagement, student engagement, employee engagement, user engagement).

In recent years, numerous studies have investigated the relationship between gamification and different forms of engagement. Student engagement with academic activities is one of the engagement forms that has received the most attention (e.g., Bouchrika et al., 2019; Çakıroğlu et al., 2017; da Rocha Seixas et al., 2016; Ding et al., 2018; Filsecker & Hickey, 2014; Göksün & Gürsoy, 2019; Juho Hamari et al., 2016; Zainuddin et al., 2020), given that education is one of the most fertile gamification research fields. However, research into gamification and engagement in contexts other than education is becoming increasingly popular. As shown at Table 2.1, previous studies have explored the links between gamification and customer engagement (e.g., Eisingerich et al., 2019; Jang et al., 2018; Yang et al., 2017), brand engagement (e.g., Berger et al., 2018; Syrjälä et al., 2020; Xi & Hamari, 2020), employee engagement (e.g., Hammedi et al., 2021; Silic et al., 2020) and user engagement (e.g., Featherstone & Habgood, 2019; Suh et al., 2018; Wang et al., 2017). The focus of the present study is on user engagement, which has been defined as "*a quality of user experience characterized by the depth of an actor's cognitive, temporal, affective and behavioral investment when interacting with a digital system*" (O'Brien et al., 2018, p. 29).

Table 2.1. Relevant empirical studies investigating the relationship between engagement and gamification

Reference	Independent variables	Mediator / moderator	Dependent variables	Research design	Key findings
Customer engagement					
Harwood & Garry (2015)	Game elements (challenge, tasks, rewards, badges, leaderboards and win condition)	Customer engagement behaviours and customer engagement emotions / -	Reward, relationship, loyalty and subversion	Netnographic approach	The study identifies key processes and outcomes of online customer engagement and behaviour
Robson et al. (2016)	Gamification mechanics for player types		Customer and employee engagement	Case study	Gamification can foster customer and employee engagement, improving the way customers interact with a brand/firm and increasing the productivity at work
Hammedi et al. (2017)	Gamification mechanics	Challenge, entertainment, social dynamics and escapism / Medical predispositions and age	Patient engagement (cognitive, emotional and behavioural)	Case study	Gamification mechanics foster four experiential outcomes in patients: challenge, entertainment, social dynamics, and escapism, which in turn stimulate patient engagement
Yang et al. (2017)	Perceived usefulness, ease of use, social influence and enjoyment	Customers' engagement intention / -	Brand attitude	Focus group and survey	Perceived usefulness and perceived enjoyment predict intention of engagement and brand attitude. Perceived ease of use does not influence these variables. Perceived social influence only influences brand attitude
Xu et al. (2017)	Game elements		Brand awareness, tourist experiences, tourist engagement, customer loyalty, entertainment and employee management	Case study	Gamification can benefit tourism marketing

Table 2.1. Relevant empirical studies investigating the relationship between engagement and gamification (continued)

Reference	Independent variables	Mediator / moderator	Dependent variables	Research design	Key findings
Jang et al. (2018)	Gamified customer benefits (epistemic, social integrative and personal integrative)	- / Age and experience	Customer engagement behaviour and purchase	Longitudinal design	Personal and social integrative benefits are the best drivers of engagement and purchase
Leclercq et al. (2018)	Game elements (competition and cooperation)	Customer experience, losing a contest / Prior level of customer engagement	Customer engagement towards the co-creation activity (conscious attention, enthused participation and social connection) and community	Experiment	Win/lose decisions deteriorate the benefits of gamification. Losing a competition has a negative impact on customer experience and engagement
Eisingerich et al. (2019)	Gamification principles (social interaction, sense of control, goals, progress tracking, rewards and prompts)	Hope, compulsion, customer engagement / -	Purchases	Interviews and survey	Hope positively mediates the relationship between gamification principles and customer engagement. Compulsion reduces the possibility of customer engagement
Brand engagement					
Lucassen & Jansen (2014)	Gamification mechanisms		Brand engagement, brand loyalty and brand awareness	Case study and interviews	Marketing executives see an increase in engagement as one of the most important benefits of gamification
Berger et al. (2018)	High interactivity and optimal challenge	Brand engagement (emotional and cognitive) / Compulsory play and time pressure	Self-brand connection	Experiment	Gamified interactions highly interactive and optimally challenging facilitate self–brand connections through emotional and cognitive brand engagement. Compulsory play weakens emotional brand engagement whereas time pressure reduces cognitive brand engagement

Table 2.1. Relevant empirical studies investigating the relationship between engagement and gamification (continued)

Reference	Independent variables	Mediator / moderator	Dependent variables	Research design	Key findings
Högberg et al. (2019)	Gamification	Hedonic value, positive affect, reward satisfaction, continued engagement intention / -	Brand engagement	Experiment	Gamification leads to continued engagement intention through hedonic value and reward satisfaction. Continued engagement intention is associated with brand engagement
Syrjälä et al. (2020)	Gamification		Consumer brand engagement and consumer benefits (functional, hedonic, social, and educational)	Interviews	Gamified packaging generates: functional, hedonic, social, and educational benefits for the consumer, which are linked to consumer brand engagement dimensions (cognitive, emotional, and behavioural)
Xi & Hamari, (2020)	Immersion-, achievement- and social-related gamification features	Brand engagement (cognitive, emotional and behavioural) / -	Brand awareness and brand loyalty	Survey	Achievement and social interaction-related gamification features positively influence the three forms of brand engagement. Immersion-related gamification features are only positively associated with social brand engagement. Brand engagement increases brand awareness and brand loyalty
Employee / job engagement					
Passalacqua et al. (2020)	Gamified interface and seat goals		Employee engagement (cognitive and emotional) and performance	Experiment	Gamification can be a suitable strategy for a lack of employee engagement
Silic et al. (2020)	Enjoyment of gaming, recognition in gaming, usefulness of gaming and motivation, reciprocal benefit and performance expectancy		Job satisfaction and job engagement	Experiment	Reciprocal benefits, usefulness of gaming, motivation for gaming, recognition and enjoyment of gaming foster job satisfaction and engagement

Table 2.1. Relevant empirical studies investigating the relationship between engagement and gamification (continued)

Reference	Independent variables	Mediator / moderator	Dependent variables	Research design	Key findings
Hammedi et al. (2021)	Gamified work	Job satisfaction and job engagement / Employee willingness to participate	Job performance	Interviews and experiment	Gamification has a negative impact on employee engagement and well-being. The willingness of employees to participate in the gamified work moderates the negative impact
User engagement					
Kuo & Chuang (2016)	Game design mechanisms		Engagement with online platforms (objective metrics)	Experiment	Graphical incentives, gamified thematic activities and discussion boards are the three game elements influencing member retention and engagement
Wang et al. (2017)	Game elements (points, rankings, achievement and social elements)		Engagement towards a computation system, acceptance (attitude, intention to use, and intention to recommend), perceived usability and perceived output quality	Experiment	Participants experience more engagement and show higher behavioural intentions towards the gamified system. Perceived output quality and perceived engagement have a significant influence on the acceptance of the gamified system
Suh et al. (2018)	Game dynamics (rewards, competition, self-expression, altruism)	Competence, autonomy, relatedness and enjoyment / -	User engagement with a gamified information system (vigor, dedication, and absorption)	Survey	Gamification enhances user engagement through the mediation of psychological needs satisfaction (autonomy, competence, and relatedness) and enjoyment
Cechetti et al. (2019)	Game elements (score system, progress bar and levels, leaderboard, feedback)		TAM (perceived utility, ease of use, external factors, attitude towards and demonstrated results) and user engagement with a health mobile app (focus and attention, usability perception, aesthetics aspects, supportability, originality, and involvement)	Experiment	Gamification favours engagement, stimulating intrinsic motivation in the participants

Table 2.1. Relevant empirical studies investigating the relationship between engagement and gamification (continued)

Reference	Independent variables	Mediator / moderator	Dependent variables	Research design	Key findings
Featherstone & Habgood (2019)	Game elements (competition and leaderboards)		Engagement with an app (objective metric)	Experiment	Gamification increases engagement with the app
Feng et al. (2020)	Commensurate game elements (e.g., points) and incommensurate elements (e.g., likes)		Autonomy, competence, relatedness, engagement behaviour (objective metrics), intrinsic motivation, loyalty	Experiment	In comparison to incommensurate game elements, users who interact with commensurate game elements have stronger intrinsic motivation, are more engaged in participation in physical activity and show higher loyalty towards the fitness app
Kamboj et al. (2020)	Perceived usefulness, perceived ease of use, convenience and enjoyment	Engagement with mobile apps / -	Intention to use	Survey	Perceived ease of use, perceived usefulness and enjoyment have a significant influence on engagement, which in turn leads to users' intention
Liu et al. (2020)	Gamification design (badges)	Disparity in professional seniority / -	Engagement with online platforms (objective metrics) and inequality economic of returns	Experiment	Gamification design increases physicians' engagement in online health communities

To conceptualize the user engagement construct, some authors have focused on the user-system attributes that provide an engaging experience, developing in the process different self-reported questionnaires (e.g., Jacques, 1996; O'Brien & Toms, 2008). This approach is useful as it allows researchers to provide guidelines on how to enhance users' experiences and facilitates the operationalization of user engagement (O'Brien et al., 2018).

One of the most popular measures of user engagement is the user engagement scale (UES) developed by O'Brien and Toms (2010). The original UES consisted of 31 items in six dimensions of user engagement (i.e., aesthetic appeal, focused attention, novelty, perceived usability, felt involvement, and endurability). However, empirical studies have questioned the validity of the six original UES factors (O'Brien et al., 2018). In addition, due to its size, few researchers use the whole scale (O'Brien et al., 2018). To address these methodological issues, O'Brien et al. (2018) recently explored the dimensionality of the scale; they found that four (rather than six) factors better represent the underlying dimensionality of the UES. In addition, they proposed a shortened form of the UES, the UES-SF. The four dimensions of the revised UES are aesthetic appeal, reward, focused attention and perceived usability. Briefly, aesthetic appeal is the visual appeal and attractiveness of the interface; reward relates to the evaluated experiential outcome, and encompasses items from three original scale dimensions, that is, novelty, felt involvement and endurability; focused attention is the feeling of absorption while interacting with the system; finally, perceived usability relates to the end-users' perceptions of the usability of a system, the negative feelings aroused as a consequence of interacting with the system and the levels of effort and capability required to use it.

In the modern world many experiences are digitally mediated (e.g., eHealth, eLearning, digital games, social media, online search). Therefore, it is now timely, and important, to understand individuals' interactions with these digital environments (O'Brien, 2018; O'Brien & Cairns, 2016). Given the wide variety of digital technologies (e.g., web search engines, social networking sites, mobile apps), the relationship between user engagement and gamification has been investigated in several contexts (see Table 2.1), such as information systems (e.g., Suh et al., 2018), human computation (e.g., Wang et al., 2017) and online platforms (e.g., Kuo & Chuang, 2016;

Liu et al., 2020). Recently, some studies have explored how gamification can improve user engagement with mobile apps (e.g., Cechetti et al., 2019; Featherstone & Habgood, 2019; Feng et al., 2020; Kamboj et al., 2020). For instance, Cechetti et al. (2019) investigated the use of gamification to improve user engagement with a mobile health application, and Feng et al. (2020) explored the effect of different game elements on user engagement with fitness apps. In general, these studies found that gamification had a positive effect on users' engagement.

2.3. THEORETICAL BACKGROUND AND RESEARCH HYPOTHESES

2.3.1. The self-system model of motivational development (SSMMD)

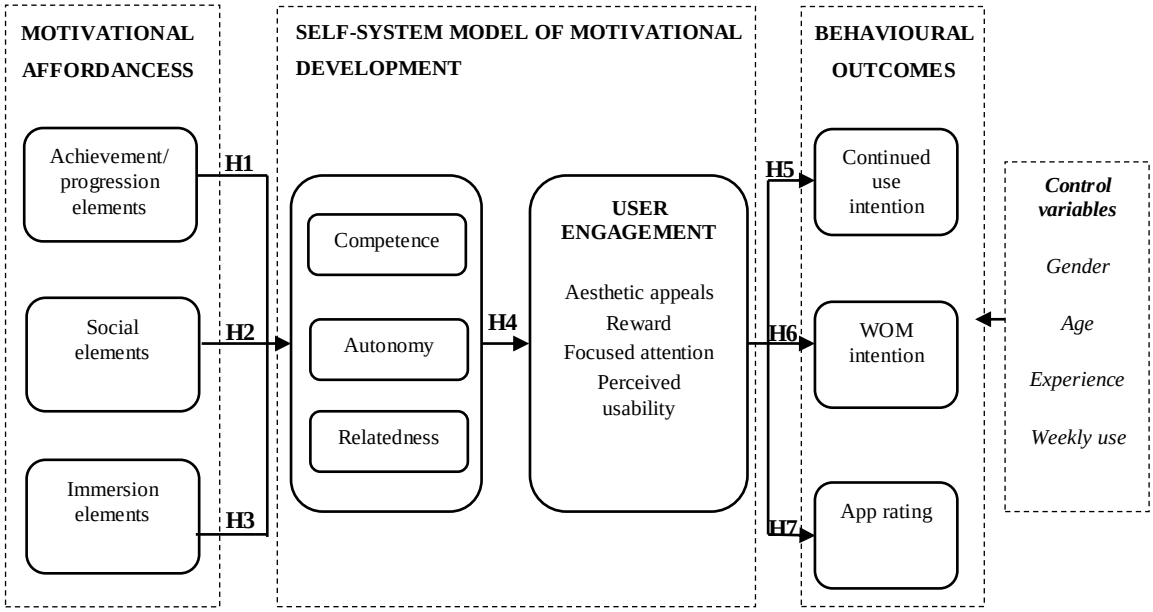
The SSMMD (Connell, 1990; Connell & Wellborn, 1991; Skinner et al., 2008) is a theoretical model, based on self-determination theory (SDT; Deci, 1975), that explains the processes through which social contextual factors impact on individuals' self-system processes and subsequently promote or undermine their engagement. Specifically, the SSMMD suggests that individuals have three fundamental psychological needs: competence, autonomy and relatedness (which are also central to the SDT). Competence relates to the individual's perception of being capable of effectively performing an activity and achieving a specific outcome (White, 1959). Autonomy is the possibility of behavioural choice (Connell, 1990; de Charms, 1968). Finally, relatedness is the experience of connection with others (Baumeister & Leary, 1995). Self-system processes are organized around these three psychological needs (Connell, 1990; Connell & Wellborn, 1991). The SSMMD suggests that engagement arises when these fundamental psychological needs are met. When they are not met, the individual feels disaffected (Connell & Wellborn, 1991).

2.3.2. Research hypotheses

Drawing on the SSMMD, and following the gamification conceptualization of Koivisto and Hamari (2019), the research model (Figure 2.1) proposes that motivational affordances included in a gamified system (i.e., achievement and progression-oriented elements, social-oriented elements and immersion-oriented

elements) lead to psychological outcomes such as the satisfaction of the needs for competence, autonomy and relatedness, and to user engagement, and other behavioural outcomes.

Figure 2.1. Proposed model



First, achievement and progression-oriented elements (e.g., badges/ medals, points, leaderboards or rankings, progress bars, and increasing difficulty levels) (Koivisto & Hamari, 2019) have been related to the satisfaction of psychological needs (Deci & Ryan, 2000). Previous research has found that users experience feelings of competence when they interact with these type of elements (e.g., Hassan et al., 2020; Peng et al., 2012; Sailer et al., 2017; van Roy & Zaman, 2019; Wee & Choong, 2019; Xi & Hamari, 2019). The need for competence is linked to challenge and the feeling of having the ability to behave effectively when carrying out an activity (Ryan et al., 2006; White, 1959). Therefore, these elements lead individuals to experience competence, as they continuously inform and provide them with affective feedback (Hassan et al., 2019). Moreover, some of these elements, such as leaderboards, badges (Xi & Hamari, 2019) and challenges (van Roy & Zaman, 2019), have been shown to evoke feelings of freedom in users and, thus, perceptions of higher autonomy. Finally, this game element category helps users understand the activity of the other actors in the gamified system, which fosters feelings of social relatedness (Xi & Hamari, 2019). For instance, the need for relatedness is satisfied when gamified systems include

leaderboards (Hassan et al., 2020; Xi & Hamari, 2019), as these allow players to compare their accomplishments with others (Sailer et al., 2017), and challenges (van Roy & Zaman, 2019), and badges and goals (Hassan et al., 2020; Xi & Hamari, 2019), as they publicize the behaviour and performance of the users involved and allow them to compare the quantity of badges/goals achieved (Hamari & Koivisto, 2015).

Second, social-oriented elements (e.g., cooperation, competition, social networking features and teammates) (Koivisto & Hamari, 2019) have mainly been linked to feelings of relatedness. The need for relatedness is tied to the sense of belonging and social connections (Baumeister & Leary, 1995; Ryan et al., 2006). Therefore, users may experience social relatedness through competing with other users (van Roy & Zaman, 2019; Wee & Choong, 2019), through cooperating with other users (which can create a sense of belonging to a group, or team), and by connecting with other users to work together to achieve common goals (Wee & Choong, 2019). Similarly, the introduction of social networking features into gamified systems helps individuals to communicate and exchange information with more people (Wee & Choong, 2019), which also fulfils the need for relatedness (Hassan et al., 2019; Wee & Choong, 2019). Moreover, interacting with social-oriented elements eases information exchange and, in consequence, helps users gain skills and knowledge, which increases their sense of accomplishment (Xi & Hamari, 2019). As these elements help individuals develop close social relationships with others, they have strong incentives to continually improve their skills and progress (Xi & Hamari, 2019). Therefore, a sense of competence arises when people compete, cooperate and interact with others through social networking features (van Roy & Zaman, 2019; Xi & Hamari, 2019). Similarly, a sense of autonomy is developed when users interact with these game elements (Xi & Hamari, 2019).

Finally, immersion-oriented elements (e.g., avatars, or profiles, narratives or meaningful stories, and customization) (Koivisto & Hamari, 2019) are tied to perceptions of escaping the real world in new virtual locations, playing new roles and being involved in stories (Ryan et al., 2006). These elements have been related to the satisfaction of psychological needs (Deci & Ryan, 2000). For instance, through storylines or narratives, which divide activities into small, similarly themed steps (Wee & Choong, 2019), users can easily fulfil broad goals by using strategies tied to the task

themes (Dong et al., 2012), thus fostering feelings of competence. Similarly, feelings of autonomy arise when gamified systems include personalization (Kim et al., 2015; Peng et al., 2012), as this element provides users with choices and a sense of control (Kim et al., 2015). Autonomy has also been associated with avatars, or personal profiles (Wee & Choong, 2019), as these allow users to choose how they want to be represented (Sailer et al., 2014). Finally, when users create their own characters, or avatars (Sailer et al., 2017), which take on the user's role in the gamified system (Mulcahy et al., 2020), feelings of social relatedness are evoked.

Based on the arguments above, we propose:

H1. The user's interaction with achievement and progression-oriented elements in the app helps to satisfy his/her needs for **(a)** competence, **(b)** autonomy and **(c)** relatedness.

H2. The user's interaction with social-oriented elements in the app helps to satisfy his/her needs for **(a)** competence, **(b)** autonomy and **(c)** relatedness.

H3. The user's interaction with immersion-oriented elements in the app helps to satisfy his/her needs for **(a)** competence, **(b)** autonomy and **(c)** relatedness.

The SSMMD proposes that contexts that support the satisfaction of the psychological needs for competence, autonomy and relatedness facilitate user engagement (Connell, 1990; Connell & Wellborn, 1991; Skinner et al., 2008). This relationship between individuals' self-system processes and engagement has been proved in different contexts. For instance, students' sense of competence, autonomy and relatedness have been linked to cognitive (Buil et al., 2020; Dupont et al., 2014), emotional and behavioural engagement (Buil et al., 2020; Dupont et al., 2014; Skinner et al., 2008). Similarly, research focusing on work engagement (e.g., Kovjanic et al., 2013; Schreurs et al., 2014) has found that satisfaction of the needs for competence, autonomy and relatedness leads to a higher degree of engagement with, and lower intention to abandon, activities; and Hsieh and Chang (2016) demonstrated that brand innovation value creation activities that promote competence and relatedness foster individuals' engagement in activities. Finally, Suh et al. (2018) determined that

gamified information systems which satisfy users' basic psychological needs successfully engage users by adding hedonic value. Therefore, we hypothesize:

H4a. The satisfaction of the need for competence has a positive impact on user engagement.

H4b. The satisfaction of the need for autonomy has a positive impact on user engagement.

H4c. The satisfaction of the need for relatedness has a positive impact on user engagement.

Motivational affordances facilitate individuals' psychological outcomes, such as engagement, which leads to behavioural outcomes (Koivisto & Hamari, 2019). Specifically, this study explores three outcomes: continued use intention of the app, WOM and users' ratings of apps. Consumers who are highly engaged with mobile applications tend to maintain valued relationships with them and incorporate them into their self-concepts (Kim & Baek, 2018). Previous studies have found that user engagement is positively associated with continued use intention of mobile applications (Suzianti et al., 2019; Tarute et al., 2017). Similarly, Algesheimer et al. (2005) found that, within a brand community, engagement is a predictor of continued intention to participate in the community; and research into online brand communities has demonstrated that customer engagement results in greater intention to recommend the brand community to non-members (Algesheimer et al., 2005; Ray et al., 2014; Wu et al., 2018), knowledge contribution (Ray et al., 2014) and higher ratings in online reviews (Wu et al., 2018). Taking these arguments into account, we hypothesize that:

H5. Users' engagement with the app has a positive effect on their continued use intention.

H6. Users' engagement with the app has a positive effect on their WOM intention.

H7. Users' engagement with the app has a positive effect on their ratings of the app.

2.4. METHODOLOGY

2.4.1. Data collection and participants

The Fitbit app, one of the best-known exercise apps, with 31 million active users worldwide in 2020 (Statista, 2022), was chosen for this study. The Fitbit app provides its users with a personalized experience that allows them to view their stats, and to set the goals that matter most to them personally. This customized experience begins with the users' profiles, which include personal information such as name, gender, age, weight and photos). The Fitbit app is built around 3 main tabs: Today, Discover and Community.

The Today tab receives, from the Fitbit tracker, information that provides daily stats such as steps taken, distance and calories burned. By clicking on the stats users can monitor the evolution of their performance in particular activities over time, which can help them make progress towards their goals.

The Discover tab includes exercise and wellness programs, and challenges. Fitbit uses challenges to help its users stay motivated. These challenges include the "Daily Showdown" (who can take the most steps in 24 hours), the "Workweek Hustle" (who can take the most steps Monday to Friday), the "Family Faceoff" (which member of the user's Fitbit family account takes the most steps Monday to Friday), the "Weekend Warrior" (who takes the most steps over the weekend) and "Goal Day" (who can reach his/her daily step goal). When users reach a milestone or achieve a goal they receive badges to reward their efforts. The Fitbit app also features "Adventures", in which users can apply their daily steps to make their way through virtual 3-D destinations, for example, Yosemite National Park. These adventures can be non-competitive, solo journeys, but users can also challenge their friends to, for example, be the first to scale a peak in a race.

Finally, the Community tab allows users to add Facebook friends, join groups, interact with other community members, receive fitness-related news, etc. In addition, users can share their stats and accomplishments with the rest of the community, including the badges they obtain, daily stats, exercise, hourly activity, progress towards

weight goals, etc., so they might cheer each other on. Users' stats can be shared also on other social media channels, such as Facebook.

In a careful analysis of the app, 12 game elements, grouped here into the three previously described categories, were identified: achievement and progression-oriented elements (scores, performance graphs, challenges, badges/trophies, progress bars and rankings/leaderboards), social-oriented elements (competition, social networking features and cooperation) and immersion-oriented elements (profile/virtual identity/avatar, personalization and a virtual/3D world).

The data were collected through an online survey aimed at U.S. users of the Fitbit app. Amazon Mechanical Turk (MTurk) was used to recruit the participants. Previous research has found that MTurk is a reliable and efficient source of data (e.g., Hauser & Schwarz, 2016; Hunt & Scheetz, 2019). Participation was limited to U.S. users of Fitbit with an approval rating higher than, or equal to, 95%. The participants received $0.70 for filling in the questionnaire. After removing 53 participants who failed the attention checks included in the survey, or did not complete the whole questionnaire, the final sample included 276 individuals. Thirty-nine percent were female and sixty-one percent were male. The average age of the respondents was 36 years. The characteristics of the sample are presented in Table 2.2.

Table 2.2. Sample characteristics

Category		Percentage (%)
Gender	Men	60.87%
	Women	39.13%
Age	18-25 years old	10.11 %
	26-35 years old	48.38%
	36-45 years old	22.74%
	46-55 years old	13.36%
	> 55 years old	5.05%
Experience with the app	< 3 months	9.42%
	3-6 months	22.46%
	6-12 months	26.45%
	12-18 months	14.49%
	18-24 months	8.33%
	>2 years	18.84%
Weekly use	< 30 minutes	8.33%
	30-60 minutes	36.23%
	1-3 hours	22.10%
	3-6 hours	15.22%
	6-9 hours	9.06%
	> 9 hours	9.06%

2.4.2. Measures

The study variables were measured using 7-point scales based on previous literature (see Table 2.3). Individuals' interactions with achievement and progression-, social- and immersion-oriented elements were measured following Xi and Hamari (2019). The satisfaction of the needs for competence and relatedness were assessed following Xi and Hamari (2019), while the need for autonomy was measured using items from Xi and Hamari (2019) and Standage et al. (2005). User engagement was measured using the UES-SF developed by O'Brien et al. (2018). As mentioned previously, the UES-SF encompasses four dimensions: aesthetic appeal, focused attention, perceived usability and reward. To assess continued use intention, we adapted the scale of Tu et al. (2019). Items from Hamari and Koivisto (2015) were used to measure WOM intention. Items adopted from Peng et al. (2012) were used to measure app rating. Finally, the study includes four control variables: gender, age, experience

and how much time the user devotes to the app each week. The questionnaire is available in Appendix 1.

Table 2.3. Constructs, items, and sources

Construct and source	Items
Interaction with achievement and progression-oriented elements Xi & Hamari (2019)	**FAE1.** The frequency of interacting with scores **FAE2.**The frequency of interacting with performance graphs **FAE3.** The frequency of interacting with challenges **FAE4.** The frequency of interacting with badges/trophies **FAE5.** The frequency of interacting with progress bars **FAE6.** The frequency of interacting with rankings/leaderboards **IAE1.**The importance of interacting with scores **IAE2.** The importance of interacting with performance graphs **IAE3.** The importance of interacting with challenges **IAE4.** The importance of interacting with badges/trophies **IAE5.** The importance of interacting with progress bars **IAE6.** The importance of interacting with rankings/leaderboards
Interaction with social-oriented elements Xi & Hamari (2019)	**FSE1.** The frequency of interacting with competition **FSE2.** The frequency of interacting with social networking features **FSE3.** The frequency of interacting with cooperation **ISE1.** The importance of interacting with competition **ISE2.** The importance of interacting with social networking features **ISE3.** The importance of interacting with cooperation
Interaction with immersion-oriented elements Xi & Hamari (2019)	**FIE1.** The frequency of interacting with profile/virtual identity/avatar **FIE2.** The frequency of interacting with personalization **FIE3.** The frequency of interacting with virtual world/3D world **IIE1.** The importance of interacting with profile/virtual identity/avatar **IIE2.** The importance of interacting with personalization **IIE3.** The importance of interacting with virtual world/3D world
Competence Xi & Hamari (2019)	**COM1.** I think that I am pretty good when I use this app **COM2.** I am satisfied with my performance when I use this app **COM3.** I feel like an expert using this app **COM4.** I feel like a competent person when I use this app
Autonomy Xi & Hamari (2019); Standage et al. (2005)	**AUT1.** In this app I have different options **AUT2.** I feel free to use this app **AUT3.** I feel free to decide what activities to do in this app **AUT4.** When I use this app, it is because I want to use it
Relatedness Xi & Hamari (2019)	**REL1.** I feel like other people care what I do **REL2.** I feel supported by others **REL3.** I feel that I am a valuable person to others **REL4.** I feel that I am understood

Table 2.3. Constructs, items, and sources (continued)

Construct and source	Items
User Engagement O'Brien et al. (2018)	**AE1.** This app is attractive **AE2.** This app is aesthetically appealing **AE3**. This app appeals to my senses **REW1**. Using this app is worthwhile **REW2.** My experience is rewarding **REW3**. I feel interested in this experience **FA1.** I lose myself in this experience **FA2.** The time I spend using this app just slips away **FA3.** I am absorbed in this experience **PU1.** I feel frustrated while using this app (R) **PU2**. I find this app confusing to use (R) **PU3.** Using this app is taxing (R)
Continued use intention Tu et al. (2019)	**CUI1.** I would like to continue using this app **CUI2.** I expect to continue using this app
WOM intention Hamari & Koivisto (2015)	**WOM1.** I will recommend this app to anyone who seeks my advice **WOM2.** I will say positive things about this app to other people
App rating Peng et al. (2012)	**RAT.** How would you rate this app?

Note: (R) reverse item

2.4.3. Common method bias assessment

As the data were based on self-reported measures and collected through a one-time survey, common method bias was evaluated by both procedural and statistical methods (Podsakoff et al., 2003). First, participation in the study was voluntary and the responses were anonymous. Furthermore, the dependent and independent variables were included on different pages of the survey, thus preventing the respondents identifying cause-effect relationships among the constructs. In addition, the variance inflation factor (VIF) values were assessed. The results suggested there is no common method bias in the study, as all values are between 1.098 and 2.540, lower than the 3.3 threshold (Kock, 2015).

2.5. ANALYSES AND RESULTS

Partial least squares (PLS) structural equation modeling with SmartPLS 3.0 was used to test the hypotheses (Ringle et al., 2015). PLS is appropriate when the model is complex and includes formative and reflective measures (Chin, 2010; Hair et al., 2011), as in our study. Moreover, this article focuses on predicting variables, which makes the use of PLS more convenient (Shmueli et al., 2016). PLS simultaneously assesses the measurement and structural model. These two steps are described next.

2.5.1 Measurement model analysis

The proposed model includes both reflective and formative constructs. First, the formative measurement model for the first-order dimensions was assessed (see Table 2.4). Following previous research (e.g., Xi & Hamari, 2019), interaction with the motivational affordances embedded in the app (i.e., scores, performance graphs, challenges, badges, progress bars, rankings, competition, social networking features, cooperation, profile, personalization and virtual worlds) was measured formatively through two indicators: the frequency of the user's interaction with the game element and the importance the user gave to the interaction. First, collinearity was evaluated through the VIF values. The values ranged from 1.417 to 3.197, below the threshold of 5, which indicates there are no collinearity problems (Hair et al., 2011). The significance and relevance of the formative indicators were also confirmed, as all the indicators' weights were statistically significant.

Table 2.4. Formative measurement model results (first-order constructs)

Construct	Items	Mean	SD	Loading	t-value	Weight	t-value	VIF
Scores	Frequency	5.34	1.45	0.897	15.761	0.503	3.632	1.793
	Importance	5.40	1.46	0.927	21.329	0.592	4.269	1.793
Performance graphs	Frequency	5.26	1.43	0.984	58.705	0.832	9.795	1.704
	Importance	5.54	1.38	0.771	13.053	0.236	2.140	1.704
Challenges	Frequency	4.66	1.70	0.936	24.606	0.561	4.180	2.134
	Importance	4.77	1.61	0.923	23.345	0.514	3.811	2.134
Badges	Frequency	4.32	1.78	0.934	30.011	0.495	4.271	2.508
	Importance	4.17	1.93	0.950	40.567	0.566	4.887	2.508
Progress bars	Frequency	5.15	1.46	0.885	17.131	0.571	5.394	1.453
	Importance	5.14	1.49	0.881	18.062	0.562	5.239	1.453
Rankings	Frequency	3.92	1.94	0.932	30.368	0.432	3.724	2.893
	Importance	4.01	2.03	0.967	53.961	0.618	5.438	2.893
Competition	Frequency	3.98	1.91	0.902	31.620	0.316	2.956	2.854
	Importance	4.08	1.92	0.982	77.220	0.728	7.447	2.854
Social networking features	Frequency	3.71	2.09	0.934	22.747	0.442	2.734	2.908
	Importance	3.70	2.07	0.966	40.664	0.607	3.888	2.908
Cooperation	Frequency	3.81	2.02	0.956	44.162	0.522	4.113	3.197
	Importance	3.80	1.96	0.956	39.958	0.524	4.161	3.197
Profile	Frequency	3.90	1.85	0.965	59.556	0.707	8.941	1.961
	Importance	3.87	1.89	0.863	20.177	0.368	4.374	1.961
Personalization	Frequency	4.87	1.49	0.889	17.554	0.593	5.792	1.417
	Importance	4.99	1.63	0.867	16.262	0.545	4.973	1.417
Virtual world/ 3D world	Frequency	3.70	2.05	0.923	40.021	0.323	3.420	3.438
	Importance	3.82	2.06	0.985	105.503	0.713	7.994	3.438

Note: VIF: Variance inflation factor.

The reflective measurement model for the first-order dimensions was then assessed following the criteria proposed by Hair et al. (2017) (see Table 2.5). Internal consistency reliability was confirmed as the Cronbach's alphas and composite reliability (CR) for all constructs were greater than 0.7. Convergent validity was thereafter assessed through the factor loadings of the indicators and average variance extracted (AVE). Individual item reliability for all factor loadings was confirmed as they were all above 0.60 and statistically significant at 1% (Carmines & Zeller, 1979), while the average variance extracted values were above 0.5 (Fornell & Larcker, 1981). Finally, to examine the discriminant validity of the reflective constructs, we verified

that all the indicators' outer loadings on the associated constructs were greater than any of their cross-loadings on other constructs (Hair et al., 2017). We also confirmed that the square roots of the AVEs of each construct were greater than the inter-construct correlations (Fornell & Larcker, 1981). Finally, following Henseler et al. (2015), we confirmed that the normal bootstrap confidence interval of the HTMT criterion, with Bonferroni adjustment, did not contain the value 1.

Following the assessment of the first-order constructs, we created the second-order constructs using the two-stage approach proposed by Hair et al. (2018). In particular, interaction with achievement and progression-oriented elements, interaction with social-oriented elements, and interaction with immersion-oriented elements were conceptualized as second-order formative constructs composed of the following first-order factors: scores, performance graphs, challenges, badges, progress bars and rankings for achievement and progression elements; competition, social networking features and cooperation for social elements; and profile, personalization and virtual worlds for the immersion elements. Similarly, engagement was conceptualized as a second-order formative construct composed of four first-order factors: aesthetic appeal, reward, focused attention and perceived usability.

The resulting model was re-estimated and reassessed. First, collinearity was evaluated through the VIF values. The values should be lower than 5 to avoid collinearity problems (Hair et al., 2011). Following this criterion, the "cooperation" indicator was removed from the social-oriented elements construct as it showed a value above 5. The model was then re-estimated; the remaining VIF values ranged from 1.188 to 2.922, which indicates that the model has no multicollinearity problems (see Table 2.6). Similarly, the external validity of the formative measurement model was analysed by assessing the indicators' weights and loadings. Although the weights of the indicators should ideally be statistically significant, Hair et al. (2017) argued that indicators which present non-significant weights, but high loadings (>0.5), should be taken into account, since they contribute to the construct; thus, it can be concluded that the external validity of the model is acceptable.

Table 2.5. Reflective measurement model results

Construct	Items	Mean	Standard deviation	Factor loading	AVE	Cronbach's alpha	CR	Q^2
Competence	COM1	5.54	1.12	0.835	0.639	0.811	0.876	0.260
	COM2	5.63	1.15	0.799				
	COM3	5.07	1.39	0.749				
	COM4	5.62	1.14	0.812				
Autonomy	AUT1	5.26	1.28	0.643	0.644	0.811	0.877	0.214
	AUT2	5.83	1.15	0.867				
	AUT3	5.79	1.09	0.871				
	AUT4	5.92	1.12	0.808				
Relatedness	REL1	4.36	1.73	0.876	0.827	0.930	0.950	0.391
	REL2	4.71	1.68	0.914				
	REL3	4.66	1.66	0.921				
	REL4	4.76	1.72	0.925				
Aesthetic appeal	AE1	5.47	1.12	0.851	0.713	0.799	0.882	N.A.
	AE2	5.62	1.04	0.832				
	AE3	5.42	1.14	0.849				
Reward	REW1	5.79	1.12	0.853	0.708	0.794	0.879	N.A.
	REW2	5.68	1.16	0.845				
	REW3	5.59	1.21	0.826				
Focused attention	FA1	4.36	1.74	0.854	0.765	0.847	0.907	N.A.
	FA2	4.35	1.76	0.875				
	FA3	4.62	1.61	0.895				
Perceived usability	PU1	5.00	2.03	0.947	0.911	0.951	0.969	N.A.
	PU2	5.17	2.00	0.959				
	PU3	5.08	2.06	0.957				
Continued use intention	CUI1	5.87	1.18	0.921	0.844	0.815	0.915	0.507
	CUI2	5.89	1.20	0.916				
WOM intention	WOM1	5.66	1.26	0.931	0.870	0.851	0.931	0.509
	WOM2	5.71	1.17	0.935				
App rating	RAT	5.93	0.90	1.000	N.A.	N.A.	N.A.	0.359

Note: CR: Composite reliability; AVE: Average variance extract.

Table 2.6. Formative measurement model results (second-order constructs)

Construct	Items	Loading	t-value	Weight	t-value	VIF
Achievement and progression elements	Scores	0.700	9.761	0.446	5.671	1.188
	Performance graphs	0.772	14.561	0.332	3.579	1.616
	Challenges	0.668	9.806	0.183	1.907	1.765
	Badges	0.556	6.573	0.003	0.026	2.906
	Progress bars	0.731	12.940	0.255	2.629	1.816
	Rankings	0.575	6.226	0.212	1.775	2.922
Social elements	Competition	0.975	39.243	0.730	5.229	2.217
	Social networking features	0.871	14.729	0.331	2.157	2.217
Immersion elements	Profile	0.807	9.172	0.268	1.522	2.749
	Personalization	0.907	12.605	0.640	4.103	1.406
	Virtual world/ 3D world	0.779	8.783	0.260	1.569	2.602
Engagement	Aesthetical appeal	0.866	31.002	0.392	8.185	1.967
	Reward	0.944	77.568	0.608	12.609	2.038
	Focused attention	0.371	5.268	0.095	2.186	1.533
	Perceived usability	0.381	6.685	0.136	3.487	1.474

Note: VIF: Variance inflation factor.

2.5.2 Structural model analysis

The statistical significance of the standardized paths was assessed through a bootstrapping process with 5,000 subsamples. The model explains 42.8% of competence need satisfaction variance, 35.5% of autonomy need satisfaction, 48.3% of relatedness need satisfaction, 70.7% of user engagement, 62.2% of continued use intention, 62.4% of WOM intention and 41.5% of app rating. Finally, the Q^2 values for the dependent variables were all positive, which indicates that the model has predictive relevance (see Table 2.5).

The results of the structural model are summarized in Table 2.7. In support of H1a, H1b and H1c, interaction with achievement and progression-oriented game elements in the app promotes the satisfaction of the needs for competence ($\beta = 0.646$; $t = 11.462$), autonomy ($\beta = 0.670$; $t = 11.336$) and relatedness ($\beta = 0.189$; $t = 2.713$). Similarly, interaction with social-oriented game elements in the app is positively associated with relatedness need satisfaction ($\beta = 0.315$; $t = 3.962$), supporting H2c. Contrary to our predictions, we did not find a significant relationship between

interaction with social-oriented elements and competence need satisfaction (β = − 0.076; t = 1.190), which leads us to reject H2a. Similarly, the results indicated that interaction with social oriented elements in the app is negatively related to autonomy need satisfaction (β = − 0.456; t = 5.513). Thus, H2b is also rejected. With regard to interaction with immersion-oriented game elements in the app, the results showed that it promotes only relatedness need satisfaction (β = 0.290; t = 3.082), supporting H3c; no significant effect was found on competence (β = 0.074; t = 0.922) or on autonomy need satisfaction (β = 0.090; t = 0.856), rejecting H3a and H3b, respectively.

In addition, the results indicated that satisfaction of the needs for competence (β = 0.435; t = 6.577), autonomy (β = 0.425; t = 6.833) and relatedness (β = 0.130; t = 2.622) while using the gamified app promote user engagement. Hence, H4a, H4b and H4c are supported. Finally, the findings demonstrated that user engagement with the gamified app promotes continued use intention (β = 0.738; t = 20.431) and WOM intention (β = 0.776; t = 22.835) and is positively associated with app rating (β = 0.585; t = 11.433). Therefore, H5, H6 and H7 are supported.

Regarding the control variables, the results showed that the user's age (β = 0.120; t = 3.076) and experience with the app (β = 0.097; t = 2.193) positively impact on intention to continue using the app. On the contrary, high-frequency app use negatively affects intention to continue using the app (β = − 0.083; t = 2.164), although it is positively associated with the user's rating of the app (β = 0.152; t = 3.647).

Table 2.7. Structural model results

Hypotheses	β	t-value	Supported
H1a: Achievement and progression elements → Competence	0.646	11.462***	Yes
H1b: Achievement and progression elements → Autonomy	0.670	11.336***	Yes
H1c: Achievement and progression elements → Relatedness	0.189	2.713***	Yes
H2a: Social elements → Competence	-0.076	1.190	No
H2b: Social elements → Autonomy	-0.456	5.513***	No
H2c: Social elements → Relatedness	0.315	3.962***	Yes
H3a: Immersion elements → Competence	0.074	0.922	No
H3b: Immersion elements → Autonomy	0.090	0.856	No
H3c: Immersion elements → Relatedness	0.290	3.082***	Yes
H4a: Competence → Engagement	0.435	6.577***	Yes
H4b: Autonomy → Engagement	0.425	6.833***	Yes
H4c: Relatedness → Engagement	0.130	2.622***	Yes
H5: Engagement → Continued use intention	0.738	20.431***	Yes
H6: Engagement → WOM intention	0.776	22.835***	Yes
H7: Engagement → App rating	0.585	11.433***	Yes
Control variables:			
Experience → Continued use intention	0.097	2.193**	
Experience → WOM intention	-0.037	0.872	
Experience → App rating	0.013	0.261	
Weekly use → Continued use intention	-0.083	2.164**	
Weekly use → WOM intention	0.017	0.458	
Weekly use → App rating	0.152	3.647***	
Gender → Continued use intention	-0.010	0.283	
Gender → WOM intention	0.035	0.927	
Gender → App rating	0.057	1.079	
Age → Continued use intention	0.120	3.076***	
Age → WOM intention	0.076	1.876	
Age → App rating	-0.041	0.833	

Note: ***p<0.01; **p<0.05

2.5.3 Post-hoc analysis of the indirect effects

The structural model results underline the importance of psychological need satisfaction and engagement. Thus, this section analyses the potential existence of indirect paths of influence among these variables. For this purpose, we followed the procedure suggested by Hair et al. (2017), which is based on the significance of both direct and indirect effects. The results of this analysis are shown in Table 2.8.

Table 2.8. Mediation analysis

	Direct effects		Indirect effects		Mediation	Total effects	
	β	*t-value*	β	*t-value*		β	*t-value*
Achievement → Competence → Engagement			0.223	5.174	Partial		
Achievement → Autonomy → Engagement	0.235	3.788	0.182	4.636	Partial	0.670	11.903
Achievement → Relatedness → Engagement			0.031	1.968	Partial		
Social → Competence → Engagement			0.042	2.070	Partial		
Social → Autonomy →Engagement	-0.185	3.563	-0.090	3.111	Partial	-0.139	2.606
Social → Relatedness → Engagement			0.094	3.094	Partial		
Immersion → Competence → Engagement			0.045	1.755	No		
Immersion → Autonomy → Engagement	-0.056	1.018	0.051	1.589	No	0.077	1.073
Immersion → Relatedness → Engagement			0.038	1.710	No		
Achievement → Engagement → Continued use	0.188	3.267	0.149	3.529	Partial	0.612	10.489
Achievement → Engagement → WOM	0.120	1.921	0.165	3.459	Full	0.590	9.533
Achievement → Engagement → Rating	0.065	0.845	0.124	3.173	Full	0.419	5.778
Social → Engagement → Continued use	-0.087	1.598	-0.117	3.442	Full	-0.176	2.860
Social → Engagement → WOM	0.015	0.329	-0.130	3.530	Full	-0.082	1.468
Social →Engagement → Rating	0.095	1.535	-0.098	3.325	Full	0.021	0.345
Immersion → Engagement → Continued use	0.002	0.033	-0.035	1.019	No	0.051	0.643
Immersion → Engagement → WOM	-0.014	0.263	-0.039	1.016	No	0.040	0.528
Immersion → Engagement → Rating	-0.006	0.105	-0.029	1.007	No	0.035	0.532

The results suggested that the user's interaction with achievement and progression-oriented elements positively influences user engagement both directly (β = 0.235; t = 3.788), and indirectly through the satisfaction of the needs for competence (β = 0.223; t = 5.174), autonomy (β = 0.182; t = 4.636) and relatedness (β = 0.031; t = 1.968). Similarly, interaction with these motivational affordances positively influences continued use intention directly (β = 0.188; t = 3.267), and indirectly through engagement (β = 0.149; t = 3.529). Moreover, while there is no evidence to suggest a direct effect on either WOM intentions (β = 0.120; t = 1.921) or on app rating (β = 0.065; t = 0.845), we found indirect effects on WOM intentions (β = 0.165; t = 3.459) and app rating (β = 0.124; t = 3.173), through engagement. The results suggested that interaction with social-oriented elements negatively affects user engagement directly (β

= − 0.185; t = 3.563), and indirectly through autonomy need satisfaction (β = − 0.09; t = 3.111). On the contrary, while competence (β = 0.042; t = 2.070) and relatedness need satisfaction (β = 0.094; t = 3.094) also play mediating roles in this effect, they work as suppressor variables which mitigate the magnitude of the negative direct effect. As these effects conflict, we analysed the total effect of interaction with social-oriented elements on user engagement. The results suggested that this effect is significant and negative (β = − 0.139; t = 2.606). In addition, the results suggested that interaction with social-oriented elements does not promote continued use intention (β = − 0.087; t = 1.598), WOM intention (β = 0.015; t = 0.329) or app rating (β = 0.065; t = 0.845) directly, and that interaction with social-oriented elements impacts only indirectly on continued use intention (β = − 0.117; t = 3.442), WOM intention (β = − 0.130; t = 3.530) and app rating (β = − 0.098; t = 3.325), through engagement. In addition, the results suggested that interaction with social-oriented elements does not promote continued use intention (β = − 0.087; t = 1.598), WOM intention (β = 0.015; t = 0.329) or app rating (β = 0.065; t = 0.845) directly, and that interaction with social-oriented elements impacts only indirectly on continued use intention (β = − 0.117; t = 3.442), WOM intention (β = − 0.130; t = 3.530) and app rating (β = − 0.098; t = 3.325), through engagement. Finally, we found no effect of interaction with immersion-oriented elements on engagement, neither directly (β = − 0.056; t = 1.018), nor indirectly through competence (β = 0.045; t = 1.755), autonomy (β = 0.051; t = 1.589) or relatedness (β = 0.038; t = 1.710). Similarly, we found neither a direct effect on continued use intention (β = 0.002; t = 0.033), WOM intention (β = − 0.014; t = 0.263) or app rating (β = − 0.006; t = 0.105), nor an indirect effect mediated through engagement.

2.6. DISCUSSION

Drawing on the SSMMD this study proposes and tests a model to explain how motivational affordances embedded in gamified mobile apps based on achievement and progression, socialization, and immersion, satisfy basic psychological needs and promote user engagement, which ultimately results in positive marketing outcomes.

This study provides empirical evidence of the potential that interaction with achievement and progression-oriented elements has for satisfying users' needs for competence, autonomy and relatedness. Contrary to our predictions, interaction with immersion-oriented elements in the app promotes feelings only of relatedness among users, and does not enhance feelings of competence or autonomy. Although unexpected, these results are in line with previous research which found that immersive elements, such as avatars and meaningful stories, are helpful for developing feelings of relatedness among users, but have no impact on users' perceptions of competence (e.g., Xi & Hamari, 2019) or autonomy (e.g., Sailer et al., 2017). Even more unexpected were the findings about users' interactions with the app's social-oriented elements. As expected, the results demonstrated that this category of game elements has a strong impact on the development of feelings of social relatedness. However, contrary to our predictions, it had no effect on the development of feelings of competence and, most importantly, it negatively affected the users' feelings of autonomy. A possible explanation for this might be that implementing social-oriented elements, such as competition or cooperation, in the app might be perceived as controlling, as they 'force' users to make decisions based on other users' actions, instead of on themselves, thus reducing their feelings of autonomy. For instance, in the case of Fitbit, users might invite Facebook friends to join a competition based on who walks most steps during one week. If users receive an invitation from a friend, they might feel they are under some pressure to accept it, thus reducing their feelings of autonomy. In addition, as the competition is based solely on walking, users are 'forced' to walk, instead of, for example, working out through push-ups, or lifting exercises, as they might have wanted, again reducing their feelings of autonomy.

In line with the SSMMD, this study demonstrates that, to foster user engagement, mobile apps must satisfy users' needs for competence, autonomy and relatedness. In fact, this study demonstrates the mediating role of psychological need satisfaction on the effects of competence and autonomy on user engagement. Previous studies (e.g., Xi & Hamari, 2020) have suggested that gamification features promote brand engagement. However, as Eisingerich et al. (2019) noted, this relationship is mediated by psychological states, such as the satisfaction of the psychological needs included in the SSMMD. This is also in line with the SDT, which proposes that using the gamified mobile app in itself becomes the reward if its users feel that they are

capable of dealing with its functions, have freedom to decide how to use it, and can interact with other users.

In addition, this study demonstrates the positive impact of user engagement with the mobile app on desirable marketing outcomes, and the mediating role of user engagement in the relationship between interaction with motivational affordances and the marketing outcomes. In particular, engaged users develop greater intentions to continue using the gamified mobile app, recommend it to others, say positive things about it, and are more prone to evaluate the app positively.

Finally, this study showed that older users are more prone to continue using the app. A possible explanation for this might be that, while older users who are not digital natives tend to remain loyal to those apps that they use, and are familiar with, younger users are more accustomed to mobile apps and, therefore, have no problem changing from one to another, as they can easily become familiar with its new functions. Similarly, users that have been operating the app for a longer time are already accustomed to it and, therefore, are more inclined to continue using it. This interesting finding contradicts the 'novelty effect' of gamification suggested in previous studies (e.g., Hamari et al., 2014). Similarly, less frequent users will be more inclined to continue using the app than will be more frequent users. This may be because users who operate the app more hours a week might be more saturated with it than those who use it only occasionally and, therefore, find it more original. On the contrary, those who use it more frequently rate the app higher as they are expert with it and know, based on their experience, that it works well.

2.6.1. Theoretical implications

This study makes a number of theoretical contributions to the user engagement literature. First, recent studies have noted that there is a lack of research examining engagement with mobile apps (Ho & Chung, 2020). This study sheds new light on the topic by analysing user engagement in the context of gamified mobile apps. In particular, it examines the processes through which users' interaction with three motivational affordances categories commonly embedded in gamified apps (i.e., achievement and progression-oriented elements, social-oriented elements and immersion-oriented elements) promote user engagement with the app and influence

subsequent marketing outcomes (i.e., continued use intention, WOM intention and app rating). In addition, this research adds to the user engagement literature by testing O'Brien et al.'s (2018) UES-SF in a new context, gamified mobile apps.

Furthermore, the study also makes key contributions to the gamification literature. First, the underlying mechanisms that explain how gamification engages users are not yet fully understood, as empirical research in the field is scarce (Rapp et al., 2019), and few studies have provided explanations for the effects of gamification based on well-grounded theoretical models (Seaborn & Fels, 2015). This study bridges this gap by proposing and testing a model based on the SSMMD (Connell, 1990). Drawing on the SSMMD, this study demonstrates that gamification promotes user engagement through the satisfaction of the basic psychological needs for competence, autonomy and relatedness. To the best of our knowledge, this is the first attempt to apply the SSMMD to the context of mobile apps, thus it provides valuable insights.

Second, unlike previous studies, this research examines the effectiveness of gamification as a continuous process. That is, it provides empirical evidence for the impact of different motivational affordances on various psychological outcomes, such as basic psychological need satisfaction and user engagement, and their subsequent effects on behavioural outcomes (i.e., users' intention to continue using the app, WOM intention and positive rating of the app), as Koivisto and Hamari (2019) suggested.

A further contribution of this research to the gamification literature is that it analyses the impact of the three most common motivational affordances/game elements embedded in gamified systems: achievement and progression, social and immersion elements (Koivisto & Hamari, 2019). Recent literature reviews (e.g., Koivisto & Hamari, 2019; Rapp et al., 2019; Tobon et al., 2020) have noted the lack of research into the specific effects of particular game elements; many studies have investigated gamification only as a research context or for its overall effect, while ignoring how different categories of gamification elements might influence user engagement and other outcomes. Thus, this study bridges this gap.

Finally, as various studies have indicated (e.g., Hamari et al., 2014; Koivisto & Hamari, 2019; Rapp et al., 2019), most existing research into gamification lacks methodological rigor as the studies are descriptive, and use small samples and

unvalidated measures. This study overcomes these limitations by carrying out an empirical study, in a real gamified context, using data collected through a questionnaire and previously validated measures.

2.6.2. Managerial implications

The results of this study also provide a number of practical contributions to support the decision-making of mobile app developers and marketers. With so many options in the app store, engaging with a specific app is a difficult task. In addition to retaining current users, mobile apps need to be well positioned within the app store to gain new users. In this regard, it is crucial to have a high rating.

This study has demonstrated that being engaged with the mobile app is critical in the decision to continue to use and recommend it, and to rate it positively. Thus, fostering engagement among mobile app users is imperative for marketers and developers. As this study has revealed, engagement is promoted through the satisfaction of basic psychological needs. Therefore, app developers should design gamified mobile apps that enable users to feel competent, autonomous and related to other users.

This study has demonstrated that the most effective motivational affordances are those oriented towards achievement and progression, as they positively influence user engagement both directly and indirectly through the simultaneous promotion of the three basic needs. Due to the potential of these elements, most gamified apps already include the 'PBL triad' (points, badges and leaderboards). In this regard, app developers should consider designing mobile apps that also contain challenges and offer real-time feedback to enable users to monitor their progress and their results. Users can earn points through their achievements and, based on the points collected, can reach higher levels that feature tasks with increased difficulty, so that they feel that their capacities are evolving.

In addition to achievement and progression-oriented elements, this study has demonstrated that the inclusion of immersion-oriented elements is also worthwhile. Although it has been demonstrated that they do not influence user engagement either directly or indirectly through need satisfaction, they at least create context for the

gamified app and promote relatedness among users. Thus, app developers might include immersive elements that enable users to customize their avatars and empower them to interact with the avatars of other users.

However, when it comes to the inclusion of social-oriented elements, mobile app developers should be cautious. While these elements have a strong effect on the creation of feelings of social relatedness, they can also reduce feelings of autonomy, and be detrimental for user engagement as they can be perceived as controlling. To avoid this, when app developers include social-oriented elements, their use should be voluntarily, and not pivotal to the full functionality of the app. To develop feelings of relatedness, app developers should consider creating a community of users within the app. For instance, exercise apps normally have their own user communities that facilitate interaction between users, who can voluntarily share their workout routines, their walking tours, and even their recipes for healthy eating. Developers should also enable users to invite their Facebook friends to join their communities, which would bring more users to the app, and to share their achievements publicly to gain recognition and 'likes'. In addition, app developers should consider launching one-time challenges that require competition or cooperation among app users. Some exercise apps foster one-time competitions among their users, for example, based on who walks the most steps in a week. Similarly, they might also encourage one-time cooperation, for example, through challenges where users invite app friends to join a team and add up all the steps they take in a day to complete a marathon. In any case, as previously noted, all these motivational affordances should be voluntary, and secondary, so that they do not interfere with users' autonomy and, consequently, decrease user engagement with the app.

2.6.3. Limitations and future research directions

The main limitations of the present study offer avenues for future research. First, the data were collected using a one-time, self-administered questionnaire. Thus, it would be interesting if future studies could use longitudinal data to determine gamification effectiveness in the long term, as well as data gathered directly from the app, to measure this effectiveness objectively. Second, the data were collected based on one specific mobile app. While this app includes most of the motivational affordances embedded in gamified apps, future research should replicate this model using other

gamified mobile apps in different categories (e.g., learning apps, tourism apps). Third, an interesting avenue for future research might include a deep analysis of the concept of usability in gamified mobile apps. The present study has included end-users' perceived usability as a dimension of user engagement; however, as Holzinger et al. (2005) noted, usability is a broader concept that should be taken into account when designing, developing and implementing gamified mobile apps.

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CHAPTER III

MAKING FINANCE FUN: THE GAMIFICATION OF PERSONAL FINANCIAL MANAGEMENT APPS

3.1. INTRODUCTION

The financial industry has been one of the first to adopt mobile technologies (Jun & Palacios, 2016), making it possible for users to access banking services at any time and from anywhere (Tam & Oliveira, 2017). In this context, finance apps have gained great popularity among consumers. In 2019, finance apps accounted for 5% of app downloads (AppsFlyer, 2020) and were accessed over one trillion times (App Annie, 2023). Along with mobile banking and payment apps (Karjaluoto et al., 2019), personal financial management (PFM) apps are among the fastest growing categories of finance apps. The global PFM-tool market size was $1,449.9 million in 2018 and is expected to reach $3,338.8 million in 2025, with a compound annual growth rate of 12.65% from 2018 to 2025 (QYResearch, 2019).

Developed by banks and fintech companies, PFM apps have changed the way consumers manage their finances. PFM apps seek to improve consumers' financial health by helping them to manage and take control of their finances. PFM apps usually consolidate users' accounts in one place, which allows them to monitor how much they earn, where, and on what, they spend their money and plan their spending, saving, and investing. The apps also help users by creating budgets, setting goals, finding ways to save, sending notifications and alerts and simplifying the investing process. Examples of PFM apps include Mint, Personal Capital, You Need a Budget, Mvelopes, and Robinhood, among many others.

Mobile apps in the banking sector seek to improve their users' experiences (Komulainen & Saraniemi, 2019) and enhance their motivation and engagement (Garzaro et al., 2021). In common with apps in sectors such as health, sports, tourism, hospitality and education (e.g., Hofacker et al., 2016; Liu et al., 2019; Tu et al., 2019; Wang & Tahir, 2020), one way to achieve this is through gamification. For instance, numerous PFM apps enable users to set savings goals and seek to motivate them to achieve these through challenges. The apps use progress bars and other performance graphs to provide financial information. In addition, some of these apps enable users to compare and/or share their financial situation and goals with their peers.

In the finance context, gamification has the potential to make financial management fun and increase consumers' financial literacy (Rodrigues et al., 2016a),

that is, their understanding and use of personal finance-related information (Huston, 2010). It can also improve financial well-being and motivate their users to undertake specific behaviours, such as saving (Bayuk & Altobello, 2019).

Many studies have recognized that gamification research is largely concentrated in the domains of education and learning (Kasurinen & Knutas, 2018; Koivisto & Hamari, 2019; Seaborn & Fels, 2015). By contrast, other fields, such as finance, have received little attention, despite gamification becoming a common practice in the sector (Baptista & Oliveira, 2017). Indeed, as noted by Bayuk and Altobello (2019, p. 953), "*academic research has only begun to explore what characteristics of the new technologies, including game features or incentives, are most effective in motivating individuals to save, and whether use of these financial gaming apps improves financial well-being*". Specifically, previous research is mainly focused on the e-banking field (e.g., Baptista & Oliveira, 2017; Rodrigues et al., 2016a, 2016b, 2016c). In addition, some works explore gamification only as a research context (e.g., Rodrigues et al., 2016a), so their findings, although relevant, do not allow conclusions to be drawn about how gamification influences consumers' behaviours. Furthermore, many studies do not analyse actual gamified app-user interactions. Instead, they assess how users rate game features in hypothetical financial gaming apps (e.g., Bayuk & Altobello, 2019), banking systems (Nasirzadeh & Fathian, 2020), and e-banking (e.g., Baptista & Oliveira, 2017; Rahi & Ghani, 2018, 2019).

In addition to the narrow scope of domains that have been investigated, a further limitation identified by the gamification literature is its lack of theoretical foundations and its use of a limited number of theories (Koivisto & Hamari, 2019; Seaborn & Fels, 2015). Rapp et al. (2019, p. 5) noted that the human condition is, however, complex, and to ground gamification designs, "*it is often necessary to draw from a variety of theoretical approaches*". Without a doubt, self-determination theory (SDT; Deci, 1975) is the theoretical framework most used in gamification research (Rapp et al., 2019). Nevertheless, in the finance context, conceptual models based on the technology acceptance model (TAM; Davis, 1989) have been proposed to examine the adoption of banking services in general (e.g., Santini et al., 2019; Souiden et al., 2021) and gamified e-banking in particular (e.g., Baptista & Oliveira, 2017; Rodrigues et al., 2016a, 2016c). While both theories, SDT and TAM, are useful for explaining users'

responses to gamified finance apps and PFM apps, in particular to the best of our knowledge, no previous research has combined them in this context.

To address these gaps, this study focuses on the financial domain and integrates SDT and the TAM to explore how gamification increases users' motivation and intention to use PFM apps and how it facilitates their adoption. In particular, the study analyses the effects of motivational affordances, that is, game elements, on motivational factors such as perceived competence, perceived autonomy, and autonomous motivation, and their subsequent effects on technology acceptance variables such as perceived ease of use and perceived usefulness. An exploration is then made of users' attitudes towards gamified PFM apps and their intention to use them.

The contribution of this study is threefold. First, although gamification research has grown over the last years, there is an underrepresentation of studies in the finance domain. In addition, given that contextual factors influence the consequences of gamification (Koivisto & Hamari, 2019), results from some fields, such as education and health, might not be relevant in others. Consequently, recent calls have highlighted the need to broaden the scope of the domains under study (Koivisto & Hamari, 2019). This research contributes to the gamification literature by adding new insights into the adoption and use of PFM apps. Second, drawing on two theories, SDT and the TAM, this research provides new insights into consumers' use of PFM apps by exploring how game features influence users' motivations and beliefs about the technologies used. Finally, the research offers practical implications for fintech companies and banks seeking to attract consumers to their gamified finance apps.

The structure of the chapter is as follows. Section 3.2 presents previous studies on gamification in the finance sector. Section 3.3 examines the theoretical background and proposes the research hypotheses. Section 3.4 describes the methodology and Section 3.5 shows the results. Finally, Section 3.6 draws the conclusions and presents the main theoretical and managerial implications of the study, as well as the limitations and future research lines.

3.2. PREVIOUS RESEARCH ON GAMIFICATION IN FINANCE

Although gamification is being used more and more in the finance sector, academic research is still in its infancy (Baptista & Oliveira, 2017; Bayuk & Altobello, 2019). Table 3.1 summarizes the relatively few studies that have explored the use of gamification in this field. As the table shows, most of the empirical studies on gamification in the finance sector are developed in the specific contexts of e-banking (e.g., Baptista & Oliveira, 2017; Rodrigues et al., 2016a, 2016b, 2016c) and internet banking (e.g., Rahi & Ghani, 2018, 2019). In addition, some studies analyse gamification only as a research context (e.g., Rodrigues et al., 2016a) and others investigate the role of gamification by assessing the use of hypothetical gamified financial apps (e.g., Bayuk & Altobello, 2019), banking systems (e.g., Nasirzadeh & Fathian, 2020), and e-banking (e.g., Baptista & Oliveira, 2017; Rahi & Ghani, 2018, 2019).

From a theoretical point of view, previous research on gamification in the finance context has examined the adoption of gamified technology by drawing on the technology acceptance model (e.g., Rodrigues et al., 2016a, 2016c, 2017) or the unified theory of acceptance and use of technology (e.g., Baptista & Oliveira, 2017; Rahi & Ghani, 2018, 2019) and has analysed the intention to use it (e.g., Baptista & Oliveira, 2017; Rahi & Ghani, 2018, 2019; Rodrigues et al., 2016a, 2016c, 2017), the business impact (e.g., Rodrigues et al., 2016c), the actual use behaviour (e.g., Baptista & Oliveira, 2017) or the intention to recommend it (e.g., Rahi & Ghani, 2018, 2019). By contrast, other studies have focused on the design of these technologies to examine users' design preferences in gamified banking software (e.g., Rodrigues et al., 2016b) or have analysed how gamification may be tailored according to users' demographics and personality traits (e.g., Nasirzadeh & Fathian, 2020).

Table 3.1. Summary of empirical studies exploring gamification in the finance sector

Reference	Aim	Type / Research design	Context	Variables studied	Key findings
Rodrigues et al. (2016a)	To investigate how ease-of-use and enjoyment influence customers' use of e-banking with a gamified business software	Empirical / Quantitative (survey)	e-banking	Socialness, ease-of-use, enjoyment, usefulness and intention to use	Ease-of-use and enjoyment are interrelated, and both have influence in e-banking usage; socialness influences the user perceptions of enjoyment and usefulness
Rodrigues et al. (2016b)	To develop a framework for software gamified in e-banking	Empirical / Qualitative (discussion groups)	e-banking	Users' perceptions about the software features, functionalities, and characteristics, in five gamification cases	Based on users' designs preferences, ten dimensions organized into two categories are identified: characteristics (design, appearance, functionality, rules, and objectives) and elements (game, product, security, process, and information)
Rodrigues et al. (2016c)	To identify the main variables that influence bank customers' use of gamified e-banking applications	Empirical / Quantitative (survey)	e-banking	Gamification, socialness, ease-of-use, enjoyment, usefulness, intention to use and business impact	Gamification improves customers' perceptions of social interaction, which, in turn, influence customers' intention to use the gamified application
Baptista & Oliveira (2017)	To identify the impact of game mechanics and game design techniques in the acceptance of mobile banking services	Empirical / Quantitative (survey)	Mobile banking	Performance expectancy, effort expectancy, social influence, facilitating conditions, hedonic motivation, price value, habit, gamification, behavioural intention and use behaviour; Age and gender (moderators)	Gamification positively relates to intention to use mobile banking services. Performance expectation, effort expectancy, social influence, hedonic motivation, price value and habit have a positive influence on behavioural intention. Facilitating conditions, habit and behavioural intention positively influence use behaviour
Rodrigues et al. (2017)	To investigate how game design integrated in a banking website influences customers' intention to use e-banking	Empirical / Quantitative (survey)	e-banking	Gamification, ease-of-use, information, web design, web characteristics and intention to use	Gamification has a significant influence on the perceptions of ease of use, the web design, information, webpage characteristics and the intention to use e-banking

Table 3.1. Summary of empirical studies exploring gamification in the finance sector (continued)

Reference	Aim	Type / Research design	Context	Variables studied	Key findings
Rahi & Ghani (2018)	To examine factors influencing the adoption of internet banking	Empirical / Quantitative (survey)	Internet banking	Performance expectancy, effort expectancy, innovativeness, compatibility, intention to adopt internet banking and intention to recommend in social networks Gamification (moderator)	Innovativeness and perceived technology security are the most important factors influencing users' intention to adopt internet banking. Gamification moderates the relationship between customer's intention to adopt internet banking and customer's intention to recommend internet banking in social networks
Bayuk & Altobello (2019)	To explore the potential benefits of gamification for financial well-being and motivation to save	Empirical / Quantitative (survey and experiment)	Financial apps	Subjective knowledge, expertise with financial topics, game features (social vs. economic), motivation to use the app, efficacy of the app and perceived usefulness	Users with experience with finance and money-savings apps are motivated by both social and economic features of financial applications, whereas those with no experience prefer economic features
Rahi & Ghani (2019)	To investigate factors influencing the adoption of internet banking	Empirical / Quantitative (survey)	Internet banking	Performance expectancy, effort expectancy, website design, website characteristics, general self-confidence, intention to adopt internet banking and intention to recommend Gamification (moderator)	Performance expectancy, effort expectancy, website design, website characteristics and general self-confidence positively influence the intention to adopt internet banking. Gamification moderates the relationship between customer's intention to adopt and customer's intention to recommend internet banking
Nasirzadeh & Fathian (2020)	To investigate the relationship between demographic and personality traits of individuals and their preferences for gamification elements and expected benefits	Empirical / Quantitative (survey)	Banking system	Age, education, gender, personality traits, game elements (point, level, badge, reward, leaderboard, etc.) and expected benefits	Preferences towards gamification elements and perceived expected benefits depend on the demographic characteristics and personality traits

3.3. THEORETICAL BACKGROUND AND RESEARCH HYPOTHESES

3.3.1. Self-determination theory and the technology acceptance model

Gamification applies motivational design to persuade individuals to behave in certain ways (Werbach & Hunter, 2012). Thus, understanding the individuals' motivations is key in addressing gamification effectiveness. In this regard, SDT (Deci & Ryan, 2000) has become one of the leading frameworks for gamification research (Tobon et al., 2020).

SDT identifies distinct types of motivation that are dependent on the perceived forces that move a person to act, focusing on type, rather than amount, of motivation (Ryan & Deci, 2000). Initially, SDT distinguished two types of motivation: intrinsic and extrinsic. However, more recently, SDT have distinguished between autonomous and controlled motivation, based on whether individuals behave with a full sense of choice or under pressure (Deci & Ryan, 2015). More precisely, autonomous motivation is based on individuals behaving voluntarily, seeking fun and enjoyment (Ryan & Deci, 2000), acting in certain ways because they identify themselves with the value of the behaviour, and find it personally important and valuable (Deci et al., 1996). On the other hand, controlled motivation relates to behaviours undertaken because individuals are controlled, irrespective of whether the control is exerted by external sources (e.g., to obtain a reward or to avoid punishment) or internal (e.g., to satisfy ego needs or to avoid shame) (Deci & Ryan, 2015). Of these two types of motivation, autonomous motivation is more valuable for the individual because it improves his/her performance (Gagné et al., 2015) and psychological well-being (Deci et al., 1996). SDT-based research has analysed the factors that encourage this form of motivation, finding that autonomous motivation develops when the individual's needs for competence, that is, the feeling that (s)he has mastered his/her own actions and become skilled at an activity (Ryan et al., 2006; White, 1959), and autonomy, that is, the feeling of freedom, and of liberty to choose (de Charms, 1968), are satisfied (Ryan & Deci, 2000). In addition, individuals may present a third basic psychological need called relatedness. Relatedness refers to the feeling of being connected with others (Baumeister & Leary, 1995). However, this psychological need is not examined in this chapter, since in the

context of study (i.e., personal financial management apps), feelings of relatedness are not promoted.

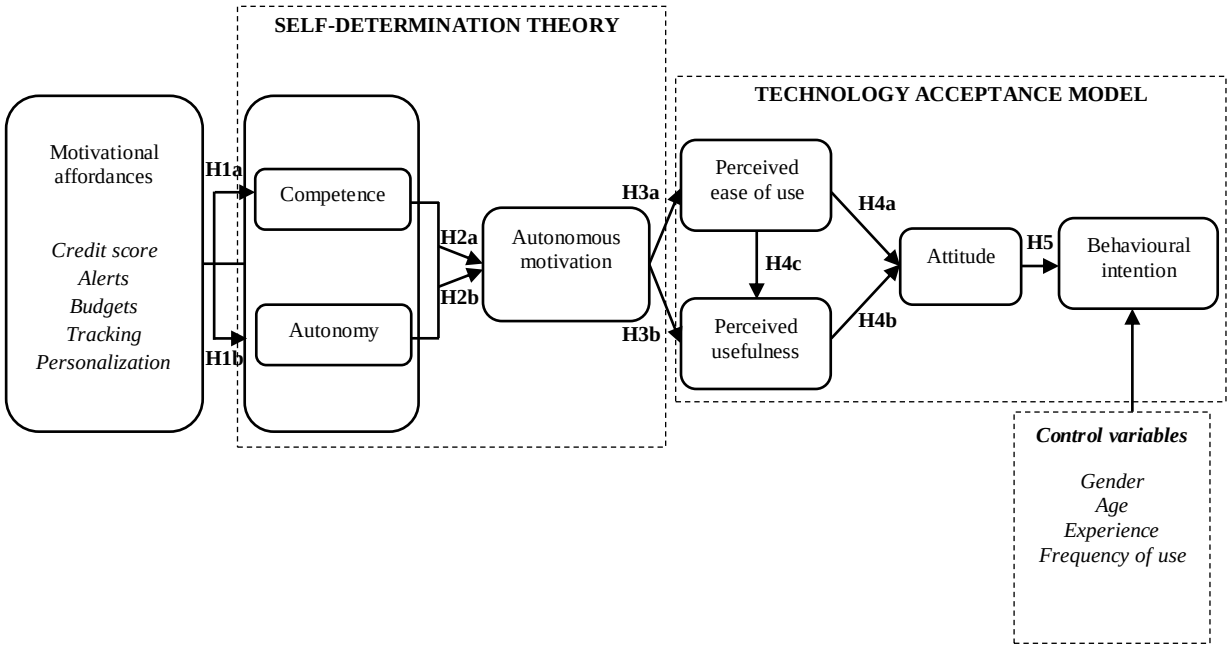
To achieve a better understanding of the effects of gamified technologies, research should focus both on the motivation derived from interacting with gameful affordances and how this motivation enhances users' perceptions of the technologies (Buil et al., 2020).

The TAM (Davis, 1989) is a widely applied model of technology acceptance that proposes that individuals' attitudes towards specific technologies are predicted by two key variables, perceived usefulness, and ease of use. Perceived usefulness relates to the user's belief that a system will boost his or her performance, while perceived ease of use refers to the user's belief that using a system will not require extra effort (Davis, 1989).

3.3.2. Research hypotheses

Figure 3.1 shows the proposed model. It integrates SDT, which provides a useful framework for analysing motivation, and the TAM, which focuses on technology acceptance, in a comprehensive model, to gain insights into how gamification increases users' motivation and intention to use PFM apps and how it facilitates their adoption. In particular, the study examines the effect of several motivational affordances on motivational factors, that is, feelings of competence and autonomy, as well as autonomous motivation. In addition, it analyses how these impact on technology acceptance variables such as perceived ease of use and perceived usefulness and attitude towards PFM apps. Finally, it investigates how attitude promotes behavioural intention to use PFM apps.

Figure 3.1. Proposed model



In general, research into gaming has suggested that games foster competence through challenges, rewards and feedback, and autonomy through flexibility to make choices about objectives and tasks (Ryan et al., 2006). As shown in the previous chapter, gamification research has also analysed whether interacting with different motivational affordances/game elements (e.g., challenges, achievements, points, leaderboards, rewards, badges, progress bars, increasing difficulty levels, cooperation, competition, avatars/profiles, narratives/ meaningful stories, customization) embedded in gamified applications satisfies their users' needs for competence and autonomy. With some exceptions (e.g., Mekler et al., 2017), research has suggested that motivational affordances can help satisfy these needs. For instance, some studies have found that overcoming challenges (van Roy & Zaman, 2019; Wee & Choong, 2019), reaching increasing difficulty levels (Peng et al., 2012), receiving performance feedback (Sailer et al., 2017; Wee & Choong, 2019) and being rewarded (Peng et al., 2012; Suh et al., 2018; van Roy & Zaman, 2019) facilitate users' feelings of competence, as these game elements provide users with a sense of purpose and information on their progress (Sailer et al., 2014). In the same vein, facing challenges (van Roy & Zaman, 2019) and receiving rewards (Suh et al., 2018) have been shown to give users a sense of autonomy as they provide flexibility and choice over tasks.

Although some studies have suggested that neither competition nor cooperation with teammates facilitates feelings of competence and autonomy (Bitrián et al., 2020; Sailer et al., 2017), others have argued that competition (Suh et al., 2018; van Roy & Zaman, 2019; Xi & Hamari, 2019), cooperation, and social networking features (Xi & Hamari, 2019) can satisfy these needs. Similarly, with some exceptions (Sailer et al., 2017; Xi & Hamari, 2019), most studies have found that motivational affordances related to customization, avatars, and meaningful stories are positively associated with higher levels of competence (Bitrián et al., 2020; Wee & Choong, 2019) and autonomy (Bitrián et al., 2020; Peng et al., 2012; Suh et al., 2018; Wee & Choong, 2019; Xi & Hamari, 2019), as having the possibility to personalize profiles and activities enables users to make their own decisions (Kim et al., 2015; Sailer et al., 2014).

As noted earlier, more and more PFM apps are using gamification to enhance their users' experiences. Some apps offer users the possibility to set financial goals and take on personal challenges related to achieving a certain level of savings and reducing expenses in one specific category. In addition, they include real-time tracking of financials, usually depicted in the form of progression charts, so users can monitor their ongoing success towards meeting their goals. They also provide feedback to users in the form of alerts and notifications regarding expenditure, account balances, upcoming bills, etc. Finally, as these apps are individually tailored to each user's needs (e.g., budgeting, planning, investing), they allow customers to personalize their experiences.

Based on the arguments set out above, we expect that the motivational affordance-user interaction included within gamified PFM apps will increase their users' perceptions of competence and autonomy. Accordingly, the following hypotheses are proposed:

H1. Users' interactions with motivational affordances in gamified PFM apps positively influences their perceptions of **(a)** competence and **(b)** autonomy.

SDT proposes that contexts that facilitate the satisfaction of competence and autonomy foster users' autonomous motivation (Deci & Ryan, 2000; Ryan & Deci, 2000). The relationship between need satisfaction and autonomous motivation has been explored in the gamification domain. For instance, research analysing the use of gamification to promote sustainable consumption and energy conservation behaviours

has found that promoting competence and autonomy among users facilitates intrinsic (Wee & Choong, 2019) and identified (Mulcahy et al., 2020) forms of motivation, which are regarded as autonomous motivation (Ryan & Deci, 2000). Similarly, studies into the use of gamification to promote exercise have found that experiencing competence and autonomy increases users' motivation to continue playing the exercise game (Peng et al., 2012). Likewise, autonomy has been associated with autonomous motivation to use gamified exercise apps (Bitrián et al., 2020). Finally, research into work gamification has also found a positive correlation between the satisfaction of the needs for competence and autonomy and autonomous motivation (Buil et al., 2020; Mitchell et al., 2020). Based on these arguments, we hypothesize that:

H2a. Competence positively influences users' autonomous motivation to use gamified PFM apps.

H2b. Autonomy positively influences users' autonomous motivation to use gamified PFM apps.

Previous research has also shown that perceptions of ease of use and usefulness are influenced by users' motivations to use systems (e.g., Buil et al., 2020; Sun & Zhang, 2006). When users enjoy operating technology and find it entertaining and motivating, they tend to perceive it as easy to use (Fagan et al., 2008; Laumer et al., 2012; Roca & Gagné, 2008; Venkatesh, 2000; Venkatesh et al., 2002; Yi & Hwang, 2003) and to find it useful (Laumer et al., 2012; Roca & Gagné, 2008; Yi & Hwang, 2003). In the mobile banking context, previous research has reported that experiencing enjoyment promotes greater perceptions of ease of use (Koenig-Lewis et al., 2015; Rodrigues, Oliveira, et al., 2016a, 2016c; Santini et al., 2019) and usefulness (Koenig-Lewis et al., 2015; Santini et al., 2019) of the mobile technology.

On the basis of these arguments, we propose that users who are autonomously motivated to use gamified PFM apps will perceive them as easy to use and useful. Hence, we propose the following hypotheses:

H3. Users' autonomous motivation to use gamified PFM apps positively influences their perceptions of **(a)** ease of use and **(b)** usefulness.

As previously mentioned, users' attitudes towards specific technologies are more favourable when they perceive them as easy to use and useful (Davis, 1989; Davis et al., 1989). The TAM also suggests that when users believe that technology is easy to use and requires minimum time and effort, they perceive it as effective and provides benefits. Therefore, the ease of use of a system also positively influences users' perceptions of its usefulness (e.g., Ong et al., 2004; Shang et al., 2005; Shih, 2004; Venkatesh, 2000).

In gamified contexts, Hamari and Koivisto (2015) demonstrated that the usefulness of gamified apps is positively related to users' attitudes towards them. In the banking field, previous research has also found that the perceived ease of use and perceived usefulness of mobile banking apps create more favourable attitudes towards mobile banking (Akturan & Tezcan, 2012; Giovanis et al., 2019; Lee, 2009; Mohammadi, 2015). Similarly, when users perceive that using a mobile banking app is easy, they tend to perceive it to be useful (Akturan & Tezcan, 2012; Lee, 2009; Mohammadi, 2015; Riquelme & Rios, 2010; Rodrigues et al., 2016a, 2016c).

Early finance apps were based on manual information inputs provided by users, but the newest PFM apps are linked to users' accounts and bank cards and receive transaction data automatically. Therefore, the newest apps are easier to use, more useful, and efficient, as their users are not forced to perform unnecessary actions, and they do not rely on the users' memories, which saves them much time (Srivastava, 2023).

Based on these arguments we propose the following hypotheses:

H4a. Perceived ease of use positively influences users' attitudes towards gamified PFM apps.

H4b. Perceived usefulness positively influences users' attitudes towards gamified PFM apps.

H4c. Perceived ease of use positively influences perceived usefulness.

The TAM proposes that having a favourable attitude towards technology is the main determinant of behavioural intention to use the technology (Davis et al., 1989).

Previous research has shown that when users have a positive attitude towards mobile apps, they are willing to continue using those apps and recommend them to others (Hamari & Koivisto, 2013, 2015b). Similarly, users' attitudes have been shown to be highly important factors in predicting the use of internet banking and mobile banking services (Akturan & Tezcan, 2012; Baptista & Oliveira, 2016; Chauhan et al., 2019; Giovanis et al., 2019; Lee, 2009; Muñoz-Leiva et al., 2017). In addition, it has been found that positive attitudes towards mobile applications may lower barriers to adoption (Muñoz-Leiva et al., 2017). Therefore, we hypothesize that:

H5. Users' attitudes towards gamified PFM apps positively influences their behavioural intention to use them.

3.4. METHODOLOGY

3.4.1. Data collection and participants

To test the proposed model, an empirical study was undertaken with a sample of Mint users. The Mint app, owned by the Intuit company, was selected because it is one of the most popular PFM apps in the U.S. (Insider Intelligence, 2022). This gamified app provides its users with feedback by rating their achievements and sets up alerts in the form of reminders and notifications. In addition, the app allows users to set budgetary goals in different expense categories, track money movements, bills and expenses, and personalize some of the apps' aspects. Therefore, five motivational affordances/game elements (i.e., credit score, alerts, budgets, tracking, and personalization) were examined in the study.

A sample of 208 users of the Mint app was recruited using the SurveyMonkey Audience service. The characteristics of the sample are presented in Table 3.2.

Table 3.2. Sample characteristics

Category		Percentage (%)
Gender	Men	36.54 %
	Women	63.46 %
Age	< 31 years old	10.10 %
	31-40 years old	14.42 %
	41-50 years old	15.87 %
	> 50 years old	59.62 %
App experience	< 3 months	1.44 %
	3-6 months	1.44 %
	6-12 months	5.77 %
	12-18 months	7.69 %
	18-24 months	8.65 %
	> 24 months	75 %
Frequency of app use	Almost every day	10.10 %
	Once in 2-3 days	8.65 %
	Once in 4-5 days	3.37 %
	Once a week	23.08 %
	Once a month	37.02 %
	Once in three months	8.65 %
	Once in six months	6.25 %
	Once a year	2.88 %

3.4.2. Measures

All the variables used in the study were adapted from relevant previous literature and measured through 7-point scales (see Table 3.3). Users' interactions with motivational affordances and their need for competence were measured following Xi and Hamari (2019). Their need for autonomy was measured using items from Xi and Hamari, (2019) and Standage et al. (2005). Autonomous motivation was measured following Guay et al. (2000). Perceived ease of use and perceived usefulness were both measured based on Davis (1989), while attitude was measured following Taylor and Todd (1995). Finally, items from Venkatesh et al. (2012) were used to measure behavioural intention. The full questionnaire can be found in Appendix 2.

Table 3.3. Constructs, items and sources

Constructs and sources	Items
Interaction with motivational affordances Xi & Hamari (2019)	**AFF1.** The frequency of interacting with credit score in Mint
	AFF2. The frequency of interacting with bill reminder alerts in Mint
	AFF3. The frequency of interacting with budgets in Mint
	AFF4. The frequency of interacting with tracking in Mint
	AFF5. The frequency of interacting with personalization in Mint
	AFF6. The importance of interacting with credit score in Mint
	AFF7. The importance of interacting with bill reminder alerts in Mint
	AFF8. The importance of interacting with budgets in Mint
	AFF9. The importance of interacting with tracking in Mint
	AFF10. The importance of interacting with personalization in Mint
Competence Xi & Hamari (2019)	**COM1.** I think that I am pretty good when I use this app
	COM2. I am satisfied with my performance when I use this app
	COM3. I feel like an expert using this app
	COM4. I feel like a competent person when I use this app
Autonomy Standage et al. (2005); Xi & Hamari (2019)	**AUT1.** In this app I have different options
	AUT2. I feel free to use this app
	AUT3. I feel free to decide what activities to do in this app
	AUT4. When I use this app, it is because I want to use it
Autonomous motivation Guay et al. (2000)	**MOT1.** I use Mint because I think that this app is interesting
	MOT2. I use Mint because I think that this app is pleasant
	MOT3. I use Mint because this app is fun
	MOT4. I use Mint because I feel good when using this app
	MOT5. I use Mint because I am doing it for my own good
	MOT6. I use Mint because I think that this app is good for me
	MOT7. I use Mint because of personal decision
	MOT8. I use Mint because I believe that this app is important for me
Perceived ease of use Davis (1989)	**PEOU1.** I find this app easy to use
	PEOU2. My interaction with this app is clear and understandable
	PEOU3. I find this app easy to interact with
Perceived usefulness Davis (1989)	**PU1.** Using this app enables me to control my finances/expenses
	PU2. Using this app makes easier to control my finances/expenses
	PU3. I find this app useful to control my finances/expenses
Attitude Taylor and Todd (1995)	**ATT1.** Using this app is a good idea
	ATT2. Using this app is a wise idea
	ATT3. I like the idea of using this app
Behavioural intention Venkatesh et al. (2012)	**BI1.** I intend to continue using this app in the future
	BI2. I will always try to use this app in my daily life
	BI3. I plan to continue to use this app frequently

3.4.3. Common method bias assessment

As the data were collected through a self-reported survey, some procedural and statistical methods were followed to ensure that common method bias was not an issue in this study (Podsakoff et al., 2003). Regarding the procedural methods, the participants freely agreed to participate in the study, and their anonymity was guaranteed. In addition, in the online survey design, the dependent and independent variables were included on different pages of the survey to prevent the respondents from identifying cause-effect relationships among the constructs. As to the statistical methods, common method bias was assessed through a full collinearity test based on the variance inflation factors (VIF). The VIF values ranged from 1.000 to 1.841 (all lower than 3.3). Thus, there is no evidence in this research to suggest the presence of a common-method bias (Kock, 2015).

3.5. ANALYSES AND RESULTS

As the proposed model includes formative and reflective constructs, partial least squares (PLS) structural equation modeling with SmartPLS 3.0 was used to test the model (Chin, 2010; Hair et al., 2011; Ringle et al., 2015; Shmueli et al., 2016). PLS simultaneously assesses the measurement and the structural model. These two steps are described next.

3.5.1. Measurement model analysis

First, the formative measurement model for the first-order dimensions was analysed (Table 3.4). User interaction with the app's motivational affordances was conceptualized as a second-order formative construct with five first-order factors: credit score, alerts, budgets, tracking, and personalization. Following Xi and Hamari (2019), each factor was measured formatively by two indicators, the frequency and the importance of the interactions. External validity was analysed by assessing the indicators' weights and loadings. Although the weights of the indicators should ideally be statistically significant, Hair et al. (2017) argued that indicators with non-significant weights but with high loadings (> 0.5) should be retained, as they contribute to the construct. Thus, the external validity of the model was shown to be acceptable.

Thereafter, collinearity was evaluated through the VIF values. The values ranged from 1.902 to 2.952, below the threshold of 5, which indicates an absence of collinearity problems (Hair et al., 2011).

Table 3.4. Formative measurement model results (first-order constructs)

Construct	Indicator	Mean	SD	Loading	t-value	Weight	t-value	VIF
Credit Score	Frequency	3.99	2.13	0.657	4.197	-0.260	0.864	2.483
	Importance	4.43	2.18	0.986	21.912	1.187	5.721	2.483
Alerts	Frequency	3.77	2.06	0.743	6.330	-0.114	0.395	2.635
	Importance	4.25	2.10	0.998	40.834	1.087	4.840	2.635
Budgets	Frequency	4.09	2.03	0.884	11.397	0.232	0.760	2.952
	Importance	4.58	2.02	0.991	24.336	0.802	2.884	2.952
Tracking	Frequency	5.42	1.85	0.993	27.726	0.855	3.402	2.349
	Importance	5.74	1.69	0.830	7.213	0.181	0.617	2.349
Personalization	Frequency	3.09	1.75	0.824	6.445	0.285	0.959	1.902
	Importance	3.80	1.93	0.978	15.234	0.782	3.019	1.902

Note: SD: Standard deviation; VIF: Variance inflation factor.

Then, the two-stage approach suggested by Hair et al. (2018) was used to assess the second-order formative construct. As Table 3.5 shows, the external validity was assessed through the indicators' weights and loadings. Following Hair et al. (2017), the item "personalization" was removed, as it had neither statistically significant weights nor high loadings. The model was then re-estimated, and the external validity of the remainder of the indicators was shown to be acceptable (Hair et al., 2017). In addition, the model had no collinearity problems, as the VIF values were all below 5 (Hair et al., 2011).

Table 3.5. Formative measurement model results (second-order constructs)

Construct	Items	Loading	t-value	Weight	t-value	VIF
Motivational affordances	Credit Score	0.680	8.155	0.542	4.841	1.210
	Alerts	0.562	6.477	0.138	1.204	1.384
	Budgets	0.584	6.700	0.154	1.379	1.486
	Tracking	0.768	10.248	0.603	5.625	1.351

Note: VIF: Variance inflation factor.

Second, the reflective measurement model was analysed following Hair et al.'s (2017) criteria (see Table 3.6). The results show that the Cronbach's alpha and composite reliability (CR) of all constructs were greater than 0.7, confirming internal consistency reliability. Then, the individual item reliability for all factor loadings was confirmed, as they were all greater than 0.60 and statistically significant at 1% (Carmines & Zeller, 1979). Convergent validity was also confirmed as the average variance extracted (AVE) values were above 0.5 (Fornell & Larcker, 1981). Finally, discriminant validity was examined using three tests (Hair et al., 2017): cross-loadings, the Fornell-Larcker criterion, and the HTMT ratios. First, we checked that all indicators' outer loadings on the associated construct were greater than any of their cross-loadings on other constructs. Next, we confirmed that the square roots of the AVEs of each construct were greater than the inter-construct correlations (Fornell & Larcker, 1981). Third, we confirmed that the normal bootstrap confidence interval of the HTMT criteria, with Bonferroni adjustment, did not contain the value 1 (Henseler et al., 2015).

Table 3.6. Reflective measurement model results

Construct	Items	Mean	Standard deviation	Factor loading	AVE	Cronbach's alpha	CR	Q^2
Competence	COM1	4.73	1.60	0.920	0.810	0.922	0.944	0.246
	COM2	4.89	1.55	0.899				
	COM3	3.94	1.67	0.860				
	COM4	4.84	1.67	0.919				
Autonomy	AUT1	5.54	1.39	0.832	0.730	0.877	0.915	0.181
	AUT2	5.89	1.35	0.895				
	AUT3	5.87	1.42	0.888				
	AUT4	6.16	1.26	0.800				
Autonomous motivation	MOT1	5.40	1.64	0.860	0.679	0.931	0.944	0.315
	MOT2	5.13	1.70	0.896				
	MOT3	5.31	1.62	0.715				
	MOT4	4.99	1.61	0.813				
	MOT5	4.61	1.67	0.826				
	MOT6	4.36	1.70	0.866				
	MOT7	3.69	1.71	0.725				
	MOT8	4.18	1.68	0.874				
Perceived ease of use	PEOU1	5.37	1.52	0.968	0.946	0.972	0.981	0.267
	PEOU2	5.40	1.48	0.975				
	PEOU3	5.32	1.60	0.975				
Perceived usefulness	PU1	5.04	1.58	0.939	0.911	0.951	0.968	0.479
	PU2	5.31	1.55	0.963				
	PU3	5.23	1.59	0.961				
Attitude	ATT1	5.71	1.46	0.957	0.908	0.949	0.967	0.493
	ATT2	5.66	1.50	0.956				
	ATT3	5.55	1.58	0.946				
Behavioural intention	BI1	5.70	1.65	0.888	0.817	0.887	0.930	0.493
	BI2	3.74	1.88	0.872				
	BI3	4.72	1.91	0.951				

Note: SD: Standard deviation; CR: Composite reliability; AVE: Average variance extract.

3.5.2. Structural model analysis

The next section of the analysis evaluated the statistical significance of the standardized paths through a bootstrapping process, with 5,000 subsamples. It was shown that the model explains 31.5% of the variance of competence need satisfaction, 27.3% of autonomy need satisfaction, 47.4% of the user's autonomous motivation, 28.9% of perceived ease of use, 53.4% of perceived usefulness, 54.9% of the user's

attitude and 62.2% of behavioural intention. In addition, as the Q^2 values for the dependent variables were positive, the model has predictive relevance (Table 3.6). The standardised root mean square residual (SRMR) value was less than the threshold of 0.08, indicating that the model has a good fit (Hu & Bentler, 1998).

The results obtained from the structural model analysis are presented in Table 3.7. As can be seen, all the proposed hypotheses are supported. First, interaction with motivational affordances in the gamified PFM app facilitates the satisfaction of the needs for competence ($\beta = 0.56$; $t = 10.55$) and autonomy ($\beta = 0.52$; $t = 8.96$), supporting H1a and H1b, respectively. Both the satisfaction of the need for competence ($\beta = 0.46$; $t = 5.91$) and for autonomy ($\beta = 0.32$; $t = 4.61$) promote users' autonomous motivation to use the gamified PFM app. Therefore, H2a and H2b are supported. In accordance with our predictions, autonomous motivation is positively related to the perceived ease of use ($\beta = 0.53$; $t = 9.11$) and the perceived usefulness ($\beta = 0.33$; $t = 4.16$) of the gamified PFM app, which supports H3a and H3b, respectively. In addition, perceived ease of use ($\beta = 0.36$; $t = 4.29$) and perceived usefulness ($\beta = 0.44$; $t = 5.59$) are positively associated with users' attitudes towards the gamified PFM app, supporting H4a and H4b, respectively. Similarly, perceived ease of use influences perceived usefulness ($\beta = 0.49$; $t = 6.56$), supporting H4c. Finally, users' attitudes towards the gamified PFM app positively predict their behavioural intention to use the app ($\beta = 0.60$; $t = 11.30$). Thus, H5 is supported.

Regarding the control variables, the results showed that the frequency of use of the gamified PFM app positively affected users' behavioural intention to use it ($\beta = 0.41$; $t = 7.95$).

Table 3.7. Structural model results

Hypotheses	β	t-value	Supported
H1a: Motivational affordances → Competence	0.562	10.553***	Yes
H1b: Motivational affordances → Autonomy	0.522	8.960***	Yes
H2a: Competence → Autonomous motivation	0.463	5.911***	Yes
H2b: Autonomy → Autonomous motivation	0.321	4.618***	Yes
H3a: Autonomous motivation→ Perceived ease of use	0.538	9.117***	Yes
H3b: Autonomous motivation → Perceived usefulness	0.330	4.169***	Yes
H4a: Perceived ease of use → Attitude	0.360	4.296***	Yes
H4b: Perceived usefulness → Attitude	0.449	5.598***	Yes
H4c: Perceived ease of use → Perceived usefulness	0.498	6.569***	Yes
H5: Attitude→ Behavioural intention	0.602	11.300***	Yes
Control variables:			
Experience → Behavioural intention	-0.029	0.630	
Frequency of app use → Behavioural intention	0.416	7.954***	
Gender → Behavioural intention	0.043	0.838	
Age → Behavioural intention	0.021	0.422	

Note: ***p<0.01

3.6. DISCUSSION

PFM apps have recently gained popularity among users. To improve users' experiences and increase their motivation to use PFM apps, most have been gamified. However, there has been little research analysing the effect of users' interactions with gameful affordances on their motivation to use the apps and their adoption. To bridge this gap, this study combined SDT and the TAM and simultaneously analysed the influence of the motivational factors of perceived competence, perceived autonomy, and autonomous motivation, and the technology acceptance factors perceived ease of use and perceived usefulness, on users' attitude towards gamified PFM apps, and their behavioural intention to use them.

The results of this study provide support for the use of gamification in PFM apps. In particular, this study showed that the users' interactions with the motivational affordances embedded in PFM apps (e.g., budgets, tracking, credit scores, alerts) make them feel more competent and autonomous. The impact of various motivational affordances on competence and autonomy need satisfaction has been proven in various

contexts, such as exercise (Peng et al., 2012), education (van Roy & Zaman, 2019), information systems (Suh et al., 2018), and energy conservation (Wee & Choong, 2019). However, this issue is still under debate. Other studies in contexts such as online simulations (Sailer et al., 2017), online brand communities (Xi & Hamari, 2019), and exercise apps (Bitrián et al., 2020) have found that the effect of some game elements on competence, autonomy, or even both, are non-significant. Nonetheless, our findings add weight to the argument that motivational affordances have a positive influence on the satisfaction of these needs. In addition, in line with previous research drawing on SDT (Bitrián et al., 2020; Buil et al., 2020; Mitchell et al., 2020), this study proved that when users feel competent and self-determined as a result of using gamified PFM apps, they are autonomously motivated to use them.

The study also demonstrated that users' autonomous motivation to use gamified PFM apps leads them to perceive the apps as useful and easy to use. This finding contributes to the current debate about the direction of the relationship between motivation and perceived ease of use (Sun & Zhang, 2006) by showing that the motivation to use PFM apps makes users regard them as more useful, and easy to use. In line with the TAM, this research demonstrates that perceiving the app as easy to use promotes the user's perception that the app is useful (e.g., Akturan & Tezcan, 2012; Lee, 2009; Riquelme & Rios, 2010). Moreover, as shown in previous studies (e.g., Akturan & Tezcan, 2012; Giovanis et al., 2019; Lee, 2009), this research demonstrates that users' perceptions of PFM apps' usefulness and ease of use promote favourable attitudes towards them. Similarly, it was demonstrated that a positive attitude leads to a higher behavioural intention to use the gamified PFM app.

3.6.1. Theoretical implications

This study makes several theoretical contributions to the gamification literature in general, and to research into PFM apps in particular. First, compared to other contexts, relatively few studies have focused on the use of gamification in the finance domain. Thus, this study responds to the call for academic research into the effects of gamified PFM apps (Bayuk & Altobello, 2019). In addition, as most previous research into app gamification in the finance/banking sector has not focused on the user's interactions with motivational affordances, this study contributes to the literature by

providing new insights into the use of PFM apps and how these user-game element interactions affect their users' motivation and their use of the apps.

Second, taking into account the lack of theoretical foundations in the gamification literature reported by previous research (Koivisto & Hamari, 2019; Seaborn & Fels, 2015), this study contributes to the existing body of research by proposing and testing a model combining SDT, one of the major theories explaining human motivation, and the TAM, which focuses on the factors that affect new technology acceptance, and which has been used successfully to analyse finance apps (Tam & Oliveira, 2016). In fact, to the best of our knowledge, the present study is the first attempt to combine both theories in this context, providing a better explanation of the antecedents of users' attitude towards gamified PFM apps.

Finally, by conducting an empirical study in a real gamified context using previously validated measures, this work overcomes some of the methodological shortcomings reported in previous studies, such as the use of small samples and non-validated measures, and the use of overly descriptive approaches (Hamari et al., 2014; Koivisto & Hamari, 2019; Rapp et al., 2019), and responds to the call for more empirical research into the acceptance of gamified PFM apps in real-life scenarios (Rodrigues et al., 2017; Rodrigues et al., 2016a).

3.6.2. Managerial implications

This study also provides a number of practical implications for PFM app managers and designers, especially for fintech companies and banks seeking to enhance the user experience. First, the design of apps should help their users experience autonomous motivation and, thus, their integrated gamified elements should allow them to feel competent and self-determined. In addition to merely storing financial information about users' cards and accounts, it would be interesting if PFM apps could offer their users the possibility to set personal goals regarding their finances, such as fixing saving objectives for the family's summer holidays, or to buy a new car. This would offer users a feeling of self-determination, as they would perceive a sense of autonomy through being able to customize their app experience. Similarly, this would help to promote feelings of competence, as setting and accomplishing these financial goals would give users a sense of purpose. In addition, providing functionality that will

allow users to create specific budgets for the categories that are more important to them personally (e.g., household bills, food, leisure), and let them fix maximum limits for those categories they want to cut (e.g., fashion, technology items), will help them feel more autonomous, and permit them to flexibly customize their experiences. Moreover, to motivate users to achieve their financial goals, PFM apps should offer real-time money tracking, and provide visual information in the form of performance graphs/progress bars, so they can see how successful they are in meeting their goals. This will help them feel more competent in the use of the app, and to feel purposeful. Similarly, keeping users informed about specific events (e.g., expenditure, account balances, upcoming bills) with in-app alerts and notifications, and rewarding them with scores/virtual badges for their achievements, will also promote feelings of competence and autonomy, and make them more motivated to use the app.

In addition, to promote favourable attitudes towards PFM apps they should be designed such that users find them easy to use and useful. Unlike mobile banking apps designed to manage the money users have in one specific branch, PFM apps compile information from different financial sources. Thus, users should be able to link all their accounts and bank cards within the app, so that it automatically receives all the necessary information. The alerts and notifications provided by the app might also enhance perceptions of usefulness.

3.6.3. Limitations and future research directions

Despite its substantial contributions, this study has some limitations that offer avenues for future research. First, only one specific PFM app was analysed. Thus, it would be interesting to replicate this study using other PFM apps. Second, while this study has shown how gamification can increase behavioural intention to use PFM apps, variables related to positive financial behaviours were not considered. Hence, future research might analyse if applying gamification to PFM apps increases their users' financial well-being and financial literacy. In addition, the data were collected at one specific time. Therefore, it would be interesting to analyse the effectiveness of gamification within a longitudinal framework, as this might provide insights into probable causation and long-term effects.

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CHAPTER IV

GAMIFICATION IN WORKFORCE TRAINING: IMPROVING EMPLOYEES' INFORMATION SECURITY BEHAVIOURS AND PERCEPTIONS OF SELF-EFFICACY

4.1. INTRODUCTION

Information security, which encompasses the processes and tools developed and implemented to ensure the confidentiality, integrity and availability of sensitive business information, is a high priority for organisations (Andersson et al., 2022; Ogbanufe et al., 2021). Its importance has significantly increased due to several factors, such as a rise in cyber-attacks and data breaches. The global Covid-19 pandemic also faced organisations with new security challenges and cyber risks due to the need for employees to work remotely and use non-corporate devices for business tasks (Deloitte, 2021). A recent study showed that data breaches during the pandemic cost, on average, a record $4.24 million per incident (IBM, 2021).

Information security incidents can have serious negative consequences, internally by affecting organisations in terms of operations and production, workforce retention, legal issues and financial losses, and externally by impacting on organisational image and reputation (Schlackl et al., 2022). For example, a data breach announcement may result in a loss of customer confidence (Janakiraman et al., 2018), and customer reactions on social media through mass complaints and negative word-of-mouth (Ivaturi & Bhagwatwar, 2020). As a consequence, organisations are increasingly investing in information security to protect their information assets (Andersson et al., 2022). Recent forecasts predict that the information security technology market will reach a value of $174.7 billion worldwide in 2024 (Statista, 2022).

Despite these large investments in information security technologies and information security management systems, in many cases organisations fail to protect their information assets because they neglect the human factor (Khando et al., 2021). Within organisations, people are often an overlooked vulnerable link in the security system. Therefore, increasing employees' information security awareness and education are critical for improving information security behaviours (Silic & Lowry, 2020), addressing data privacy concerns (Dincelli & Chengalur-Smith, 2020), ensuring that a security culture emerges within the organisation (Khando et al., 2021) and for reducing the probability of information security incidents (Kweon et al., 2021).

Simply providing employees with guidelines about the best information security practices is, however, not enough to increase their knowledge and create change (van

Steen & Deeleman, 2021). Traditional methodologies that address information security and data privacy training, such as e-mail communications and instructor-led classroom sessions, are often perceived as distractions from the daily workload and are ineffective in encouraging employees to follow appropriate information security behaviours (Silic & Lowry, 2020) and in increasing data privacy awareness (Dincelli & Chengalur-Smith, 2020). To improve the information security and data protection training experience organisations are implementing new learning methodologies, such as gamified e-training (Baxter et al., 2016; Ghazvini & Shukur, 2018; Hart et al., 2020).

Within information security skills training, gamified methods range from incorporating gamification elements into employees' training platforms and e-learning (Baxter et al., 2016; Petrykina et al., 2021; Thornton & Francia III, 2014), running computer security competitions, such as "Capture the Flag" events (Boopathi et al., 2015; Karagiannis & Magkos, 2020) and playing serious games (Hendrix et al., 2016).

Prior studies have posited that implementing gamification in information security and data protection training systems in organisations promotes experiential and active learning, creates deeper understanding, increases intrinsic motivation and improves security policy compliance (e.g., Banfield & Wilkerson, 2014; Baxter et al., 2016; Dincelli & Chengalur-Smith, 2020; Silic & Lowry, 2020). However, there are still major challenges and limitations in this area of research that need to be addressed.

First, the previous literature has not provided clear empirical evidence about the effectiveness of gamification in enhancing employees' security learning and security efficacy perceptions, that is, employees' perceptions of having the abilities and knowledge to properly undertake appropriate information security behaviours and cope with security incidents (Silic & Lowry, 2020). Many studies have discussed the effectiveness of gamification in information security education from the theoretical viewpoint (e.g., Adams & Makramalla, 2015; Wolfenden, 2019), while others have proposed various gamified designs for use in information security education, but have offered only general insights into its effectiveness (e.g., Alqahtani & Kavakli-Thorne, 2020; Boopathi et al., 2015; Ghazvini & Shukur, 2018; Hart et al., 2020; Petrykina et al., 2021; Thornton & Francia III, 2014; Yamin et al., 2021; Yasin et al., 2019, 2018). Therefore, more empirical studies supporting the use of gamification in security awareness training are needed. Second, most studies have used samples of students and,

therefore, have neither analysed actual working gamified training nor actual organisations (e.g., Alqahtani & Kavakli-Thorne, 2020; Banfield & Wilkerson, 2014; Bioglio et al., 2019; Karagiannis & Magkos, 2020; Petrykina et al., 2021; Thornton & Francia III, 2014; Yasin et al., 2018, 2019). This makes it difficult to generalise their results to the corporate context. Finally, with some exceptions (e.g., Silic & Lowry, 2020), few studies have objectively measured the improvement in employees' actual information security behaviours after completing gamified e-training.

In two studies we aim to address the gaps identified above and offer new insights into the effectiveness of gamified e-training on information security awareness and data protection. In study 1, employees' subjective perceptions of a large international company are explored. Specifically, we propose and test a model to better understand how gamification can increase the success of e-training systems and enhance employees' information security self-efficacy. In particular, the research model draws on previous information systems (IS) success literature (DeLone & McLean, 1992, 2003; Seddon, 1997; Seddon & Kiew, 1996) to analyse how motivational affordances embedded in e-training systems improve information quality and system quality, and how it fosters enjoyment when using e-training systems. In addition, it examines the influence of information quality, system quality and enjoyment on perceived usefulness and employee satisfaction. Finally, it analyses how perceived usefulness enhances employee satisfaction and how these factors improve employees' perceptions of security self-efficacy. In study 2, an examination of employees' actual behaviours in the same international company is undertaken. Specifically, the effectiveness of a gamified e-training on information security awareness and data protection is examined by analysing employees' responses to a phishing attack.

This study contributes to the literature and practice in a number of ways. First, gamification is underrepresented in the IS literature (Koivisto & Hamari, 2019) and results obtained in this field regarding gamification are often contradictory (Baptista & Oliveira, 2019). Therefore, this study contributes to the IS success literature by examining the role played by gamification as an antecedent to IS success under a mandatory use context within an organisation. Second, this research provides valuable insights into the gamification literature (Koivisto & Hamari, 2019; Rapp et al., 2019;

Tobon et al., 2020), in general, and the security gamification literature (Silic & Lowry, 2020), in particular. Gamification has been examined in different contexts, however, scholars have called for more research empirically analysing its use for employee information security training (Silic & Lowry, 2020). Therefore, this study provides important insights by empirically analysing the effects of motivational affordances embedded in gamified information security and data privacy e-training systems. Finally, this study not only looks at employees' perceptions, but also answers the call in the literature to objectively analyse employees' security behaviours (van Steen & Deeleman, 2021) by conducting a phishing campaign to measure improvements in employee information security behaviours.

The remainder of this chapter is structured as follows. Section 4.2 discusses the most relevant gamification-related studies into information security and data protection training. Section 4.3 proposes the research hypotheses and a research question. Section 4.4 and section 4.5 present the methodology and results of the two studies. Finally, section 4.6 discusses the theoretical and practical contributions, as well as the limitations and future research lines.

4.2. PREVIOUS GAMIFICATION STUDIES RELATED TO INFORMATION SECURITY AND DATA PROTECTION

Gamification refers to information systems designed to promote game-like experiences with the final goal of shaping users' behaviours (Koivisto & Hamari, 2019). It is, therefore, an information systems' phenomenon, as it makes use of leisure information systems, such as video games, in different utilitarian information systems' contexts (Koivisto & Hamari, 2019).

Organisations implement motivational affordances/game elements at the intra-organisational level to influence employees' attitudes and behaviours (Wünderlich et al., 2020). In particular, more and more organisations are using gamification to train employees in information security and data protection (Adams & Makramalla, 2015; Baxter et al., 2016; Dincelli & Chengalur-Smith, 2020; Ghazvini & Shukur, 2018; Hart et al., 2020; Silic & Lowry, 2020; van Steen & Deeleman, 2021). As noted earlier,

making large investments in information security technologies to provide the best security systems is not effective if employees lack information security awareness (Khando et al., 2021). For this reason, a key objective of information security research has been to explore ways to enhance employees' security-related decision-making and motivate them to protect sensitive business information (Vedadi et al., 2021). Some studies have highlighted the need to introduce financial incentives to improve compliance with information security policies and vigilance against phishing emails (Goel et al., 2021). Other studies, however, have emphasised that including gamification elements (i.e., points, avatars, gamemaster, notifications, trophies) in training systems encourages positive outcomes, such as avoiding downloading malware (Petrykina et al., 2021) and identifying phishing attacks (Silic & Lowry, 2020). Indeed, the gamification used to develop information security skills does not try to convey theoretical concepts, but is used to promote experiential learning, which makes it more difficult for learners to forget the knowledge acquired (Banfield & Wilkerson, 2014; Silic & Lowry, 2020).

Table 4.1 presents a summary of the relatively few studies that have investigated gamification in the information security and data protection context. As the table shows, the gamified systems that have been proposed/designed to provide training and education in information security and data protection are very diverse. As can be seen, serious games are very popular (Hendrix et al., 2016). The purpose of serious games, considered a subset of gamification (Kapp, 2012), or *"special cases of gamification"* (Werbach & Hunter, 2012, p. 33), is not entertainment, but training. Serious information security training games include board games (e.g., Hart et al., 2020), augmented reality games (e.g., Alqahtani & Kavakli-Thorne, 2020), card games (e.g., Yasin et al., 2018, 2019), simulation and casual genre games (e.g., Ghazvini & Shukur, 2018), computer games (e.g., van Steen & Deeleman, 2021), attack and defence games –in which one team is the threat actor, trying to steal information, and the other is the company, trying to build defences and respond to attacks– (e.g., Adams & Makramalla, 2015; Luh et al., 2020; Yamin et al., 2021) and Cyber Ranges –which are virtual platforms, that simulate real-world scenarios, so that employees can interact with real threats in a risk-free environment, initially used by government entities (e.g., Wolfenden, 2019). "Capture the Flag" challenges are also popular computer security competitions; participants compete in security-related challenges to capture a flag (or

file) from another team and protect their own flag (e.g., Boopathi et al., 2015; Karagiannis & Magkos, 2020). On the other hand, some organisations implement gamified security education, training and awareness (SETA) programmes to decrease security breaches caused by human error (Dincelli & Chengalur-Smith, 2020; Silic & Lowry, 2020). These programmes seek to make employees aware of information security and data protection issues. Finally, in many cases gamification elements are incorporated into online information security and data protection training systems to enhance the learning experience and integrate the hedonic aspect of games into a utilitarian system (i.e., the training platform) (Baxter et al., 2016; Petrykina et al., 2021; Thornton & Francia III, 2014). The focus of the present study is on this last case.

Table 4.1. Gamification studies related to information security and data protection

Reference	Aim	Gamification system	Research design	Variables studied	Participants/ sample size	Key findings
Thornton & Francia III (2014)	To develop a gamification tool for information systems and information security training; to discuss the tool's viability based on preliminary results	Game elements embedded in a training platform	Survey	Motivation, attendance, awareness	150 students/ student control group	Gamified tools showed quite promising benefits: results showed positive attitudes towards the interventions and improved attendance and success rate
Adams & Makramalla (2015)	To describe a gamification method from an attacker's perspective to develop cyber security skills among an organisation's employees and leaders	Serious game: Attack and defence game play	Discussion paper	Cyber security skills	N/A	The combination of gamification, an entrepreneurial perspective and attacker type streams allowed trainees to experience an attack through the eyes of a cyber-attacker and develop cyber security skills
Boopathi et al. (2015)	To introduce a gaming approach to learn cyber security skills by developing a game, and to test students' knowledge at each level of the game	Capture the Flag Challenge	No empirical study conducted	Security knowledge level	N/A	Introducing a gaming approach to cyber security education (such as a Capture the Flag security competition) creates an effective tool to train in computer security and for developing a secure online world
Baxter et al. (2016)	To examine if a gamified training environment promotes higher trainee satisfaction and knowledge acquisition	Game elements embedded in a training platform	Laboratory experiment Field study	Satisfaction and knowledge acquisition	Study 1: 33 students in True Office company, 38 in Thomson Reuters group, 45 in control group Study 2: 856 employees	Gamification enhanced satisfaction in the lab and field studies, but showed only marginally significant improvements in knowledge acquisition

Table 4.1. Gamification studies related to information security and data protection (continued)

Reference	Aim	Gamification system	Research design	Variables studied	Participants/ sample size	Key findings
Ghazvini & Shukur (2018)	To design a serious game (In-foSecure) to improve information security awareness in the healthcare sector	Serious game: simulation and casual genre game	Empirical/ qualitative (record of playing; pilot test)	Employees' performance	5 students 5 employees	Employees found the serious game interactive and enjoyable. The level of employees' information security awareness increased after playing the serious game. In addition, employees showed a greater willingness to participate in information security awareness training as they had a pleasant time playing the game
Yasin et al. (2018)	To design a serious game to improve security awareness and evaluate the game's effectiveness	Serious game: Card game	Empirical/ quantitative and qualitative (survey and observation)	Perceived fun to play, perceived ease of playing, perceived intention to play, collaborative learning, learning performance, helps in security requirements elicitation	16 Students Lab study	Serious games can be an effective and fun way of learning security concepts, replicating real life problems and making them more understandable, and motivating individuals to learn
Wolfenden (2019)	To discuss how gamification in the form of Cyber Ranges is gaining importance as a learning strategy in cyber security	Serious game: Cyber Range	Discussion paper	N/A	N/A	Gamified learning is evolving the cyber security industry and, along with innovations and advances in artificial intelligence and machine learning, security professionals are paving new pathways to address cyber security issues

Table 4.1. Gamification studies related to information security and data protection (continued)

Reference	Aim	Gamification system	Research design	Variables studied	Participants/ sample size	Key findings
Yasin et al. (2019)	To design and evaluate a serious game to teach software security concepts and make the learning experience more engaging	Serious game: Card game	Empirical/ qualitative (survey, brainstorming and observation)	Fun to play, ease of playing, intention to play, game-based learning, cyber security knowledge and avoidance behaviour.	96 students	The serious game had a positive impact on players' security learning outcomes, engagement and participation. Game-based learning may be an effective methodology for teaching security related concepts.
Alqahtani & Kavakli-Thorne (2020)	To develop an augmented reality (AR)-based serious game to increase cyber security awareness and knowledge and to evaluate and test its effectiveness for cyber security education	Serious game: an augmented reality game	Experimental study (survey) Descriptive analysis	Learning, fun, motivation. Perceived ease of playing, continuous use	91 undergraduate students	Augmented reality game for cyber security awareness was engaging and increased understanding of cyber security attacks and vulnerabilities The results highlighted 3 main benefits: it is very easy to play, it supports individuals' cybersecurity awareness and it facilitates understanding of cyber security issues and solutions
Dincelli & Chengalur-Smith (2020)	To create a gamified security education, training and awareness (SETA) artefact, to identify the security threats to which trainees are most susceptible and to facilitate behavioural change	Gamified security education, training and awareness artefact	Empirical/ quantitative (experiment and survey).	Instrumental outcomes, (attitudes, intentions and online self-information disclosure – OSD - behaviours) experiential outcomes (memorability and user experience)	1,718 employees	This gamified SETA intervention is an innovative solution which is more effective than current solutions to the problem of OSD behaviours, which can lead to security threats. The results also showed that of the gamified interventions the text-based artefact was better at improving instrumental outcomes, and the visual-based artefact was better at improving experiential outcomes

Table 4.1. Gamification studies related to information security and data protection (continued)

Reference	Aim	Gamification system	Research design	Variables studied	Participants/ sample size	Key findings
Hart et al. (2020)	To propose a serious game to increase cyber security awareness for people with non-technical backgrounds working in organisations, and to assess the perceived efficacy of the game for increasing cyber security awareness	Serious game: Board game	Empirical/ quantitative (4 experiments and survey)	Perceived ease of use, perceived usefulness, intention to use	1st experiment: 14 undergraduate students 2nd experiment: 15 students 3rd experiment: 12 employees 4th experiment: 13 legal practitioners and lawyers	Employees are more confident than students that serious games can improve their awareness of cyber security issues. Employees enjoyed the game rules and mechanics; however, the students did not enjoy playing the game
Karagiannis & Magkos (2020)	To show the potential of Capture the Flag challenges for enhancing the learning experience and improving students' skills and knowledge	Capture the Flag Challenge	Empirical/ quantitative (experiment, survey)/ Qualitative (experiment, observation)	Perceived learning, self-directed learning, assessment capabilities, attention, relevance, confidence and satisfaction	32 undergraduate students for the pre-engagement survey (to select the appropriate Capture the Flag challenge) 25 to 30 students for the observation research during the lab experiment	Students showed higher confidence in their skills and were more engaged during the learning experience. The outcomes related to technical skills and knowledge acquisition were positive

Table 4.1. Gamification studies related to information security and data protection (continued)

Reference	Aim	Gamification system	Research design	Variables studied	Participants/ sample size	Key findings
Luh et al. (2020)	To propose and test a meta model designed to provide a complete view on information system attacks and their reduction and a tool for security education	Serious game: Attack and defence game play	Quantitative (experiment, survey)/ Qualitative (interviews)	Knowledge gain, attack categories, game evaluation (accessibility, balance and design) and model evaluation	Higher education environment	The gamified model defines a wide range of actors, assets and actions. It allows the evaluation of cyber risks while giving technical experts the opportunity to explore specific attack scenarios in the context of an abstract IT infrastructure. The serious game prototype was successfully tested in a higher education environment
Silic & Lowry (2020)	To create a gamified security training system to enhance intrinsic motivation and security learning and efficacy To propose a hedonic-motivation system adoption model which assesses security related constructs, employees' intrinsic motivations and their ability to cope with security challenges, to positively change their behaviours	Game elements embedded in a training platform	Empirical/ quantitative (survey and experiment) SEM	Perceived ease of use, perceived intrinsic usefulness, curiosity, joy, control, challenge, learning, security response efficacy, security self-efficacy, immersion, behavioural intention to follow security policies, actual phishing response following security policies	420 employees	Game elements can improve organisational security training systems, providing intrinsic motivation to learn and comply with security measures, and provide the efficacy necessary for employees to actually carry out appropriate anti-phishing behaviours. All the hypotheses were supported except the relationship between joy and behavioural intention

Table 4.1. Gamification studies related to information security and data protection (continued)

Reference	Aim	Gamification system	Research design	Variables studied	Participants/ sample size	Key findings
Petrykina et al. (2021)	To develop and describe a gamified interactive security system that rewards users based on their online security behaviours To evaluate its effectiveness compared to traditional security messages	Game elements embedded in a training platform	Empirical/ quantitative (experiment)	Productivity and security	94 students	The gamified experience decreased the volume of downloaded malware without harming productivity; presenting pre-emptive notifications enhanced this effect
van Steen & Deeleman (2021)	To design a serious game for cyber security training and test its efficacy compared to a non-cyber security-based game, incorporating factors of the theory of planned behaviour (TPB)	Serious game: Computer game	Empirical/ quantitative (experiment; survey)	Attitude, subjective norms, perceived behavioural control, intention, self-reported behaviours	258 participants (Employees and students)	The cyber security game showed higher self-reported scores on attitudes, perceived behavioural control, intentions and behaviour than did non-cyber security games
Yamin et al. (2021)	To develop and evaluate a serious game which simulates cyber security exercise scenarios where players can act as cyber attackers or defenders in a multiplayer environment	Serious game: Attack and defence game play	Empirical/ survey	Realism and efficiency	25 participants	The game realistically represented the cyber security exercise scenario

4.3. THEORETICAL BACKGROUND

4.3.1. Employees' perceptions of gamified e-training systems related to information security and data protection: Hypotheses development

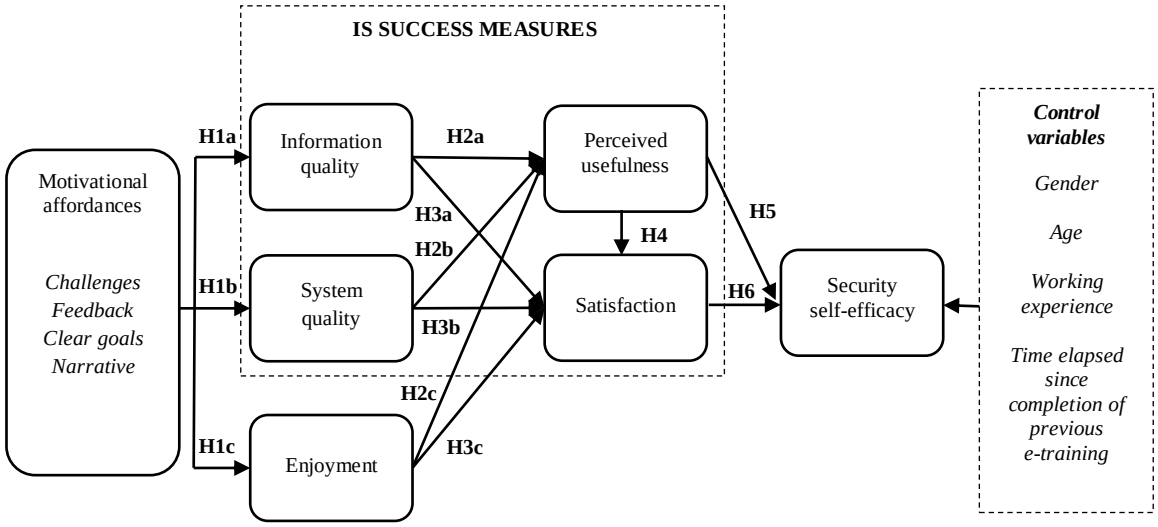
Over the last decades, special attention has been paid to the identification of the factors that contribute to IS success. The work of DeLone and McLean (1992) is considered one of the most influential studies in this field. These authors reviewed different measures of IS success and developed a six-dimensional taxonomy: system quality, information quality, use, user satisfaction, individual impact and organisational impact. These categories form the well-known Delone and McLean's IS success model. Since its publication, the model has been tested, modified and updated (see DeLone & McLean, 2003).

One of the first attempts to empirically test the model was performed by Seddon and Kiew (1996). These authors proposed an alternative model in which system use was replaced by usefulness. The argument for this approach was that usefulness is a better measure of IS success in mandatory contexts and in situations where a system is not used continuously. In addition, the variable "system importance" was added to the model to explain variations in users' perceptions of usefulness and of user satisfaction. Finally, the simultaneous causality between use and user satisfaction included in the original DeLone and McLean (1992) model was replaced by one-way causality (i.e., usefulness causes user satisfaction).

Subsequently, Seddon (1997) proposed a respecified IS success model that included two different variance sub-models, a partial behavioural model of IS use and the IS success model. Focusing on the IS success model, Seddon (1997) included three types of variable: 1) measures of information and system quality; 2) general perceptual measures of the net benefits of IS use (i.e., perceived usefulness and user satisfaction); and 3) other measures of the net benefits of IS use. In this sub-model it was proposed that information quality and system quality influence perceived usefulness and user satisfaction, perceived usefulness influences user satisfaction and, finally, the net benefits for individuals, organisations and society are expected to influence perceived usefulness and user satisfaction.

In the present study, Seddon's sub-model of IS success, more specifically its measures of information and system quality, and the general perceptual measures of the net benefits of IS use (i.e., perceived usefulness and user satisfaction), serve as the basis for the proposed model. As depicted in Figure 4.1, the research model explores the role of gamification as a success determinant in the context of e-training systems to promote information security and data protection. As such, it proposes that motivational affordances embedded in e-training systems influence information quality, system quality and enjoyment. In addition, it examines the influence of information quality, system quality and enjoyment on perceived usefulness and employee satisfaction. Finally, it analyses the relationship between perceived usefulness and employee satisfaction and whether these two IS success measures improve employees' security self-efficacy.

Figure 4.1. Proposed model



The effect of motivational affordances on two of the IS success measures, information quality and system quality, and on enjoyment, is first explored. In the information systems field, information and system quality are considered key dimensions of success and effectiveness (DeLone & McLean, 1992, 2003; Seddon, 1997; Seddon & Kiew, 1996). In e-learning environments, information quality refers to useful, understandable and reliable content delivered through learning management systems (DeLone & McLean, 1992). Displaying information and content in a logical

and comprehensible manner in learning courses allows to achieve learning goals faster (Al-Fraihat et al., 2020). In this sense, motivational affordances, such as challenges, clear goals, feedback and narrative may simplify learning content and adapt it to the learners' abilities and knowledge (Krath et al., 2021). For example, transmitting learning content through stories with specific plots may help disaggregate it into smaller topics (Küpper et al., 2021; Wee & Choong, 2019). Similarly, reframing content in a meaningful narrative may help individuals to immerse themselves in the activity (Koivisto & Hamari, 2019). The feedback offered by gamified systems in the form of giving points, reporting progress and through comments (Fu et al., 2009) can also be very helpful. As such, instructional content can be complemented by information which is provided based on players' inputs, so that they receive feedback on their actions (Laine & Lindberg, 2020). In the information security context, gamification can also help represent real-life problems in a presentable and understandable form (Yasin et al., 2018), model learning content, such as attack and defence scenarios for cyber security exercises, and aid in the design of cyber-attack strategies (Yamin et al., 2021). In sum, game design elements and mechanics are powerful tools for communicating information (Rodrigues et al., 2017) and supporting pre-existing instructional content (Landers, 2014).

System quality refers to technological characteristics, ease of use, functionality and flexibility (DeLone & McLean, 2003). Including too many features in e-learning systems can waste effort and induce users to become frustrated with the relevant technologies, leading to possible system abandonment (Sun et al., 2009). Therefore, system quality is crucial for a good learning experience (Cidral et al., 2018). Motivational affordances help users navigate through systems and support decision-making by quantifying individuals' activities within the information system itself (García-Jurado et al., 2021; Koivisto & Hamari, 2019; Rodrigues et al., 2017). Gamification also reframes tasks and activities with game elements and motivational affordances, such as by communicating clear goals which divide the main activity into smaller activities, by giving immediate feedback to report achievements and by creating a mutually supportive social community (Koivisto & Hamari, 2019). Providing continuous challenges and positive immediate feedback, or feedback in the form of a performance graph, clarifies individuals' development and, therefore, helps to ensure

that users do not become bored or overwhelmed by the activity (Csikszentmihalyi, 1975).

Finally, perceived enjoyment refers to the extent to which interacting with the system is perceived as enjoyable in itself (Davis, 1989). Incorporating game elements into information systems provides hedonic benefits, such as enjoyment (Hamari & Koivisto, 2015; Högberg et al., 2019). Prior research has demonstrated that motivational affordances, such as challenges (Mulcahy et al., 2020) and rewards/badges (Zhang et al., 2021), can enhance feelings of enjoyment. Similarly, employing serious games to address information security may help users achieve their learning objectives in an interactive and fun way (Ghazvini & Shukur, 2018; Yasin et al., 2018). Gamification is particularly useful in learning and training contexts because it can build enthusiasm, provide feedback on performance, give recognition to learners and encourage goal setting (Bai et al., 2020). In addition, incorporating gamification into the work environment not only leads to enjoyment with a specific working task, but increases work enjoyment in general (Gerdenitsch et al., 2020).

Therefore, based on these arguments, the following hypotheses are proposed:

H1a: Motivational affordances are positively related to information quality.

H1b: Motivational affordances are positively related to system quality.

H1c: Motivational affordances are positively related to enjoyment.

The relationship between information quality, system quality, enjoyment and perceived usefulness is next explored. Perceived usefulness captures the degree to which an individual believes that the use of a particular system will improve his/her performance (Davis, 1989). In the literature on IS success, information quality and system quality have been related to usefulness (Seddon & Kiew, 1996). In particular, perceived usefulness has been considered a better measure of IS success than system use, especially in those cases when system use is mandatory (Seddon & Kiew, 1996; Seddon, 1997).

Previous studies in the online learning context have also examined the positive impact of information quality and system quality on perceived usefulness. Providing

students undertaking online courses with logical, understandable, up-to-date and accurate information, in a readable and attractive format, makes them perceive the courses as more useful for achieving their learning goals (Al-Fraihat et al., 2020; Lwoga, 2014; Wu et al., 2010). Similarly, learners find e-learning systems useful when they are easy to use and meet their learning requirements (Al-Fraihat et al., 2020; Joo et al., 2018; Lwoga, 2014; Wu et al., 2010). Distance learning and electronic device-based training make the learning process non-dependent on others. In the absence of human contact, system and information quality become more important (Chen, 2010). For instance, in an academic context, Saeed and Abdinnour-Helm (2008) found that providing students with accurate and well-formatted information on a website makes them perceive that web-based educational information systems usefully support their efforts. In an organisational context, Chen (2010) also demonstrated that good system quality reduces users' opposition towards systems, and that good information quality facilitates their understanding of course content. Thus, both variables lead to systems being perceived as more useful.

Prior research has also highlighted the important role of fun and pleasure in enhancing perceived usefulness in contexts such as mobile technologies (Alalwan et al., 2018; Koenig-Lewis et al., 2015), banking technologies (De Oliveira et al., 2019) and augmented reality and virtual reality technologies (Holdack et al., 2022; Lee et al., 2019; Manis & Choi, 2019). In the context of distance learning, enjoyment has also been shown to create higher perceptions of the usefulness of learning systems (Rizun & Strzelecki, 2020; Syahruddin et al., 2021). Thus, it is proposed that if individuals perceive that interacting with a technology is enjoyable, they will regard the technology as more productive and beneficial.

Therefore, the following hypotheses are proposed:

H2a: Information quality is positively related to perceived usefulness.

H2b: System quality is positively related to perceived usefulness.

H2c: Enjoyment is positively related to perceived usefulness.

Satisfaction, which is associated with all the benefits that an individual expects to receive when using a particular IS (Seddon & Kiew, 1996), has also been considered to be an IS success measure (DeLone & McLean, 1992, 2003; Seddon, 1997; Seddon & Kiew, 1996). In IS success-related studies, information quality and system quality have been broadly related to user satisfaction (DeLone & McLean, 1992, 2003; Seddon, 1997; Seddon & Kiew, 1996). Previous literature in the context of distance learning has also found that information quality and system quality are determinant factors of learners' satisfaction. Learners' satisfaction is greater when e-learning systems provide interesting and understandable content, and accurate, reliable and updated information (Al-Fraihat et al., 2020; Aparicio et al., 2016; Cidral et al., 2018; Eom et al., 2012; Lin, 2007; Martins et al., 2019). Similarly, when users find that using a system is easy, and not technologically challenging, they pay more attention to the learning materials, given that they have to focus less effort on mastering the technology and, consequently, they derive greater satisfaction (Sun et al., 2008). Therefore, system quality, as evidenced in a user-friendly and well-structured system, enhances user satisfaction with e-learning systems (Aparicio et al., 2019; Cidral et al., 2018; Lin, 2007; Lwoga, 2014). This relationship between system quality and user satisfaction is found also in the organisational context. In this sense, previous studies have shown that system quality affects employee satisfaction with e-learning systems (Chen, 2010; Marjanovic et al., 2016) and a cloud system (Donovan et al., 2018). In particular, the absence of personal contact in distance learning means that system quality is very important for improving student satisfaction (Lin, 2007).

Information systems designed to enhance users' productivity are increasingly incorporating entertainment-oriented components to maximise user enjoyment (Koivisto & Hamari, 2019). As noted earlier, enjoyment is an intrinsic experience related to the extent to which using a system is perceived as enjoyable and pleasurable in itself, regardless of external outcomes (Davis et al., 1992). Prior studies have found that hedonic values in mobile technologies, such as enjoyment, fun, pleasure and excitement, have a higher impact on user satisfaction than do utilitarian values (Hsu & Lin, 2016; Kim et al., 2013; Lee & Kim, 2018). Yousaf et al. (2021) also found that experiencing enjoyment while interacting with a technology enhances user satisfaction. Similarly, integrating components which promote enjoyment into workplace systems enhances job satisfaction (Silic et al., 2020).

Taking these arguments into account, the following hypotheses are proposed:

H3a: Information quality is positively related to employee satisfaction.

H3b: System quality is positively related to employee satisfaction.

H3c: Enjoyment is positively related to employee satisfaction.

Seddon and Kiew (1996) argued that for users to be satisfied with an IS it must, at least, be useful, and the more useful it is, the greater will be their satisfaction. In distance learning, the perceived usefulness of e-learning systems has been found to be an important cause of extrinsic learner satisfaction (Lwoga, 2014). In other words, learners will be satisfied if they perceive that systems enable them to improve their learning performance and complete learning tasks faster (Al-Fraihat et al., 2020). Previous research has also shown that a positive relationship exists between the perceived usefulness of online learning systems and learner satisfaction (Al-Fraihat et al., 2020; Chen, 2010; Joo et al., 2018; Lin & Wang, 2012; Lwoga, 2014; Sun et al., 2008; Wu et al., 2010). Therefore, we expect that employees will feel more satisfied when they perceive that gamified e-training systems are useful. Accordingly, the following hypothesis is proposed:

H4: Perceived usefulness is positively related to employee satisfaction.

The effect of perceived usefulness and satisfaction on employees' security self-efficacy is now examined. Self-efficacy refers to individuals' beliefs in their capacity to perform tasks and achieve given goals (Bandura, 1977). In the specific field of information security, security self-efficacy has been defined as the employee's perception of having the necessary abilities and knowledge to carry out security behaviours, perform according to established policies and, therefore, face up to threats (Herath & Rao, 2009; Silic & Lowry, 2020). Self-efficacy has been considered as an important measure of the effectiveness of training activities (Abraham & Chengalur-Smith, 2019). Thus, given the importance of security self-efficacy in reducing the risk of security threats, employees should be trained through security awareness programmes designed to make them believe in their abilities to perform the recommended security behaviours (Ng et al., 2009).

Previous literature on online learning system success has argued that increasing users' perceptions of the usefulness of, and satisfaction with, systems will result in learners perceiving that they have increased their knowledge, achieved their learning goals and are more efficient in their learning tasks (Al-Fraihat et al., 2020). Similarly, satisfaction with e-learning has been found to be related to learners' performance, that is, satisfied learners achieve better learning outcomes (Bossman & Agyei, 2022). In addition, in online collaborative learning contexts, the perceived usefulness of, and satisfaction with, learning methods have been found to positively impact on students' perceptions of their learning (Muñoz-Carril et al., 2021). At the organisational level, prior studies have also shown that, in the training systems' context, perceived usefulness and user satisfaction encourage learners to use the systems, and this systems' use improves overall job outcomes, such as task fulfilment, job satisfaction and job performance (Chen, 2010).

Thus, it is expected that both the perceived usefulness of gamified e-training systems and employee satisfaction with the systems will increase their perceptions of having the abilities to undertake effective information security behaviours. Therefore, the following hypotheses are proposed:

H5: Perceived usefulness is positively related to security self-efficacy.

H6: Employee satisfaction is positively related to security self-efficacy.

4.3.2. Employees' actual behaviours: Research question

Assessing employees' perceptions of their abilities to undertake appropriate information security behaviours is key for understanding the effectiveness of information security training (Abraham & Chengalur-Smith, 2019). When organisations have invested resources in, and implemented, information security training systems, they need to monitor whether or not they have had a real impact (Kweon et al., 2021) by assessing whether the security behaviours of their employees have significantly changed (Silic & Lowry, 2020). Therefore, this study explores whether gamified e-training systems causes positive behavioural changes.

As explained earlier, gamification has the potential to impact at the intra-organisational level by influencing employees' attitudes and behaviours (Wünderlich et al., 2020). The few studies that have analysed the impact of gamified learning in organisations on employees' information security-related behaviours have shown beneficial consequences, such as avoiding downloading malware (Petrykina et al., 2021) and identifying phishing attacks (Silic & Lowry, 2020).

Based on these previous findings, the present study investigates if gamified e-training systems improve employees' actual behaviours. Employees' responses to a phishing attack were chosen as the objective and auditable security behaviour. Phishing attacks involve sending fraudulent communications, usually via e-mail, that appear to come from a trusted and reputable source. The objective is to access and steal sensitive data, or to install malware on the victim's system. Nowadays, it is one of the most important security threats (Statista, 2021). Therefore, it is important to assess whether gamified e-training improves employees' responses in this specific context. Thus, the following question is posed:

RQ1: Do gamified e-training systems improve employees' responses to a phishing campaign?

4.4. STUDY 1

In study 1 we tested the hypotheses of the proposed model to analyse whether gamification increases the success of e-training systems and employees' security self-efficacy. To achieve this objective employees' subjective perceptions were explored by collecting data through a self-reported questionnaire.

4.4.1. Methodology

4.4.1.1. Data collection and participants

To test the proposed model, data were collected through an online survey developed using Microsoft Forms. Questionnaires were distributed among employees of a German multi-national who had previously completed gamified e-training courses

in information security and data protection. With a workforce of about 14,000, the company is a global leader in its sector and is present in more than 50 countries.

The company's information security and data protection gamified e-training courses use a global learning management system that helps employees quickly identify and assess threats, and to react appropriately. The content of the courses, displayed in a main menu, is divided into chapters that cover specific topics. Most chapters contain videos, slides, quizzes and multiple-choice questions.

In a careful analysis of the gamified e-training, the following motivational affordances were identified: clear goals, challenges, feedback and narrative context. First, the e-training material covered the specific objectives of the course to make the employees aware of what they had to do to successfully complete the training course. They were informed at the beginning of the learning experience and after each chapter. The e-training included challenges presented in the form of practical exercises, such as puzzles and drag-and-drop activities, and in the form of achievements. During the learning experience the employees received feedback about their successes and failures. In particular, the e-training provided frequent feedback by awarding points, reporting on progress and by giving immediate comments. Finally, the training included a narrative context that tried to immerse the employees in the activity through real-life and animated videos which displayed examples of possible organisational information security breaches and threats; the aim was to involve the employees in the scenarios and to show that their actions are really important to the company.

Once the study was approved by the company's works council, the survey was conducted during February and March 2021. An invitation to complete the survey was sent to 8,930 employees from 11 different countries. The language of the original questionnaire was English, and it was translated into four languages (i.e., German, Spanish, Portuguese and Chinese). The different versions of the questionnaires were produced with the assistance of a professional translation agency. Of the 1,237 employees who responded to the survey, 1,178 returned valid responses.

The characteristics of the sample are presented in Table 4.2. Regarding the gender of the respondents, 76.31% were men, 16.81% were women and 6.88% preferred not to say. In terms of age, the majority of respondents (72.2%) were between

26 and 55 years. Some 91.3% of the sample completed both e-training types (i.e., in information security and data protection), and 75.5% had completed the e-training in the previous 6 months. With respect to location, 14.4% of the respondents were based in the Asia-Pacific (APAC), 66.3% in Europe, Middle East and Africa (EMEA) and 19.3% in North, Central and South America (AMER). Almost all of the sample had been working in the organisation for more than one year. Finally, in relation to work areas, 29.7% of the respondents identified their position within the area of engineering, 16.2% within the area of manufacturing and 12.1% within the area of development.

Table 4.2. Sample characteristics

Category		Percentage (%)
Gender	Men	76.3 %
	Women	16.8%
	Prefer not to say	6.9%
Age	< 18 years old	0.3 %
	18-25 years old	4.8 %
	26-35 years old	23.1 %
	36-45 years old	24.4%
	46-55 years old	24.7%
	> 55 years old	16.4%
	Prefer not to say	6.3%
Type of e-training	Data Protection	5.8 %
	Information security	2.9 %
	Both	91.3 %
Last time	< 1 month	19.3%
	1-3 months	34.5%
	3-6 months	21.7%
	6 months to 1 year	17.7%
	>1 year	6.8%
Location	APAC	14.4 %
	EMEA	66.3 %
	AMER	19.3 %
Work experience	< 1 year	7.7%
	1-5 years	29.9%
	5- 10 years	26.1%
	>10 years	36.3%
Work area	IT	7%
	HR	2.6%
	Engineering	29.7%
	Research	2.3%
	Marketing	1.2%
	Administration	5.2%
	Development	12.1%
	Manufacturing	16.2%
	Finance	3%
	Legal	0.3%
	Sales	9.8%
	Management	8.6%
	Training	2%

4.4.1.2. Measures

The variables used in the study were measured using 7-point Likert scales based on previous literature (see Table 4.3). Four motivational affordances were measured: challenges, feedback, clear goals and narrative context. Challenges were assessed following Silic and Lowry (2020); feedback and clear goals were measured following Fu et al. (2009); and narrative context used items adopted from Green and Brock (2000). To assess information quality, we adapted the scale of Aparicio et al. (2019), and to assess system quality we adopted items from Davis (1989) and Aparicio et al. (2019). Enjoyment was measured following Venkatesh (2000). Perceived usefulness was measured using items from Davis (1989). Satisfaction was assessed following Kettanurak et al. (2001), and security self-efficacy was assessed by adapting the scale of Silic and Lowry (2020). Finally, the study includes the following control variables: gender, age, time elapsed since completion of previous e-training and work experience in the company.

Table 4.3. Constructs, items, and sources

Construct and source	Items
Motivational affordances Silic & Lowry (2020); Fu et al. (2009); Green & Brock (2000)	***Challenges*** **CH1.** Completing the different practical exercises (such as puzzles) is challenging **CH2.** The different practical exercises of the e-training are demanding
	Feedback **FE1.** While I am completing e-training, I receive feedback on the progress made (such as chapters completed) **FE2.** While I am completing the e-training, I receive immediate information on my success (or failure) **FE3.** While I am completing the e-training, I receive information on my score
	Clear goals **GO1.** Overall learning goals are presented in the beginning of the e-training **GO2.** Overall learning goals are clear to me
	Narrative context **NAR1.** While I was watching the videos, I could easily picture the events in them taking place **NAR2.** I could visualize myself in the events described in the videos **NAR3.** I was mentally involved in the videos while watching them
Information quality Aparicio et al. (2019)	**IQ1.** The content provided by the e-training is understandable **IQ2** The content provided by the e-training is interesting
System quality Davis (1989); Aparicio et al. (2019)	**SQ1.** The e-training is easy to use **SQ2.** The e-training is well structured **SQ3.** The e-training is easy to interact with
Enjoyment Venkatesh (2000)	**ENJ1.** I have fun completing the e-training **ENJ2.** I find the e-training enjoyable **ENJ3.** I find the e-training pleasant
Usefulness Davis (1989)	**US1.** The e-training improves my information security and data protection behaviour **US2.** The e-training enables me to better react to potential cybersecurity threats **US3.** The e-training is useful
Satisfaction Kettanurak et al. (2001)	**SAT1.** Overall, I am very satisfied with the e-training **SAT2.** Overall, I have had a very positive learning experience
Security self-efficacy Silic & Lowry (2020)	**SE1.** I am confident that I can perform proper information security behaviours **SE2.** I can protect my computer by following proper information security behaviours **SE3**. I am able to perform proper information security behaviours

4.4.1.3. Common method bias assessment

As the data were collected through a self-administrated questionnaire an assessment was made of the presence of common method bias, using both procedural and statistical methods (Podsakoff et al., 2003). First, participation in the study was voluntary and anonymous. In addition, to prevent the respondents identifying cause-effect relationships among the constructs the dependent and independent variables were included on different pages of the survey. Finally, a variance inflation factor (VIF) assessment suggested there was no common method bias: values ranged from 1 to 3.253, lower than the 3.3 threshold (Kock, 2015).

4.4.2. Results

Partial least squares (PLS) structural equation modelling with SmartPLS 3.0 software was used to test the hypotheses (Ringle et al., 2015). First, the measurement model was assessed, and then the structural model. These two steps are described below.

4.4.2.1. Measurement model analysis

First, the reflective measurement model for the first-order dimensions was assessed (Hair et al., 2017). Individual item reliability was tested by examining the standardised factor loadings. Individual item reliability for all factor loadings was confirmed; they were all above 0.70 and statistically significant at 1% (Carmines & Zeller, 1979) (Table 4.4). Construct reliability was confirmed as the Cronbach alphas and composite reliability (CR) for all constructs were above the threshold of 0.7. To assess the convergent validity of the constructs the average variance extracted (AVE) was calculated. The results showed that the AVE values were above the threshold of 0.5 (Fornell & Larcker, 1981). Finally, to evaluate discriminant validity we verified that all the indicators' outer loadings were higher than the respective cross-loadings (Hair et al., 2017). We also proved that the square roots of the AVEs of each construct were greater than the inter-construct correlations (Fornell & Larcker, 1981). Finally, we confirmed that the normal bootstrap confidence interval of the HTMT criterion, with Bonferroni adjustment, did not contain the value 1 (Henseler et al., 2015).

Table 4.4. Reflective measurement model results

Construct	Item	Mean	Standard deviation	Factor loading	AVE	Cronbach's alpha	CR	Q^2
Challenges	CH1	4.29	1.66	0.941	0.893	0.881	0.944	N.A.
	CH2	4.36	1.55	0.950				
Feedback	FE1	5.75	1.33	0.926	0.892	0.939	0.961	N.A.
	FE2	5.90	1.28	0.959				
	FE3	5.91	1.29	0.948				
Clear goals	GO1	5.79	1.25	0.964	0.926	0.920	0.962	N.A.
	GO2	5.78	1.28	0.961				
Narrative	NAR1	5.43	1.30	0.937	0.876	0.929	0.955	N.A.
	NAR2	5.26	1.42	0.955				
	NAR3	5.02	1.47	0.916				
Information quality	IQ1	5.76	1.30	0.907	0.832	0.798	0.908	0.525
	IQ2	5.27	1.48	0.917				
System quality	SQ1	5.90	1.30	0.956	0.909	0.950	0.968	0.478
	SQ2	5.78	1.28	0.947				
	SQ3	5.83	1.30	0.958				
Enjoyment	ENJ1	4.51	1.68	0.954	0.907	0.949	0.967	0.312
	ENJ2	4.41	1.66	0.957				
	ENJ3	4.79	1.62	0.946				
Usefulness	US1	5.38	1.46	0.947	0.898	0.943	0.963	0.520
	US2	5.36	1.45	0.955				
	US3	5.48	1.48	0.940				
Satisfaction	SAT1	5.40	1.37	0.979	0.959	0.957	0.979	0.741
	SAT2	5.32	1.46	0.979				
Security self-efficacy	SE1	5.74	1.25	0.968	0.935	0.965	0.977	0.426
	SE2	5.75	1.29	0.960				
	SE3	5.77	1.24	0.973				

Note: CR: Composite reliability; AVE: Average variance extract.

Motivational affordances were conceptualised as a second-order formative construct composed of four first-order factors: challenge, feedback, clear goals and narrative. Thus, the assessment of the first-order constructs was followed up by the creation of a second-order construct using the two-stage approach proposed by Hair et al. (2018). The resulting model was re-estimated and re-evaluated. Collinearity was assessed through the VIF values; VIF values lower than 5 demonstrate there are no collinearity issues (Hair et al., 2011). As can be seen in Table 4.5, the model has no multicollinearity problems as the VIF values range from 1.182 to 2.438. Finally, we

evaluated the external validity of the formative measurement model through the weights and loadings of the indicators. The external validity of the model was acceptable as the weights of the indicators were statistically significant and, therefore, they contributed to the construct (Hair et al., 2017).

Table 4.5. Formative measurement model results (second-order constructs)

Construct	Items	Loading	t-value	Weight	t-value	VIF
Motivational affordances	Challenges	0.455	14.387	0.102	4.166	1.182
	Feedback	0.768	30.986	0.182	4.917	2.278
	Clear goals	0.818	41.086	0.273	7.458	2.438
	Narrative	0.941	105.465	0.627	20.768	1.899

Note: VIF: Variance inflation factor.

4.4.2.2. Structural model analysis

After analysing the measurement model, the statistical significance of the standardised paths was assessed through a bootstrapping process with 5,000 subsamples. The model explains 66% of information quality variance, 52% of system quality, 38.4% of enjoyment, 58.6% of perceived usefulness, 78.2% of employee satisfaction and 46.1% of security self-efficacy. To analyse predictive relevance, the Stone-Geisser test was carried out. The Q^2 values for the dependent variables were all positive, which indicates that the model has predictive relevance (see Table 4.4). Finally, the model has a good fit, since the standardised root mean square residual (SRMR) value was less than the threshold of 0.08 (Hu & Bentler, 1998).

The results of the structural model are summarised in Table 4.6. The results show that motivational affordances were positively related to information quality ($\beta = 0.813$; $t = 60.098$), system quality ($\beta = 0.721$; $t = 33.276$) and enjoyment ($\beta = 0.620$; $t = 31.265$), supporting H1a, H1b and H1c. Information quality ($\beta = 0.409$; $t = 9.325$), system quality ($\beta = 0.171$; $t = 4.704$) and enjoyment ($\beta = 0.284$; $t = 8.490$) were positively associated with perceived usefulness, supporting H2a, H2b and H2c. Similarly, information quality ($\beta = 0.350$; $t = 9.847$), system quality ($\beta = 0.131$; $t = 4.520$) and enjoyment ($\beta = 0.296$; $t = 11.415$) were positively related to satisfaction, supporting H3a, H3b and H3c. Perceived usefulness was shown to promote satisfaction

(β = 0.239; t = 8.844), supporting H4. Finally, the findings demonstrated that perceived usefulness (β = 0.208; t = 5.179) and employee satisfaction with the e-training (β = 0.506; t = 12.954) increased employees' security self-efficacy, supporting H5 and H6. The only control variable with a significant impact on employees' security self-efficacy was the time elapsed since they last completed the e-training (β = − 0.046; t = 2.077); employees who had completed the e-training more recently showed higher security self-efficacy.

Table 4.6. Structural model results

Hypotheses	β	t-value	Supported
H1a: Motivational affordances → Information quality	0.813	60.098***	Yes
H1b Motivational affordances → System quality	0.721	33.276***	Yes
H1c: Motivational affordances → Enjoyment	0.620	31.265***	Yes
H2a: Information quality → Perceived usefulness	0.409	9.325***	Yes
H2b: System quality → Perceived usefulness	0.171	4.704***	Yes
H2c: Enjoyment → Perceived usefulness	0.284	8.490***	Yes
H3a: Information quality → Satisfaction	0.350	9.847***	Yes
H3b: System quality → Satisfaction	0.131	4.520***	Yes
H3c: Enjoyment → Satisfaction	0.296	11.415***	Yes
H4: Perceived usefulness → Satisfaction	0.239	8.844***	Yes
H5: Perceived usefulness → Security self-efficacy	0.208	5.179***	Yes
H6: Satisfaction → Security self-efficacy	0.506	12.954***	Yes
Control variables:			
Time elapsed → Security self-efficacy	-0.046	2.077**	
Working experience → Security self-efficacy	0.017	0.724	
Gender → Security self-efficacy	-0.011	0.433	
Age → Security self-efficacy	0.019	0.769	

Note: ***p<0.01; **p<0.05

4.5. STUDY 2

Study 1 provided interesting insights into employees' perceptions. Study 2 addressed the research question by analysing, through objective measures, the effectiveness of gamified information security e-training systems. In other words, the aim was to examine employees' actual behaviours, not their perceptions.

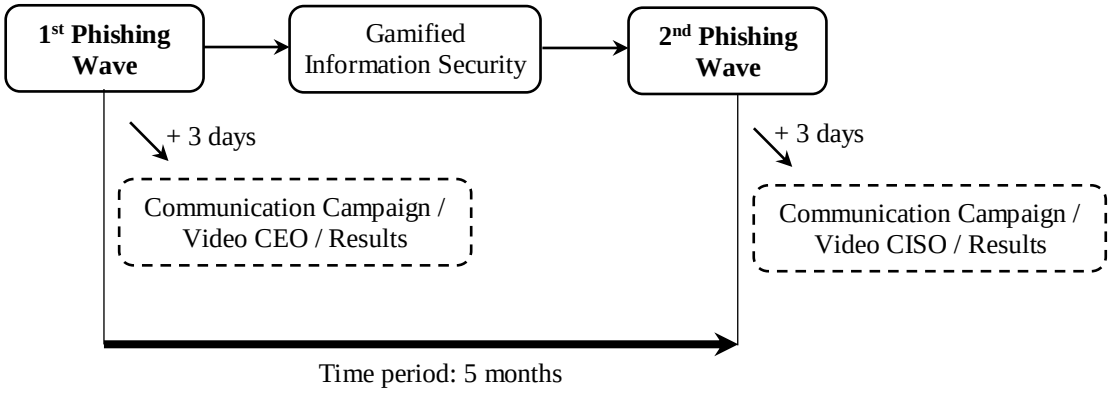
4.5.1. Methodology

4.5.1.1. Participants and procedure

The employees' responses to a phishing attack were chosen as the objectively auditable security behaviours. As previously noted, this is one of the most common cyber-attacks. The phishing campaign targeted all the employees of the same large company examined in study 1. The phishing campaign was launched three months after the survey was distributed, that is, in June 2021.

As shown in Figure 4.2, the campaign consisted of two phishing waves, with a period of 5 months between the first and the second wave; in this intervening period the employees completed a gamified e-training course with the same structure and design as the e-training analysed in study 1 but, in this case, focused on the topic of phishing. The gamified e-training was mandatory for all employees, and was provided in different languages, depending on location.

Figure 4.2. Timeline phishing campaign



Some 13,452 phishing e-mails were sent in the first wave and 13,714 in the second. Thus, most of the company's employees received phishing e-mails. An external firm specialised in phishing training managed the process. The phishing scenario for the first wave was identical in all cases.

A video of the Chief Executive Officer (CEO) explaining the phishing test, and the importance of identifying fake emails and acting correctly, was shown to those

employees who clicked on the link. Three days after the first wave all employees, including those who acted correctly during the test, received a company newsletter showing the video and the results of the phishing campaign. The scenario in the second phishing wave was different, but the difficulty level and structure were the same as in the first wave to ensure comparability. In the second phishing wave a video of the Chief Information Security Officer (CISO), also explaining the phishing test, and the importance of identifying fake emails and acting correctly, was shown to the employees who clicked on the link. Again, three days after the phishing e-mails were sent, employees received a communication with the CISO's video and the results of the phishing campaign.

4.5.1.2. Measures

After both waves the number of e-mails opened, links clicked, usernames/passwords submitted by employees (after clicking on the link in the fake email employees were asked to introduce some personal data, such as a username and password) and the number of phishing e-mails reported to the company's IT service desk, were recorded. Due to security and confidentiality reasons, only the variation in the click rate percentage, that is, the percentage of employees who clicked on the phishing link inside the e-mail, and in the percentage of the number of phishing e-mails reported to supervisors, can be identified in this study.

4.5.2. Results

To address the research question, the variation in the percentage of click rate and the number of phishing e-mails reported to supervisors were analysed. The variation in the click rate percentage significantly decreased from the first wave to the second wave, by which time the employees had completed the gamified e-training course; the total percentage reduction between the first and the second wave was 50.2%. As previously noted, the click rate itself cannot be reported due to security and confidentiality reasons.

The phishing campaign also measured how many employees reported the suspicious phishing e-mail to their supervisor or the information security team, which is

the desired behaviour. In this case, the reporting rate increased by 70% between the first wave and the second wave, after completion of the gamified e-training course.

4.6. DISCUSSION

This research analysed the effectiveness of gamified e-training systems on information security awareness and data protection across two studies. In study 1, employees' subjective perceptions were explored. In particular, drawing on the IS success literature (DeLone & McLean, 1992, 2003; Rai et al., 2002; Seddon, 1997; Seddon & Kiew, 1996) and gamification theory (Deterding et al., 2011; Hamari et al., 2014; Koivisto & Hamari, 2019), this research investigated how gamification can enhance the success of e-training systems and improve employees' security self-efficacy.

The results provide empirical evidence of the potential of gamification for improving information quality and system quality, important factors for the success of information systems in general (DeLone & McLean, 1992, 2003; Seddon, 1997; Seddon & Kiew, 1996), and e-learning systems in particular (Aparicio et al., 2019; Chen, 2010; Cidral et al., 2018; Eom et al., 2012). The findings also confirmed that gamified e-training systems increase enjoyment. This result is in line with previous research that found that gamification influences the hedonic value of an activity (Högberg et al., 2019) and the enjoyment of performing tasks (Gerdenitsch et al., 2020; Zhang et al., 2021). Therefore, the inclusion of motivational affordances in training environments helps employees better understand the content of training sessions, to perceive them as interesting and to interact more with, and enjoy, e-training systems.

The results also showed that information quality and system quality enhance employees' perceptions of the usefulness of e-training systems. This finding is in accordance with previous research in contexts such as taxation information systems (Floropoulos et al., 2010) or e-learnings systems (Chen, 2010; Lwoga, 2014). Similarly, both information quality and system quality were found to increase employees' satisfaction with e-training systems. This result is in line with previous research in contexts such as mobile banking (Tam & Oliveira, 2016, 2017), e-learning systems

(Cidral et al., 2018; Eom et al., 2012) and online brand communities (Hsieh et al., 2022). The results also showed that enjoyment increases employees' perceptions of usefulness as well as satisfaction. Perceived usefulness, in turn, generates higher satisfaction, which is in line with previous IS success literature (Chen, 2010; Seddon & Kiew, 1996).

Finally, the results demonstrated that perceived usefulness and satisfaction lead to higher security self-efficacy, that is, they increase employees' perceptions of being able independently to comply with security requirements and cope with security threats. These results are consistent with previous e-learning systems' literature which argued that systems must be perceived as useful to deliver individual benefits to learners and that higher satisfaction leads to positive outcomes, such as increased knowledge and achieving learning goals (Al-Fraihat et al., 2020).

Study 2 went beyond employees' perceptions and analysed, through objective measures, their actual information security behaviours. In particular, how to behave towards/cope with a phishing attack. The results showed that gamified information security e-training systems effectively improve employees' security behaviours. Specifically, they showed that the click rate percentage on a phishing email link significantly decreased from a first phishing wave to a second, that is, after completion of the e-training. In addition, the percentage of phishing e-mails reported to supervisors increased.

4.6.1. Theoretical implications

This study makes a number of theoretical contributions. First, although gamified e-training systems are gaining popularity among organisations, relatively few studies have empirically explored how gamification can make them more successful and promote employees' security self-efficacy (Silic & Lowry, 2020). In addition, while previous studies have emphasised the need to objectively analyse employees' security behaviours (van Steen & Deeleman, 2021), research into the effect of gamification on employees' perceptions and actual behaviours is uncommon.

This study contributes to the gamification literature by analysing the use of gamification for training employees on information security and data protection and by

examining the effectiveness of gamified e-training in improving employees' perceptions of security self-efficacy and actual behaviours in the context of a phishing attack. Unlike previous studies, this research analyses an actual e-gamified training system implemented in a real organisation.

The study also contributes to the IS literature. In a recent IS success literature review, Jeyaraj (2020) highlighted that previous studies in the field have tended to focus on IS success variables, and that the antecedents of IS success remain unexplored. The present study responds to this call and contributes to the IS success literature by analysing gamification as a driver of IS success. The results also support the relationships proposed between the different measures of IS success, reinforcing the importance of these variables.

4.6.2. Managerial implications

This study has a number of practical implications for organisations, in general, and for information security managers, in particular. Organisations tend to allocate more resources to visible investments, such as technological solutions and security products, than to information security training and education (Kweon et al., 2021). However, many information security incidents are caused by human factors (Khando et al., 2021). Our results highlight the importance of employee information security training, confirm that gamification enhances e-training systems' success and confirm it increases employees' security self-efficacy and enhances security behaviours, in particular, in response to a phishing attack. Therefore, information security decision makers should consider implementing continuous employee information security training using gamified e-training courses.

Second, this study provides guidelines to developers and providers of information security e-training systems whose target groups are CISOs, CIOs and other cyber professionals responsible for educating employees at all levels about cyber-attacks and the best security counter measures. Our results showed that gamified e-training systems are highly effective for improving employees' information security behaviours. This study has also demonstrated that high-quality content, user-friendly training systems and enjoyable training experiences are central to security awareness training. When these conditions are met, employees perceive that training can improve

their information security and data protection behaviours and are, therefore, more satisfied with the training experience, which ultimately leads them to perceive they have the abilities to perform appropriate information security behaviours.

This study reveals that, in an e-training context, employees' perceptions of content quality, system quality and enjoyment are enhanced by implementing motivational affordances. Therefore, developers and providers of e-training systems should design systems that contain motivational affordances. Clear task goals should be presented at the beginning of, and throughout, the e-training courses to inform and remind the employees what is required to successfully complete the courses; because, of course, it is important that the employees perceive that, with proper instruction, they can successfully complete the e-training. Challenges should be included in e-training courses in the form of tasks and practical exercises, for instance, puzzles and drag-and-drop activities. It is important that the users understand that resolving the challenges requires effort, and that they are of appropriate levels of difficulty (i.e., the challenges should be neither too difficult, nor too easy), and that the systems provide continuous and concrete feedback during the training experience so that the learners know how they are performing. Feedback can be presented to the employees in different formats, such as by awarding points, by giving information about their progress and by providing advice about how to improve their performance. Finally, e-training system designers and developers might present course content through an ongoing story that immerses individuals in the training course, for example, through videos showing how employee actions can individually contribute to ensuring information security in the company.

4.6.3. Limitations and future research directions

The main limitations of this study provide avenues for future research. First, the data were collected using a self-administered questionnaire in a cross-sectional study. Future research might use longitudinal data to analyse the effectiveness of gamification over time. This might provide insights into how often employees should be trained, and into at which point in time good behaviours revert to old habits, such as a loss of confidence/feelings of insecurity in their abilities to undertake appropriate information security behaviours. Second, this research investigates both employees' perceptions of gamified e-training systems (study 1) and their actual security behaviours (study 2).

However, due to privacy data issues, it was not possible to track employees' perceptions and subsequent actual behaviours, even under conditions of anonymity. In addition, due to security and confidentiality reasons, in study 2 it was only possible to report variations in the click rate percentage and in the percentage of number of phishing e-mails reported. Third, although the present study has high ecological validity, given that it was carried out in an actual organisation with a real gamified security e-training system, an analysis of only one organisation limits the generalisability of the results. Finally, the phishing campaign was conducted without a control group, so future research should replicate the study comparing the results of employees who had undergone gamified e-training and those who did not.

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CHAPTER V

CONCLUSIONS

This chapter presents the main conclusions derived from this doctoral dissertation, as well as the main theoretical contributions and managerial implications. Limitations and future research lines are presented at the end of the chapter.

In the last few years, the number of organizations using gamification strategies, both externally aimed at customers and internally aimed at employees, has skyrocketed. Data shows the gamification market is expected to grow from $10.5 billion in 2021 to $96.8 billion in 2030 (Precedence Research, 2023). In addition to attracting business attention, this phenomenon has captured academics' interest, becoming a relevant research line (Huotari & Hamari, 2017; Koivisto & Hamari, 2019; Wünderlich et al., 2020). However, despite the advances in research, literature on gamification is still in its early stages (Rapp et al., 2019) and previous studies have highlighted thematic, theoretical and methodological challenges (Koivisto & Hamari, 2019). Addressing the gaps identified in the literature and drawing on different theories –such as the self-system model of motivational development (SSMMD; Connell, 1990; Connell & Wellborn, 1991; Skinner et al., 2008), the self-determination theory (SDT; Deci, 1975), the technology acceptance model (TAM; Davis, 1989), and the information system success theory (DeLone & McLean, 1992, 2003; Seddon, 1997; Seddon & Kiew, 1996)–, the overall goal of this doctoral dissertation has been to better understand the underlying mechanisms through which gamification influences the attitudes and behaviours of individuals in different domains. This overall research goal has been divided into specific objectives.

First, this doctoral dissertation has sought to provide a broader understanding of the effects of gamification by analysing their use in different application contexts –beyond the educational domain– and directed to different users. To achieve this objective, on the one hand, external gamification aimed at strengthening the relationship between firms and customers has been analysed. On the other hand, internal gamification aimed at employees and with the purpose of supporting human resources tasks has been examined. Specifically, Chapters II and III have focused on external gamification and have empirically analysed users' perceptions towards gamified mobile apps. By contrast, Chapter IV has investigated internal gamification, examining employees' perceptions and behaviours towards a gamified e-training system.

The second research goal was to provide theoretical support to explain and understand gamification effectiveness and its impact on individuals' attitudes and behaviours. In this sense, Chapter II provided a theoretical framework based on the self-system model of motivational development (SSMMD; Connell & Wellborn, 1991) to explain how game elements increase users' engagement with mobile apps and foster positive marketing outcomes. Chapter III integrated different theories to advance in the knowledge of the influences of gamification in the financial sector. In particular, it combined the self-determination theory (SDT) and the technology acceptance model (TAM) to explain the effect of gamification on motivational factors and their subsequent effects on technology acceptance variables and users' attitudes and intentions. Finally, Chapter IV drew on the information systems success literature (DeLone & McLean, 1992, 2003; Seddon, 1997; Seddon & Kiew, 1996) and proposed a theoretical framework to show how gamification increases the success of gamified e-training systems and enhances employees' perceptions of security self-efficacy.

The third research goal was to investigate the effect of different individual motivational affordances (i.e., game elements) implemented in the gamified systems to offer a more detailed analysis of their efficacy. In particular, Chapter II investigated the impact of the three most common types of motivational affordances embedded in gamified systems: achievement and progression-oriented elements, social-oriented elements and immersion-oriented elements. In Chapter III, five motivational affordances/game elements (i.e., credit score, alerts, budgets, tracking and personalization) included in the gamified app under study were examined. Likewise, chapter IV focused on four motivational affordances identified in the gamified e-training: challenges, feedback, clear goals and narrative context. Overall, the findings provided strong support for the inclusion of different motivational affordances or game elements in mobile apps (e.g., fitness apps and personal financial management apps) to help achieve marketing objectives and in the workplace to increase the success of e-training systems and employees' security self-efficacy.

Finally, the fourth research goal was to explain the underlying mechanisms through which the motivational affordances (i.e., game elements) affect the psychological and behavioural responses of individuals. By doing this, the doctoral dissertation has

provided a complete empirical analysis of the impact of game elements on individuals' psychological and behavioural outcomes.

In this sense, Chapter II provided a complete overview of the effects of game elements on the psychological variables of individuals –such as feelings of competence, autonomy and relatedness and engagement– and the subsequent effect on the behavioural outcomes –such as intention to use and recommend the apps and positively rate the apps. Specifically, the findings provided strong support for the potential of achievement and progression-oriented elements to increase feelings of competence, autonomy and relatedness. Furthermore, the results showed that immersion-oriented elements in the apps promote feelings of relatedness among users, but do not influence feelings of autonomy and competence. Finally, the findings provided strong evidence on the use of social-oriented elements in mobile apps to promote feelings of relatedness. However, this category of game elements did not affect feelings of competence and negatively affected feelings of autonomy. That is, the use of this category of game elements could be perceived as controlling. Findings also revealed that gamification increases user engagement with the gamified app through satisfaction of the needs for competence, autonomy and relatedness. Finally, results showed that user engagement, in turn, leads to greater intention to use the app, recommend it and to positively rate the app.

Similarly, Chapter III confirmed gamification effectiveness as a continuous process, which influences on the psychological variables of the finance app users –such as feelings of competence and autonomy, autonomous motivation, perception of ease of use and usefulness, as well as users' attitudes towards financial apps– and on the behavioural variables –such as intention to continue using the personal finance management app. Specifically, the findings revealed that game elements embedded in personal financial management apps, such as providing feedback to users (by incorporating credit score and alerts), as well as allowing them to set budget goals across spending categories and track money movements, positively affect motivational factors, such as perceived competence, perceived autonomy, and autonomous motivation. Autonomous motivation, in turn, increases users' perceptions of ease of use and usefulness of the apps and, as a consequence of this, users develop a more favourable attitude towards them and a higher intention to continuously use them.

Finally, Chapter IV included two studies. On the one hand, findings of the first study provided evidence of the positive impact of gamification as a driver of IS success and the relationships proposed between the different measures of IS success. In this sense, game elements positively influence information quality and system quality, as well as foster employees' enjoyment during the training experience. In addition, these variables increase employees' security self-efficacy, that is, employees' perception of being able to perform correct security behaviours. On the other hand, the second study, focused on actual employees' behaviours, demonstrated that employees' security behaviours improve after carrying out the gamified e-training system.

5.1. THEORETICAL CONTRIBUTIONS

This doctoral dissertation provides several theoretical contributions to the gamification literature, in general, and to the specific contexts where it has been applied and analysed, that is, gamified mobile apps and gamified employee e-training systems.

First, from a thematic point of view, prior research has indicated that empirical research on gamification should broaden the study areas, beyond the traditional ones, such as education (Koivisto & Hamari, 2019; Seaborn & Fels, 2015). Similarly, gamification literature should focus on analysing the impact of gamification on different stakeholder groups, such as users, customers or employees (Wünderlich et al., 2020). Broadening the study areas of gamification research is of great importance because the results of gamification depend to a large extent on the context in which it is implemented and the user who interacts with it (Hamari et al., 2014). Therefore, this doctoral dissertation sheds new light on the effectiveness of gamification in different contexts –external and internal gamification– and among different users –consumers and employees. By doing this, this thesis provides strong evidence on gamification effectiveness in the context of mobile apps to increase users' engagement and continued use intention, as well as in the employee training context to increase employees' satisfaction and their self-efficacy in information security.

Second, extant research has usually investigated gamification effects in general or only as a research context (Koivisto & Hamari, 2019; Rapp et al., 2019; Tobon et al.,

2020). Many studies explore the effect of gamification as a uniform concept (Sailer et al., 2017) or focus on few elements, mostly points, badges and leaderboards (Werbach & Hunter, 2012). Thus, in response to calls for more research into the individual impact of game elements, this doctoral dissertation provides new insights into the influence of specific game elements and their effects. More specifically, it contributes to the literature by examining how user-game element interactions affect user's engagement and users' motivation with mobiles apps, as well as foster positive marketing outcomes. Similarly, it provides evidence on the impact of different game elements emerging from a gamified training system, such challenges, feedback, clear goals and narrative, on the success of e-training systems.

Third, gamification has been conceptualized as a continuous process with three interrelated elements: motivational affordances, psychological outcomes and behavioural outcomes (Hamari et al., 2014; Koivisto & Hamari, 2019). However, more empirical studies that analyse the underlying mechanisms that explain how gamification influences individuals' psychological and behavioural responses are needed (Wünderlich et al., 2020). In addition, even though several theories can help to understand gamification effectiveness, many studies lack a theoretical foundation (Koivisto & Hamari, 2019; Seaborn & Fels, 2015). Therefore, this doctoral dissertation draws on different theories –such as the self-system model of motivational development (Connell, 1990; Connell & Wellborn, 1991; Skinner et al., 2008), the self-determination theory (Deci, 1975), the technology acceptance theory (Davis, 1989), and the information system success theories (DeLone & McLean, 1992, 2003; Seddon, 1997; Seddon & Kiew, 1996)– to provide a theoretical framework which offers a complete overview of gamification effectiveness and its impact on individuals' attitudes and behaviours.

Finally, this doctoral thesis aims to overcome some of the methodological shortcomings reported in previous gamification studies, such as the use of small samples or student samples, non-validated measures and the descriptive nature of the results (Hamari et al., 2014; Koivisto & Hamari, 2019; Rapp et al., 2019). In this sense, this doctoral dissertation has used validated measures established in the literature, analysed real gamified contexts and used consumers and employees' samples. Therefore, the results of this doctoral dissertation present a high ecological validity.

5.2. MANAGERIAL IMPLICATIONS

This doctoral dissertation also provides a number of practical implications. On the one hand, it provides managerial implications when applying external gamification to improve the experience of users and consumers. On the other hand, it provides practical implications in the design of internal gamification aimed at employees of organizations.

First, this doctoral dissertation has a number of practical implications related to the design and development of mobile apps to increase users' engagement. The app stores have a large number of mobile apps, so it is important to be well positioned within them and have a high rating to stand out among other apps and gain new users. Similarly, users need to be engaged with the mobile apps to build a long-term relationship. The results of this doctoral dissertation indicate that users' engagement is fundamental in the decision to continue using the app, recommend it and report a high rating. In this sense, in order to increase users engagement, mobile apps can make use of gamification and include game elements that promote feelings of competence, autonomy and relatedness among users.

Among the different categories of game elements, the most effective to satisfy psychological needs and enhance users' engagement are achievement and progression-oriented elements. Many mobile apps already include the most common game elements, such as points, badges, and leaderboards. Nevertheless, mobile app designers and developers should not overlook other game elements of this category such as providing challenges and continuous feedback to show the progress and performance of the users. Furthermore, the activity within the app can be framed into different levels so that as the users gain experience using the app, they may obtain points and level up.

Apart from achievement and progression-oriented elements, this doctoral dissertation shows that immersion-oriented elements promote feelings of relatedness among users. For instance, giving the option to create an avatar can encourage apps' users to relate to each other, which in turn will promote users' engagement.

Finally, app designers should be careful when implementing social-oriented elements. Including these elements is important when the objective is to foster the feeling of relatedness. For instance, developers should encourage the creation of a community within the mobile app to share information with other users. This can be easily

implemented in fitness apps, where exercise routines and workouts can be easily shared with others. Developers can also organize challenges that involve competing or collaborating with others. However, interaction with this game element category should be voluntary, since results of this doctoral thesis demonstrate that these game elements can also reduce feelings of autonomy and be perceived as controlling and, therefore, negatively affect users' engagement.

Second, the results of this doctoral dissertation also indicate that users' motivation is fundamental in the decision to adopt and continue using the apps. Therefore, to increase the autonomous motivation among users, managers and designers of apps should incorporate game elements that allow users to feel competent and autonomous. In the specific case of personal financial management apps, this would imply that in addition to store financial information, this kind of apps should increase their functionalities and offer users more options. In particular, in order to promote feelings of competence and autonomy among users, personal financial management apps should allow them to set budgetary goals in different expense categories, to track money through performance graphs, to receive feedback by rating their achievements with a credit score and sending alerts and notifications (e.g., expenditure or upcoming bills...). Moreover, in order to enhance users' attitude towards such apps and, therefore, increase continued intention to use, gamified mobile apps should be designed in such a way that users find them easy and intuitive to use, as well as useful.

Finally, this doctoral thesis also provides important implications for managers when applying internal gamification (i.e., aimed at employees). The findings highlight the importance of employee training in information security to improve security behaviours. Results also show how gamification can facilitate this training process, increasing the success of training systems and generating greater employee security self-efficacy (i.e., awareness of information security behaviours and perception of being able of properly perform information security behaviours). Developers of information security training systems should consider including different game elements to improve information and system quality, as well as employees' enjoyment, which in turn will increase perception of usefulness and satisfaction. According to the results, employees' satisfaction and usefulness may enhance security self-efficacy. Therefore, challenges in the form of practical exercises, such as puzzles or drag and drop exercises, may improve the training

experience. Similarly, presenting clear goals and providing continuous feedback, through instant messaging, points or showing progress, may guide the training process. Finally, embedding the entire training experience in a narrative context is an important game element to increase e-training system success.

Table 5.1 summarises the main theoretical and practical implications derived from the three empirical investigations included in the previous chapters.

Table 5.1. Summary of the theoretical contributions and practical implications

Chapter	Theoretical implications	Practical implications

Chapter II	• Contributions to the user engagement literature:
	  o It sheds new light on the effect of users' engagement in the context of gamified mobile apps.
	  o It tests O'Brien et al.'s (2018) UES-SF in a new context: gamified mobile apps.
	• Contributions to the gamification literature:
	  o It proposes and tests a model based on the self-system model of motivational development (SSMMD) in order to examine gamification as a continuous process, that is, how game elements influence individuals' attitudes and behaviours.
	  o It analyses the impact of the three most common game element categories embedded in gamified systems on users' psychological needs and engagement.
	  o It conducts an empirical study under a real gamified context
		• The design of mobile apps should integrate different categories of game elements to increase users' engagement, individuals' continued use intention, WOM intention and ratings of apps.
		• Designers of mobile apps should mainly include achievement and progression-oriented elements in order to promote individuals' psychological needs and users' engagement.
		• Immersion-oriented elements and social-oriented elements should be also included in mobile apps to promote users' feeling of relatedness. However, the interaction with social-oriented elements should be voluntary among users, since they diminish the feeling of autonomy.

Chapter III	• It provides new insights into external gamification effectiveness aimed at customers, in particular, into the use of gamified mobile apps in the financial domain. • It sheds new light on how users' interaction with the game elements embedded in personal finance management (PFM) apps increases users' motivation and the use of the app. • It proposes and tests a model combining the self-determination theory and the technology acceptance model in order to explain the antecedents of users' attitude towards gamified PFM apps. • It conducts an empirical study into the acceptance of gamified PFM apps under a real gamified context and using previously validated measures.	• The design of apps should support users' autonomous motivation by integrating game elements that promote feelings of competence and autonomy. • Designers of apps should include game elements so that users can interact with them. In the specific case of PFM apps, this could include the possibility to set personal goals regarding their finances, track money in real time, receive alerts of expenditures or upcoming bills, and receive points or a score. • Apps should be perceived as easy to use and useful to promote favourable attitudes towards them.

Table 5.1. Summary of the theoretical contributions and practical implications (continued)

Chapter	Theoretical implications	Practical implications
Chapter IV	• Contributions to the gamification literature: o It provides new insights into internal gamification effectiveness aimed at employees (in particular, into the use of gamified e-training systems in information security). o It proposes and tests a model to analyse how game elements promote e-training system success and improve employees' security self-efficacy. o It analyses both employees' perceptions and actual behaviours. o It conducts an empirical study under a real gamified context and using previously validated measures • Contributions to the Information system (IS) literature: o It explores gamification as antecedent of IS success.	• CISOs (Chief Information Security Officer), CIOs (Chief Information Officer) and other cyber professionals should be aware of the importance of employee information security training to improve employees' security behaviours and, therefore, protect information assets. • Developers and providers of information security e-training systems should include gamification, such as challenges, continuous feedback, clear goals and narrative context, to increase e-training systems' success and employees' security self-efficacy.

5.3. LIMITATIONS AND FUTURE RESEARCH LINES

The present doctoral dissertation develops three empirical studies focused on the use of external gamification, which involves customers or potential customers and is related to marketing purposes, as well as on the use of internal gamification, aimed at the organizations' employees and generally implemented by the human resources department. Therefore, these studies represent an advance in knowledge about the use and implementation of gamification strategies in different contexts. However, as mentioned in each of the chapters, these studies also present specific limitations that may offer future research avenues. In this sense, this section aims to outline the most significant limitations of this doctoral dissertation as well as to propose future research lines.

First, this thesis analyses gamification in different contexts and aimed at different types of users, such as consumers and employees. However, in the context of external gamification, only two specific apps have been analysed, while in the context of internal gamification only a specific training system implemented in a specific organization has been examined. Therefore, although the studies present a high ecological validity because they have been developed in a real context, future research lines should consider other categories of mobile apps (e.g., learning apps, tourism apps) for the analysis, as well as other types of e-trainings (e.g., quality trainings, technical skill trainings, soft skills trainings) implemented across different organizations and industries. In addition, although the context where gamification is implemented can play an important role in gamification effectiveness, future research should also consider individual characteristics of the users, such as personality traits or player typologies, to analyse whether these factors influence gamification effectiveness. For instance, the typology suggested by Bartle (1996) distinguishes between four player types: achievers, explorers, killers and socializers. The Hexad typology (Marczewski, 2015), which distinguishes six player types when interacting with gamified applications (achievers, disruptors, free spirits, philanthropists, players, and socializers), is also frequently used. Thus, exploring these typologies and personality traits would make possible to tailor game elements according to users' profiles in order to improve their experience.

Second, with the exception of Study 2 in Chapter IV, the empirical studies are cross-sectional. Therefore, gamification effectiveness in the long term was not analysed. Some studies state that gamification may have a "novelty effect", which means that gamification may be effective at first but its results may not be long-lasting (Hamari et al., 2014). In this sense, future research should carry out longitudinal studies to shed new light on its long-term effects, provide more insights into probable causation and facilitate a better understanding of the relationships explored.

Third, data were collected through self-report measures, with the exception of Study 2 in Chapter IV. The dependent variables in the studies focused on user perception measures, such as the intention to use and recommend the app, the rating users would give the app or employee's security self-efficacy. Therefore, future research should also consider objective measures to analyse the effectiveness of gamification, for example, by collecting data directly from mobile apps. In addition, although Chapter IV included both employees' perceptions of gamified e-training systems and their actual security behaviours, due to privacy concerns, it was not possible to link employees' perceptions to objective measures of employees' behaviours. Therefore, future research should overcome these methodological shortcomings.

Finally, this doctoral dissertation has focused on the potential positive effects of gamification. However, there may be specific situations in which it is not appropriate to use this strategy. Previous studies have found a negative effect of gamification in different contexts. For instance, in the educational context, gamification was related to negative outcomes, such as loss of performance, triggering undesired behaviours, indifference and declining effects (Toda et al., 2018). This is often due to a lack of suitable methods and frameworks when implementing game elements, such as points, badges and leaderboards (Toda et al., 2018). The most common negative effect found in this context was the loss of performance, that is, in some situations gamification was found to negatively affect the learning process (Toda et al., 2018). In addition, gamification in the workplace may be perceived as an external factor to control employees' performance and, therefore, reduce intrinsic motivation to do work tasks (Mitchell et al., 2020).

Hammedi et al. (2021), for instance, found that gamification negatively affects employee engagement and well-being. Nevertheless, the willingness of employees to use gamified work moderated these negative impacts. Other studies focused on the use of gamification in the context of health management also found that the competitive elements and interactivity offered by gamification might cause individuals to feel a violation of their privacy and social overload, which may result in gamification exhaustion (Yang & Li, 2021). Similarly, losing a competition has been found to negatively affect customer experience and engagement in the context of co-creation communities (Leclercq et al., 2018). In addition, competition mechanics may cause conflicts among participants from a community and promote opportunistic behaviours, such as creating fake accounts or inviting their friends on the platform with the aim of pushing their ideas or sabotage those of others (Leclercq et al., 2017). In this sense, future research should also consider the possible adverse effects of gamification.

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APPENDIX 1

Are you user of the Fitbit app?

This survey is about the Fitbit app and it is organized by academic researchers from the University of Zaragoza in Spain.

We are conducting a survey of people who are 18 years or older and use Fitbit, one of the most popular fitness apps.

If you are not a user of the Fitbit app, please do not complete the survey. You will not be able to complete the questionnaire in full.

The survey takes approximately 6 minutes to complete and answers will be completely anonymous.

You will be paid $0.70 if you complete the survey in full with thoughtful responses, submit your responses, and enter the valid confirmation code.

1. Do you use the Fitbit app?

- □ Yes
- □ No (end of the questionnaire)

2. How long have you been user of the Fitbit app?

- □ Less than 3 months
- □ 3-6 months
- □ 6-12 months
- □ 12-18 months
- □ 18-24 months
- □ More than 2 years

3. On average, how much time per week do you spend using the Fitbit app?

- □ Less than 30 minutes
- □ 30-60 minutes
- □ 1-3 hours
- □ 3-6 hours
- □ 6-9 hours
- □ 9-12 hours
- □ More than 12 hours

4. Please indicate the extent to which you agree or disagree with the following statements *(1= strongly disagree, 7= strongly agree).*

I use Fitbit because …	1	2	3	4	5	6	7
I think that this app is interesting							
I think that this app is pleasant							
This app is fun							
I feel good when using this app							
I am doing it for my own good							
I think that this app is good for me							
Of personal decision							
I believe that this app is important for me							

5. Please indicate how often you interact with the following game elements in the Fitbit app *(1 = never, 7 = every time)*.

	1	2	3	4	5	6	7
Scores (e.g. steps)							
Performance graphs (e.g. weekly evolution of steps)							
Challenges (e.g. Goal Day, Workweek Hustle, Daily Showdown, Weekend Warrior…)							
Badges/ trophies							
Progress bars							
Rankings/ leaderboards							
Competition (e.g. Challenges and Adventure Races with friends)							
Social networking features (e.g. sharing stats in Facebook)							
Cooperation (e.g. communities)							
Profile/ virtual identify/ avatar							
Personalization (e.g. customazing your goals)							
Virtual world/ 3D world (e.g. Valley Loop)							

6. Please indicate the importance of interacting with the following game elements in the Fitbit app *(1=not at all important, 7= very important)*.

	1	2	3	4	5	6	7
Scores (e.g. steps)							
Performance graphs (e.g. weekly evolution of steps)							
Challenges (e.g. Goal Day, Workweek Hustle, Daily Showdown, Weekend Warrior…)							
Badges/ trophies							
Progress bars							
Rankings/ leaderboards							
Competition (e.g. Challenges and Adventure Races with friends)							
Social networking features (e.g. sharing stats in Facebook)							
Cooperation (e.g. communities)							
Profile/ virtual identify/ avatar							
Personalization (e.g. customizing your goals)							
Virtual world/ 3D world (e.g. Valley Loop)							

7. Please select Strongly Disagree as the response below.

	Strongly Disagree						**Strongly agree**
My response to this question is							

8. **Please indicate the extent to which you agree or disagree with the following statements about the Fitbit app** *(1= strongly disagree, 7= strongly agree).*

	1	2	3	4	5	6	7
I think that I am pretty good when I use this app							
I am satisfied with my performance when I use this app							
I feel like an expert using this app							
I feel like a competent person when I use this app							

9. **Please indicate the extent to which you agree or disagree with the following statements about the Fitbit app** *(1= strongly disagree, 7= strongly agree).*

	1	2	3	4	5	6	7
In this app I have different options (e.g. challenges, adventure races…)							
I feel free to use this app							
I feel free to decide what activities to do in this app							
When I use this app, it is because I want to use it							

10. **Please indicate the extent to which you agree or disagree with the following statements** *(1= strongly disagree, 7= strongly agree).*

When I use the Fitbit app …	1	2	3	4	5	6	7
I feel like other people care what I do							
I feel supported by others							
I feel that I am a valuable person to others							
I feel that I am understood							

11. **The following statements ask you to reflect on your experience of engaging with the Fitbit app. Please indicate the extent to which you agree or disagree with them** *(1= strongly disagree, 7= strongly agree).*

	1	2	3	4	5	6	7
This app is attractive							
This app is aesthetically appealing							
This app appeals to my senses							
Using this app is worthwhile							
My experience is rewarding							
I feel interested in this experience							
I lose myself in this experience							
The time I spend using this app just slips away							
I am absorbed in this experience							
I feel frustrated while using this app							
I find this app confusing to use							
Using this app is taxing							

12. How much is 3+3?*:* _____

13. Please indicate the extent to which you agree or disagree with the following statements *(1= strongly disagree, 7= strongly agree).*

Since I started using Fitbit, because of the app I …	1	2	3	4	5	6	7
Feel more energized							
Feel more physical active							
Have exercised more							
Feel more mentally active							
Feel less depressed and anxious							
Have spent more time outdoors							
Have made new friends							
Have interacted more with people							
Feel more social							
Feel more connected with others							

14. Please indicate the extent to which you agree or disagree with the following statements about the Fitbit app *(1= strongly disagree, 7= strongly agree).*

	1	2	3	4	5	6	7
I would like to continue using this app							
I expect to continue using this app							
I intend to use this app every time I exercise							
I would recommend this app to my friends							
I will recommend this app to anyone who seeks my advice							
I will say positive things about this app to other people							

15. How would you rate the Fitbit app?

1	2	3	4	5	6	7

16. Gender (for study purposes only):

□ Male □ Female

17. Age (for study purposes only) (please enter the number of years, e.g. enter 50 if you are 50 years old)**: _____**

Thank you for taking part in this survey, your participation is greatly appreciated.

Please, enter your MTurk ID in the box below to confirm you have completed the survey and click on the arrow to submit your responses.

APPENDIX 2

This survey is about the Mint app and it is organized by academic researchers from the University of Zaragoza in Spain.

We are conducting a survey of people who are 18 years or older and use Mint, one of the most popular budgeting apps / personal finance apps

If you are not a user of Mint, please do not complete the survey.

The survey takes approximately 6 minutes to complete and answers will be completely anonymous.

Please, complete the survey in full with thoughtful responses.

1. Do you use Mint?

□ Yes
□ No (end of the questionnaire)

2. How long have you been user of Mint?

□ Less than 3 months
□ 3-6 months
□ 6-12 months
□ 12-18 months
□ 18-24 months
□ More than 2 years

3. What is your actual frequency of use of Mint?

□ Have not used
□ Once a year
□ Once in six months
□ Once in three months
□ Once a month
□ Once a week
□ Once in 4-5 days
□ Once in 2-3 days
□ Almost every day

4. Please indicate the extent to which you agree or disagree with the following statements *(1= strongly disagree, 7= strongly agree).*

I use Mint because …	1	2	3	4	5	6	7
I think that this app is interesting							
I think that this app is pleasant							
This app is fun							
I feel good when using this app							
I am doing it for my own good							
I think that this app is good for me							
Of personal decision							
I believe that this app is important for me							

5. **Please indicate how often you interact with the following elements in Mint** *(1= never, 7= every time).*

	1	2	3	4	5	6	7
Credit Score							
Alerts (bill reminders, money alerts, etc.)							
Budgets							
Tracking (e.g. your money movements, bills, spending, etc.)							
Personalization (e.g. customizing your goals, personalized offers and insights, etc.)							

6. **Please indicate the importance of interacting with the following elements in Mint** *(1= not at all important, 7= very important)*.

	1	2	3	4	5	6	7
Credit Score							
Alerts (bill reminders, money alerts, etc.)							
Budgets							
Tracking (e.g. your money movements, bills, spending, etc.)							
Personalization (e.g. customizing your goals, personalized offers and insights, etc.)							

7. **Please select Strongly Disagree as the response below**.

	Strongly Disagree						**Strongly agree**
My response to this question is							

8. **Please indicate the extent to which you agree or disagree with the following statements** *(1= strongly disagree, 7= strongly agree).*

	1	2	3	4	5	6	7
I think that I am pretty good when I use Mint							
I am satisfied with my performance when I use Mint							
I feel like an expert using Mint							
I feel like a competent person when I use Mint							

9. **Please indicate the extent to which you agree or disagree with the following statements** *(1= strongly disagree, 7= strongly agree).*

	1	2	3	4	5	6	7
In Mint I have different options (e.g. create budgets, set money alerts…)							
I feel free to use Mint							
I feel free to decide what activities to do in Mint							
When I use Mint, it is because I want to use it							

10. **Please indicate the extent to which you agree or disagree with the following statements** *(1= strongly disagree, 7= strongly agree).*

	1	2	3	4	5	6	7
I find Mint easy to use							
My interaction with Mint is clear and understandable							
I find Mint easy to interact with							

11. **Please indicate the extent to which you agree or disagree with the following statements** *(1= strongly disagree, 7= strongly agree).*

	1	2	3	4	5	6	7
Using Mint enables me to control my finances							
Using Mint makes easier to control my finances							
I find Mint useful to control my finances							

12. **Please indicate the extent to which you agree or disagree with the following statements** *(1= strongly disagree, 7= strongly agree).*

	1	2	3	4	5	6	7
Using Mint is a good idea							
Using Mint is a wise idea							
I like the idea of using Mint							

13. **Please indicate the extent to which you agree or disagree with the following statements** *(1= strongly disagree, 7= strongly agree).*

	1	2	3	4	5	6	7
People who influence my behaviour would think that I should use Mint							
People who are important to me would think that I should use Mint							

14. **Please indicate the extent to which you agree or disagree with the following statements** *(1= strongly disagree, 7= strongly agree).*

	1	2	3	4	5	6	7
Using Mint is entirely within my control							
I have the resources and the knowledge and the ability to make use of Mint							

15. **On the whole, considering all sorts of risks, about how risky would you say it would be to sign up for and use Mint?** *(1= not risky at all, 7= very risky).*

1	2	3	4	5	6	7

16. **Please indicate the extent to which you agree or disagree with the following statements** *(1= strongly disagree, 7= strongly agree).*

	1	2	3	4	5	6	7
I intent to continue using Mint in the future							
I will always try to use Mint in my daily life							
I plan to continue to use this app frequently							
I will recommend Mint to friends and acquaintances							

17. **Gender** (for study purposes only):
    - Male
    - Female

18. **Age** (for study purposes only) (please enter the number of years, e.g. enter 50 if you are 50 years old)**: _____**

Thank you for taking part in this survey, your participation is greatly appreciated.

APPENDIX 3

Dear worker, we are conducting a survey to know your opinion about the e-learnings on data protection and information security. The survey takes approximately 5 minutes to complete and your responses will be completely anonymous.
Thank you very much for your participation.

1. **Have you ever done any of the data protection or information security e-learnings offered by the company?**

□ Yes
□ No

2. **Which of the following e-trainings have you completed?**

□ Data protection
□ Information security
□ Both

Please answer the following questions thinking about the last e-training completed.

3. **Approximately, how long has it been since you completed the e-training?**

□ Less than 1 month
□ 1-3 months
□ 3-6 months
□ 6 months to 1 year
□ More than 1 year

4. **Please, read the following statements and indicate the extent to which you agree or disagree with each one** *(1= strongly disagree, 7= strongly agree).*

The e-training …	1	2	3	4	5	6	7
Was easy to use							
Was well structured							
Was easy to interact with							
Improved my security and data protection behaviour							
Enabled me to better react to potential cybersecurity threats							
Was useful							
Increased my knowledge about how to identify security threats in time and act correctly							

After having completed the e-training, …	1	2	3	4	5	6	7
I try to apply in my daily work the knowledge acquired in the e-training							
I want to know more about the facts of handling the data confidentially							

5. **Please, indicate the extent to which you agree or disagree with the following statements** *(1= strongly disagree, 7= strongly agree).*

	1	2	3	4	5	6	7
I had fun completing the e-training							
I found the e-training enjoyable							
I found the e-training pleasant							
I like the way the e-training looked							
The design of the e-training was attractive							
The e-training was aesthetically appealing							

6. **Please, read the following statements and indicate the extent to which you agree or disagree with each one** *(1= strongly disagree, 7= strongly agree).*

The content provided by the e-training was …	1	2	3	4	5	6	7
Understandable							
Interesting							

Thinking about the activities included in the e-training, …	1	2	3	4	5	6	7
Completing the different practical exercises (such as puzzles) was challenging							
The different practical exercises of the e-training were demanding							

While I was watching the videos …	1	2	3	4	5	6	7
I could easily picture the events taking place							
I could visualize myself in the events described in them							
I was mentally involved in them							

While I was completing the e-training, I received …	1	2	3	4	5	6	7
Feedback on the progress made (such as chapters completed)							
Immediate information on my success (or failure)							
Information on my score							

Overall learning goals were …	1	2	3	4	5	6	7
Presented in the beginning of the e-training							
Clear to me							

Thinking about the duration of the e-training, …	1	2	3	4	5	6	7
Overall, I was happy with the length of the e-training							
Given the content of the e-training, I found its length appropriated							

7. **Please, indicate the extent to which you agree or disagree with the following statements** *(1= strongly disagree, 7= strongly agree).*

After having completed the e-training, …	1	2	3	4	5	6	7
I am confident that I can perform proper information security/ data privacy behaviours							
I can protect my computer by following proper information security/ data privacy behaviours							
I am able to perform proper information security/ data privacy behaviours							

Overall, …	1	2	3	4	5	6	7
I was very satisfied with the e-training							
I had a very positive training experience							

8. **Overall, my attitude towards the e-learning, was…**

	1	2	3	4	5	6	7	
Bad								Good
Unfavourable								Favourable
Negative								Positive

9. **Would you be more motivated by and interested in learning about information security and data protection in an Online Cyber Escape Room together with your colleagues rather than in a classical e-learning?** *(1= not at all, 7= very much).*

1	2	3	4	5	6	7	I do not know about Cyber-Escape Rooms

Finally, please answer the following questions which will be used exclusively for statistical purposes.

10. **Please, indicate your location:**

- □ Asia-Pacific (APAC)
- □ Europe, Middle-East, Africa (EMEA)
- □ North, Central and South America (AMER)

11. **How long have you been working in the current company?**

- □ Less than 1 year
- □ 1-5 years
- □ 5-10 years
- □ More than 10 years

12. With which area do you most identify your position at the company?

- □ Information Technology
- □ HR
- □ Engineering
- □ Research
- □ Marketing
- □ Administration
- □ Development
- □ Manufacturing
- □ Finance
- □ Legal
- □ Sales
- □ Management
- □ Training

13. Gender

- □ Male
- □ Female
- □ Prefer not to say

14. Age

- □ Less than 18 years old
- □ 18 – 25 years old
- □ 26 – 35 years old
- □ 36 – 45 years old
- □ 46 – 55 years old
- □ More than 55 years old
- □ Prefer not to say

RESUMEN Y CONCLUSIONES

RESUMEN

Los avances de la tecnología, en general, y de la tecnología móvil, en particular, han cambiado la forma en la que los seres humanos interactúan, realizan compras, gestionan sus finanzas o reciben contenidos educativos (Grewal et al., 2020; MobileAppDaily, 2022). De manera similar, el desarrollo tecnológico ha afectado a los procesos internos de las organizaciones, incluyendo la gestión de los recursos humanos, como los procesos de atracción y selección de talento o los procesos de formación de empleados (Stone et al., 2015; Vrontis et al., 2022).

La pandemia del Covid-19 ha acelerado la transformación digital y ha cambiado la forma de vivir y trabajar de las personas y las organizaciones (De' et al., 2020). Durante la propagación de la pandemia, se impusieron normas de distanciamiento social y, por tanto, muchas de las actividades cotidianas se trasladaron a un entorno virtual. En este contexto, las descargas, el uso y el gasto de los consumidores en aplicaciones móviles alcanzaron récords históricos durante el segundo trimestre de 2020 (TechCrunch, 2020). Además, la pandemia del Covid-19 obligó a muchas empresas a optar por el teletrabajo. Los empleados tuvieron que adaptarse a cambios repentinos, como las reuniones virtuales, y las empresas tuvieron que invertir en tecnologías de la información, como herramientas y tecnologías basadas en la nube, herramientas de colaboración digital, herramientas de gestión de la productividad, tecnologías de supervisión a distancia y herramientas de aprendizaje y formación para apoyar el trabajo a distancia (Statista, 2022).

En esta economía digital, en la que las organizaciones buscan nuevas formas de mejorar la experiencia de sus clientes y empleados (Robson et al., 2016), la gamificación se ha convertido en una herramienta fundamental (Klock et al., 2020). Brevemente, la gamificación consiste en la aplicación de elementos de diseño de juego, como puntos, retos, recompensas y competiciones, en contextos no lúdicos (Deterding et al., 2011), para aprovechar el atractivo y poder motivador de los juegos, con el fin de que las personas alcancen mayores niveles de motivación.

En los últimos años, el fenómeno de la gamificación ha captado la atención del mundo empresarial y se ha convertido en una línea de investigación de gran relevancia

entre los académicos (Huotari & Hamari, 2017; Koivisto & Hamari, 2019; Wünderlich et al., 2020). Existen numerosos ejemplos del uso de la gamificación en el ámbito empresarial. Por ejemplo, aplicaciones móviles relacionadas con la salud y la actividad física, como Fitbit, Strava o Runtastic, utilizan elementos de juego para motivar a las personas a utilizar estas aplicaciones e incrementar su actividad física. Del mismo modo, las aplicaciones móviles en el contexto financiero, como Mint, Personal Capital o You Need a Budget, incluyen elementos de juego (por ejemplo, retos, puntos) para mejorar la gestión de las finanzas personales. Algunas organizaciones también han aplicado la gamificación en sus procesos internos. Empresas como Mckinsey & Company o EY hacen uso de las tecnologías para ofrecer nuevos formatos en los procesos de selección de personal bajo un entorno gamificado.

Por otro lado, el creciente número de revisiones de la literatura publicadas en torno a este concepto, en general (Hamari et al., 2014; Kasurinen & Knutas, 2018; Koivisto & Hamari, 2019; Krath et al., 2021; Rapp et al., 2019; Seaborn & Fels, 2015), y en contextos específicos, como la educación (Khaldi et al., 2023; Metwally et al., 2021; Zainuddin et al., 2020), la fabricación en entornos industriales (Keepers et al., 2022), el Internet de las Cosas (Xiao et al., 2022), la participación electrónica de los ciudadanos (Hassan & Hamari, 2020), las actividades de cooperación (Riar et al., 2022), la formación empresarial (e.g., Larson, 2020), la producción y logística (Klock et al., 2021; Warmelink et al., 2020) o el turismo (Pasca et al., 2021), muestran su importancia en el mundo académico.

Aunque fue en 2002 cuando Nick Pelling, un programador informático, mencionó por primera vez el término gamificación, éste se popularizó en torno al año 2010. Una de las primeras definiciones fue propuesta por Deterding et al. (2011, p. 9), quienes la definen como "*el uso de elementos de diseño de juegos en contextos no lúdicos*". Posteriormente se han propuesto otras definiciones del término gamificación basándose en los beneficios que puede generar para el usuario (por ejemplo, Robson et al., 2015; Zichermann & Cunningham, 2011). Del mismo modo, la gamificación también se ha definido desde la perspectiva del marketing de servicios (por ejemplo, Hofacker et al., 2016; Huotari & Hamari, 2017). En este sentido, Huotari y Hamari (2017, p. 25) definen este concepto como "*el proceso de mejora de un servicio a partir de experiencias de juego, con el fin de favorecer la creación de valor general del usuario"*. En general, todas

las definiciones comparten dos características importantes: el uso de elementos de diseño de juego o *affordances* y el uso e implementación de la gamificación en diferentes contextos.

La gamificación tiene el potencial de rediseñar tareas y actividades mediante el uso de elementos de juego (Koivisto & Hamari, 2019). Sin embargo, en la literatura se encuentran diferentes terminologías y clasificaciones de elementos de juego (Klock et al., 2020). Una de las más recientes es la propuesta por Koivisto y Hamari (2019). Estos autores utilizan el término *affordance* para referirse a "*los diversos elementos y mecánicas que estructuran los juegos y que ayudan a inducir experiencias lúdicas dentro de los sistemas*" (Koivisto & Hamari, 2019, p. 193). En particular, Koivisto y Hamari (2019) diferencian entre tres categorías: *affordances* orientadas a los logros y a la progresión, que incluyen elementos como insignias/medallas, puntos, tablas de clasificación/rankings, barras de progreso y niveles; *affordances* orientadas a lo social, que incluyen elementos como la cooperación, la competición, las características de redes sociales y los compañeros de equipo; y *affordances* orientadas a la inmersión, que incluyen elementos como avatares, narrativa y personalización.

En relación con los contextos, las definiciones coinciden en que la gamificación puede aplicarse en una amplia gama de contextos. De hecho, los resultados de la gamificación dependen en gran medida de estos contextos y de los individuos que interactúan con el sistema gamificado (Hamari et al., 2014). La gamificación se ha aplicado y estudiado en diversos ámbitos, como la educación (Bouchrika et al., 2021; Buil et al., 2019; Da Rocha Seixas et al., 2016; Huang et al., 2019; Piteira et al., 2018), el deporte (Hamari & Koivisto, 2015; Hassan et al., 2020; Kim et al., 2022), la salud (Biduski et al., 2020; Hydari et al., 2022), las finanzas (Nasirzadeh & Fathian, 2020; Rodrigues et al., 2016), el marketing (Eisingerich et al., 2019; Hsu & Chen, 2018; Hwang & Choi, 2020; Jang et al., 2018), los recursos humanos (Buil et al., 2020; Hammedi et al., 2021; Mitchell et al., 2020) o el turismo (Bravo et al., 2021; Moro et al., 2019; Trigo-De la Cuadra et al., 2020; Xu et al., 2017), entre otros.

Werbach y Hunter (2012) proponen que la gamificación puede dividirse en tres categorías: gamificación interna, aplicada en las organizaciones; gamificación externa, que apoya el intercambio de comunicación entre empresas y clientes; y gamificación hacia el cambio de comportamiento, centrada en la obtención de resultados positivos para

una persona y/o toda la sociedad. De forma similar, Wünderlich et al. (2020) sugieren que la gamificación tiene potencial para influir en cuatro niveles: dentro del juego, en la organización, en los clientes y un poder transformacional.

La presente tesis doctoral sigue la conceptualización general de la gamificación propuesta por Koivisto y Hamari (2019). Estos autores postulan que, a nivel general, la gamificación se compone de tres partes: 1) las *motivational affordances* implementadas en un sistema o servicio; 2) los resultados psicológicos derivados de estas *motivational affordances*; y 3) los resultados de comportamiento posteriores. Como se ha señalado anteriormente, Koivisto y Hamari (2019) clasifican las *motivational affordances* en tres grupos: los elementos orientados al logro y la progresión, los elementos orientados a lo social y los elementos orientadas a la inmersión. En segundo lugar, se encuentran los resultados psicológicos que tanto los juegos como la gamificación buscan promover. Como indican Koivisto y Hamari (2019), estos resultados psicológicos incluyen una gran variedad de experiencias psicológicas, como la competencia, la autonomía, la relación, el disfrute o el compromiso. Por último, se encuentran los resultados de comportamiento que la gamificación intenta fomentar, como la intención de uso o mejores resultados de aprendizaje (Koivisto & Hamari, 2019).

Existen diferentes teorías en la literatura que pueden ayudar a entender la influencia de la gamificación (Krath et al., 2021). Esta tesis doctoral se centra en cuatro teorías para explicar los mecanismos a través de los cuales la gamificación influye en las respuestas psicológicas y de comportamiento de las personas: la teoría de la autodeterminación (*self-determination theory*) (SDT; Deci, 1975), el modelo de auto-sistema de desarrollo motivacional (*self-system model of motivational development*) (SSMMD; Connell, 1990; Connell & Wellborn, 1991; Skinner et al., 2008), el modelo de aceptación de la tecnología (*technology acceptance mode*l) (TAM; Davis, 1989) y la teoría del éxito de los sistemas de información (*information systems success theory)* (DeLone & McLean, 1992, 2003; Seddon, 1997; Seddon & Kiew, 1996).

A pesar del creciente interés por la gamificación y de los avances progresivos en la investigación, la literatura en torno a este fenómeno todavía se enfrenta a varios retos (Koivisto & Hamari, 2019; Rapp et al., 2019). De acuerdo con Koivisto y Hamari (2019), la investigación relacionada con este concepto debe avanzar en tres direcciones: temática, teórica y metodológica.

Desde un punto de vista temático, la investigación empírica sobre gamificación se centra principalmente en el ámbito educativo. Por lo tanto, deben ampliarse las áreas de estudio para analizar el impacto de la gamificación en otros contextos. Del mismo modo, es necesario comprender mejor el efecto de la gamificación dirigida a diferentes grupos de interés, como usuarios, clientes o empleados (Wünderlich et al., 2020). Por otro lado, la mayoría de las investigaciones anteriores analizan la gamificación como un concepto uniforme (Sailer et al., 2017) o se centran en el análisis de unos pocos elementos, como la "tríada PBL" (puntos, insignias y tablas de clasificación) (Werbach & Hunter, 2012) o la personalización y las insignias (Klock et al., 2020). De este modo, es necesario investigar el efecto individual de los elementos de juego.

Como se ha mencionado anteriormente, la gamificación se conceptualiza como un proceso que consta de tres partes interrelacionadas: *motivational affordances* o elementos de juego, resultados psicológicos y resultados de comportamiento. Sin embargo, son escasos los estudios que llevan a cabo un análisis completo de los efectos de la gamificación (Hamari et al., 2014; Koivisto & Hamari, 2019). Por lo tanto, desde un punto de vista teórico, la investigación debe avanzar en el estudio de los mecanismos a través de los cuales la gamificación, en general, y los elementos de juego, en particular, influyen en las respuestas afectivas y actitudinales de los individuos, y estas, a su vez, en los comportamientos. Además, es necesario enriquecer el estudio de este fenómeno recurriendo a diferentes enfoques teóricos que permitan comprender y explicar mejor su eficacia (Rapp et al., 2019).

Por último, desde un punto de vista metodológico, las investigaciones deben incluir muestras de mayor tamaño, medidas validadas y análisis más completos, más allá de estadísticos descriptivos (Hamari et al., 2014; Koivisto & Hamari, 2019; Seaborn & Fels, 2015).

Teniendo en cuenta el potencial de la gamificación, así como los desafíos y limitaciones encontradas en la literatura, el objetivo principal de esta tesis doctoral es comprender los mecanismos a través de los cuales la gamificación influye en las actitudes y comportamientos de los individuos. De este modo, la tesis doctoral persigue avanzar en el conocimiento de la gamificación como una herramienta para crear experiencias más motivadoras, atractivas y divertidas e influir en las actitudes y comportamientos de las personas. Este objetivo general se puede dividir en los siguientes objetivos específicos:

1. Proporcionar una comprensión más amplia de los efectos de la gamificación mediante el análisis de su uso en diferentes contextos y dirigida a diferentes usuarios. En particular, se analizan tanto la gamificación externa (dirigida a los clientes) como la gamificación interna (la que tiene lugar dentro de las organizaciones y está dirigida a los empleados actuales o a los futuros empleados).

2. Ofrecer una base teórica para explicar cómo y por qué la gamificación funciona y produce efectos positivos. Más específicamente, esta tesis doctoral se basa en cuatro enfoques teóricos (el modelo de auto-sistema de desarrollo motivacional, la teoría de la autodeterminación, el modelo de aceptación de la tecnología y la teoría del éxito de los sistemas de información) con el objetivo de comprender mejor los efectos de la gamificación en las actitudes y comportamientos de los individuos.

3. Investigar los efectos de los diferentes elementos de juego (*motivational affordances*) incluidos en los sistemas gamificados para ofrecer un análisis más detallado de su eficacia.

4. Explicar los mecanismos subyacentes a través de los cuales los elementos de juego influyen en las respuestas psicológicas y comportamentales de las personas y ofrecer, de este modo, una visión integral de los efectos de la gamificación.

Para dar respuesta a estos objetivos, el capítulo II de la presente tesis doctoral se centra en el contexto de la gamificación externa y analiza los mecanismos que facilitan el compromiso (*engagement)* de los usuarios con las aplicaciones móviles gamificadas y sus consecuencias. Basándose en el modelo de auto-sistema de desarrollo motivacional (*self-system model of motivational development*) (SSMMD; Connell & Wellborn, 1991), este capítulo investiga cómo tres categorías de elementos de juego integradas en aplicaciones móviles gamificadas –elementos orientados al logro y la progresión, elementos sociales y elementos de inmersión– satisfacen las necesidades psicológicas básicas de competencia, autonomía y relación de los individuos. A su vez, se investiga la influencia de estas necesidades psicológicas en el compromiso del usuario con las aplicaciones móviles. Por último, se analiza el impacto del compromiso del usuario en la intención de un uso continuado, la intención de recomendación y la valoración realizada de la aplicación móvil. A partir de una muestra de 276 usuarios de una aplicación móvil gamificada de

deporte y mediante un análisis de mínimos cuadrados parciales, los resultados proporcionan apoyo al uso de la gamificación para aumentar el compromiso o *engagement* de los usuarios hacia las aplicaciones móviles y generar resultados positivos de marketing. Los resultados confirman el potencial de la gamificación para aumentar el compromiso del usuario a través de la satisfacción de las necesidades psicológicas básicas. En concreto, la interacción con los elementos de juego orientados al logro y la progresión satisface las necesidades de competencia, autonomía y relación. Sin embargo, la interacción con los elementos de juego orientados a la inmersión promueve únicamente sentimientos de relación entre los usuarios y no aumenta los sentimientos de competencia o autonomía. Finalmente, la interacción de los usuarios con los elementos sociales tiene un fuerte impacto en la satisfacción de la necesidad de relación, pero no tiene ningún efecto en la necesidad de competencia y afecta negativamente al sentimiento de autonomía de los usuarios. Los resultados obtenidos también sugieren que el compromiso del usuario conduce a una mayor intención de uso y de recomendación de la aplicación móvil y a una valoración positiva de la misma.

El capítulo III de esta tesis doctoral se centra también en el contexto de la gamificación externa. En concreto analiza el uso de la gamificación en las aplicaciones móviles de gestión de finanzas personales. Para ello, se propone un modelo que integra la teoría de la autodeterminación (*self-determination theory*) (SDT; Deci, 1975) y el modelo de aceptación de la tecnología (*technology acceptance mode*l) (TAM; Davis, 1989). Esta investigación explora el efecto de los elementos de juego sobre factores motivacionales como el sentimiento de competencia y autonomía y la motivación autónoma, así como sus efectos posteriores sobre variables de aceptación de la tecnología, como la facilidad de uso percibida, la utilidad percibida y la actitud hacia dicha tecnología. Finalmente, se investiga el impacto de esta actitud sobre la intención de los usuarios de seguir utilizando la aplicación de gestión de finanzas personales. Analizando los datos de 208 usuarios de la aplicación financiera Mint, mediante un modelo de ecuaciones estructurales por mínimos cuadrados parciales, los resultados proporcionan apoyo al uso de la gamificación en este contexto para facilitar la adopción de dicha tecnología. En concreto, los resultados muestran que el uso de elementos de juego en las aplicaciones financieras satisface las necesidades de competencia y autonomía de los usuarios y aumenta su motivación autónoma para utilizarlas. La motivación autónoma, a su vez, mejora la percepción de facilidad de uso y utilidad hacia este tipo de aplicaciones y hace que los usuarios

muestren una actitud más favorable hacia ellas. Finalmente, los resultados sugieren una relación positiva entra las actitudes de los usuarios hacia las aplicaciones de finanzas y la intención de seguir utilizándolas.

Por último, el capítulo IV de la tesis doctoral analiza el uso de la gamificación interna, en concreto, la gamificación dirigida a los trabajadores de una organización. A través de dos estudios, este capítulo explora el uso de los sistemas de formación online gamificados en el contexto de la seguridad de la información. Basándose en la literatura sobre el éxito de los sistemas de información (*information systems success literature*) (DeLone & McLean, 1992, 2003; Seddon, 1997; Seddon & Kiew, 1996), el primer estudio explora cómo la gamificación aumenta el éxito de los sistemas de formación online y las percepciones de los empleados sobre la autoeficacia en materia de seguridad de la información. En concreto, se propone un modelo que analiza cómo la gamificación puede mejorar la calidad de la información presentada en la formación online y la calidad del sistema, así como aumentar el disfrute de los empleados. Además, se investiga la influencia de la calidad de la información, de la calidad del sistema y del disfrute en la utilidad percibida y la satisfacción de los empleados y cómo estos factores mejoran la percepción de autoeficacia de los empleados en materia de seguridad de la información. Este término hacer referencia a la percepción de los empleados de tener las capacidades y conocimientos necesarios para llevar a cabo comportamientos de seguridad de la información adecuados y actuar de acuerdo a las políticas establecidas para hacer frente a las amenazas de seguridad de la información. Los datos de 1.178 empleados de una empresa internacional son analizados mediante un modelo de ecuaciones estructurales y proporcionan un fuerte apoyo al uso de la gamificación en la formación de los empleados. Los resultados muestran que la gamificación influye en la calidad de la información y del sistema y en el disfrute, los cuales a su vez aumentan la utilidad percibida y la satisfacción. La utilidad influye en la satisfacción y ambas variables mejoran la autoeficacia de los empleados en seguridad de la información. Por su parte, el segundo estudio investiga los comportamientos reales de los empleados. En concreto, se examina la eficacia de una formación online gamificada sobre concienciación en seguridad de la información, mediante el análisis de las respuestas de los empleados a un ataque de phishing. El estudio 2 confirma que los sistemas de formación gamificados mejoran los comportamientos de seguridad de la información de los empleados, en particular, ante un ataque de phishing.

A modo de conclusión, a través de los estudios incluidos en la presente tesis doctoral, se aportan pruebas empíricas de la efectividad de la gamificación externa, dirigida a consumidores y usuarios de aplicaciones móviles, así como de la gamificación interna, dirigida a los empleados de una organización con el fin de apoyar la formación dentro de la misma.

CONCLUSIONES

En los últimos años, el número de organizaciones que utilizan estrategias de gamificación, tanto externas dirigidas a los clientes, como internas dirigidas a los empleados, se ha disparado. Los datos muestran que el mercado de la gamificación se espera que pase de un valor de 10.500 millones de dólares en 2021 a 96.800 millones de dólares en 2030 (Precedence Research, 2023). Además de atraer la atención empresarial, este fenómeno ha captado el interés de los académicos, convirtiéndose en una línea de investigación de gran importancia (Huotari & Hamari, 2017; Koivisto & Hamari, 2019; Wünderlich et al., 2020). Sin embargo, a pesar de los avances en la investigación, la literatura sobre gamificación se encuentra todavía en sus primeras etapas (Rapp et al., 2019) y los estudios anteriores han puesto de manifiesto desafíos temáticos, teóricos y metodológicos (Koivisto & Hamari, 2019). Abordando las lagunas identificadas en la literatura y recurriendo a diferentes enfoques teóricos –como el modelo de auto-sistema de desarrollo motivacional (*self-system model of motivational development*) (SSMMD; Connell, 1990; Connell & Wellborn, 1991; Skinner et al., 2008), la teoría de la autodeterminación (*self-determination theory*) (SDT; Deci, 1975), el modelo de aceptación de la tecnología (*technology acceptance mode*l) (TAM; Davis, 1989), y la teoría del éxito de los sistemas de información (*information systems success theory)* (DeLone & McLean, 1992, 2003; Seddon, 1997; Seddon & Kiew, 1996)–, el objetivo general de esta tesis doctoral ha sido avanzar en el conocimiento acerca de los mecanismos subyacentes a través de los cuales la gamificación influye en las actitudes y comportamientos de los individuos en diferentes contextos. Este objetivo general de investigación se ha dividido en los siguientes objetivos específicos.

En primer lugar, esta tesis doctoral ha tratado de proporcionar un conocimiento más amplio de los efectos de la gamificación analizando su uso en diferentes contextos –más allá del ámbito educativo– y dirigida a diferentes tipos de usuarios. Para lograr este objetivo, por un lado, se ha analizado la gamificación externa dirigida a fortalecer la relación entre empresa y cliente. Por otro lado, se ha examinado la gamificación interna dirigida a los empleados y con la finalidad de apoyar las actividades de recursos humanos. En concreto, los capítulos II y III se han centrado en la gamificación externa y han analizado empíricamente las percepciones de los usuarios hacia las aplicaciones móviles gamificadas. Por el contrario, el Capítulo IV ha investigado la gamificación

interna, examinando las percepciones y comportamientos de los empleados hacia un sistema de formación online gamificado.

El segundo objetivo de la tesis doctoral se ha centrado en proporcionar sustento teórico para explicar y comprender la eficacia de la gamificación y su impacto en las actitudes y comportamientos de los individuos. En este sentido, el Capítulo II proporcionó un marco teórico basado en el modelo de auto-sistema de desarrollo motivacional (*self-system model of motivational development*) (SSMMD; Connell & Wellborn, 1991) para explicar cómo los elementos de juego aumentan el compromiso de los usuarios con las aplicaciones móviles y generan resultados de marketing positivos. El capítulo III integró distintas teorías para avanzar en el conocimiento sobre la influencia de la gamificación en el sector financiero. En concreto, combinó la teoría de la autodeterminación (*self-determination theory*) (SDT; Deci, 1975) y el modelo de aceptación de la tecnología (*technology acceptance mode*l) (TAM; Davis, 1989) para explicar el efecto de la gamificación sobre los factores motivacionales y sus efectos posteriores sobre las variables de aceptación de la tecnología y las actitudes e intenciones de los usuarios. Por último, el capítulo IV se basó en la literatura sobre el éxito de los sistemas de información (*information systems success literature)* (DeLone & McLean, 1992, 2003; Seddon, 1997; Seddon & Kiew, 1996) y propuso un marco teórico para mostrar cómo la gamificación aumenta el éxito de los sistemas de formación online gamificados y mejora la percepción de autoeficacia en seguridad de la información de los empleados.

El tercer objetivo de la tesis doctoral se ha centrado en estudiar el efecto de los distintos elementos de juego implementados en los sistemas gamificados para ofrecer un análisis más detallado de su eficacia. En concreto, en el Capítulo II se investigó el impacto de tres tipos de elementos de juego: elementos orientados al logro y la progresión, elementos orientados a lo social y elementos orientados a la inmersión. En el capítulo III, se examinaron cinco elementos de juego (puntos, alertas o *feedback*, objetivos de presupuesto, gráficos de seguimiento y personalización) incluidos en la aplicación gamificada objeto de estudio. Asimismo, el capítulo IV se centró en cuatro elementos de juego identificados en la formación online gamificada: retos, *feedback*, objetivos claros y contexto narrativo. En general, los resultados aportaron un sólido respaldo a la inclusión de diferentes elementos de juego en las aplicaciones móviles (por ejemplo, aplicaciones de deporte y aplicaciones de gestión de finanzas personales) para

ayudar a lograr objetivos de marketing, así como en el lugar de trabajo para aumentar el éxito de los sistemas de formación online y la autoeficacia de los empleados en materia de seguridad de la información.

Por último, el cuarto objetivo de la tesis doctoral se ha dirigido a explicar los mecanismos subyacentes a través de los cuales los elementos de juego afectan a las respuestas psicológicas y de comportamiento de los individuos. De este modo, la tesis doctoral ha proporcionado un análisis empírico completo del impacto de los elementos del juego en los resultados psicológicos y conductuales de los individuos.

En este sentido, el Capítulo II proporcionó una visión completa de los efectos de los elementos de juego sobre las variables psicológicas de los individuos –como los sentimientos de competencia, autonomía y relación y el compromiso– y el efecto posterior sobre los resultados de comportamiento –como la intención de usar y recomendar la aplicación móvil, así como de valorarla positivamente. En concreto, los resultados apoyaron firmemente el potencial de los elementos orientados al logro y a la progresión para aumentar los sentimientos de competencia, autonomía y relación. Además, los resultados mostraron que los elementos orientados a la inmersión en las aplicaciones móviles fomentan el sentimiento de relación entre los usuarios, pero no influyen en los sentimientos de autonomía y competencia. Por último, los resultados proporcionaron pruebas sólidas sobre el uso de elementos orientados a lo social en aplicaciones móviles para promover el sentimiento de relación. Sin embargo, esta categoría de elementos de juego no afectó al sentimiento de competencia y afectó negativamente al sentimiento de autonomía. Es decir, el uso de esta categoría de elementos de juego podría percibirse como controlador. Los resultados también revelaron que la gamificación aumenta el compromiso del usuario con la aplicación gamificada a través de la satisfacción de las necesidades de competencia, autonomía y relación. Por último, los resultados mostraron que el compromiso del usuario, a su vez, conduce a una mayor intención de utilizar la aplicación, recomendarla y valorarla positivamente.

Del mismo modo, el Capítulo III confirmó la eficacia de la gamificación como un proceso continuo, que influye en las variables psicológicas de los usuarios de aplicaciones financieras –como los sentimientos de competencia y autonomía, la motivación autónoma, la percepción de la facilidad de uso y la utilidad, así como las actitudes de los

usuarios hacia la aplicación de gestión de las finanzas personales– y en las variables de comportamiento –como la intención de seguir utilizando este tipo de aplicación. En concreto, los resultados mostraron que los elementos de juego integrados en las aplicaciones de gestión de las finanzas personales, como los puntos, las alertas o el *feedback*, la posibilidad de fijar objetivos de presupuesto y los gráficos de seguimiento de los movimientos de dinero, afectan positivamente a los factores motivacionales, como los sentimientos de competencia y autonomía y la motivación autónoma. La motivación autónoma, a su vez, aumenta la percepción de los usuarios sobre la facilidad de uso y la utilidad de la aplicación móvil de gestión de las finanzas personales y, como consecuencia, los usuarios desarrollan una actitud más favorable hacia dicha aplicación y una mayor intención de seguir utilizándola.

Por último, el capítulo IV incorporó dos estudios. Por un lado, los resultados del primer estudio aportaron pruebas empíricas sobre el impacto positivo de la gamificación para promover el éxito de los sistemas de información y de las relaciones propuestas entre las distintas medidas de éxito de los sistemas de información. En este sentido, los elementos de juego influyen positivamente en la calidad de la información presentada en sistema de formación online y en la calidad del sistema, además de fomentar el disfrute de los empleados durante la experiencia de formación. Además, estas variables aumentan la autoeficacia de los empleados en materia de seguridad de la información, es decir, la percepción de los empleados de ser capaces de realizar comportamientos de seguridad de la información adecuados. Por otra parte, el segundo estudio, centrado en los comportamientos reales de los empleados, demostró que los comportamientos de seguridad de la información de los empleados mejoran tras completar el sistema de formación online gamificado.

CONTRIBUCIONES TEÓRICAS

La presente tesis doctoral aporta diferentes contribuciones teóricas a la literatura sobre gamificación, en general, y a los contextos específicos en los que se ha aplicado y analizado, es decir, las aplicaciones móviles gamificadas y los sistemas de formación online gamificados dirigidos a los empleados de una organización.

En primer lugar, desde un punto de vista temático, la literatura previa ha indicado que la investigación empírica sobre gamificación debería ampliar las áreas de estudio,

más allá de las tradicionales, como la educación (Koivisto & Hamari, 2019; Seaborn & Fels, 2015). Del mismo modo, la literatura sobre gamificación debería centrarse en analizar el impacto de la gamificación en diferentes grupos de interés, como usuarios, clientes o empleados (Wünderlich et al., 2020). Ampliar las áreas de estudio de la investigación sobre gamificación es de gran importancia debido a que los resultados de la gamificación dependen en gran medida del contexto en el que se implementa y del usuario que interactúa con el sistema o la actividad gamificada (Hamari et al., 2014). Por lo tanto, esta tesis doctoral arroja nuevos conocimientos sobre la eficacia de la gamificación en diferentes contextos –gamificación externa y gamificación interna– y entre diferentes usuarios –consumidores y empleados. De esta forma, la presente tesis aporta pruebas sólidas sobre la eficacia de la gamificación en el contexto de las aplicaciones móviles para aumentar el compromiso de los usuarios y la intención de seguir utilizando la aplicación móvil, así como en el contexto de la formación de los empleados para aumentar su satisfacción y su autoeficacia en seguridad de la información.

En segundo lugar, la investigación existente se ha centrado en los efectos de la gamificación en general o ha analizado el efecto de la gamificación como contexto de investigación (Koivisto y Hamari, 2019; Rapp et al., 2019; Tobon et al., 2020). Muchos estudios exploran el efecto de la gamificación como un concepto uniforme (Sailer et al., 2017) o se centran en unos pocos elementos de juego, principalmente puntos, insignias y tablas de clasificación (Werbach & Hunter, 2012). Por lo tanto, en respuesta a la necesidad de más investigación sobre el impacto individual de los elementos de juego, esta tesis doctoral proporciona nuevos conocimientos sobre la influencia y el efecto de elementos de juego específicos. En particular, contribuye a la literatura analizando cómo la interacción usuario-elemento de juego afecta al compromiso y a la motivación de los usuarios con las aplicaciones móviles, además de fomentar resultados positivos de marketing. Del mismo modo, aporta pruebas sobre el impacto de los distintos elementos de juego implementados en un sistema de formación online gamificado, como los retos, el *feedback*, los objetivos claros y la narrativa, en el éxito del sistema de formación online.

En tercer lugar, la gamificación se ha conceptualizado como un proceso continuo formado por tres elementos interrelacionados: las *motivational affordances*, los resultados psicológicos y los resultados de comportamiento (Hamari et al., 2014; Koivisto y Hamari,

2019). Sin embargo, se necesitan más estudios empíricos que analicen los mecanismos subyacentes que explican cómo la gamificación puede influir en las respuestas psicológicas y de comportamiento de los individuos (Wünderlich et al., 2020). Además, aunque diferentes teorías pueden ayudar a comprender la eficacia de la gamificación, muchos estudios carecen de un sustento teórico (Koivisto & Hamari, 2019; Seaborn & Fels, 2015). Por lo tanto, la presente tesis doctoral se basa en diferentes teorías –como el modelo de auto-sistema de desarrollo motivacional (*self-system model of motivational development*) (SSMMD; Connell, 1990; Connell & Wellborn, 1991; Skinner et al., 2008), la teoría de la autodeterminación (*self-determination theory*) (SDT; Deci, 1975), el modelo de aceptación de la tecnología (*technology acceptance mode*l) (TAM; Davis, 1989) y la teoría del éxito de los sistemas de información (*information systems success theory)* (DeLone & McLean, 1992, 2003; Seddon, 1997; Seddon & Kiew, 1996)– para proporcionar un marco teórico que ofrezca una visión completa de la eficacia de la gamificación y su impacto en las actitudes y comportamientos de los individuos.

Por último, esta tesis doctoral pretende superar algunas de las limitaciones metodológicas señaladas en los estudios anteriores sobre gamificación, como el uso de muestras pequeñas o muestras de estudiantes, medidas no validadas y el carácter descriptivo de los resultados (Hamari et al., 2014; Koivisto & Hamari, 2019; Rapp et al., 2019). En este sentido, la presente tesis doctoral ha utilizado medidas validadas en la literatura, ha llevado a cabo los análisis en contextos gamificados reales y ha utilizado muestras de consumidores y empleados. Por lo tanto, los resultados de esta tesis doctoral presentan una alta validez ecológica.

IMPLICACIONES PRÁCTICAS

La presente tesis doctoral también presenta una serie de implicaciones prácticas. Por un lado, aporta implicaciones gerenciales a la hora de aplicar la gamificación externa para mejorar la experiencia de los usuarios y consumidores. Por otro lado, aporta implicaciones prácticas en el diseño de la gamificación interna dirigida a los empleados de las organizaciones.

En primer lugar, esta tesis doctoral muestra una serie de implicaciones prácticas relacionadas con el diseño y desarrollo de aplicaciones móviles para aumentar el compromiso de los usuarios. Las tiendas de aplicaciones para dispositivos móviles

cuentan con un gran número de aplicaciones, por lo que es fundamental un buen posicionamiento dentro de la tienda y tener una valoración alta para destacar entre las demás y conseguir nuevos usuarios. Del mismo modo, los usuarios necesitan estar comprometidos con las aplicaciones móviles para construir una relación a largo plazo. Los resultados de esta tesis doctoral indican que el compromiso de los usuarios es fundamental en la decisión de seguir utilizando la aplicación móvil, recomendarla y reportar una valoración alta. En este sentido, para aumentar el compromiso de los usuarios, se puede hacer uso de la gamificación e incluir en la aplicación elementos de juego que promuevan sentimientos de competencia, autonomía y relación entre los usuarios.

Entre las distintas categorías de elementos de juego, los más eficaces para satisfacer las necesidades psicológicas y aumentar el compromiso de los usuarios son los orientados al logro y a la progresión. Muchas aplicaciones móviles ya incluyen los elementos de juego más comunes, como puntos, insignias y tablas de clasificación. Sin embargo, los diseñadores y desarrolladores de aplicaciones móviles no deben pasar por alto otros elementos de juego de esta categoría, como ofrecer retos y un sistema de *feedback* continuo para mostrar el progreso y el rendimiento de los usuarios. Además, la actividad dentro de la aplicación puede enmarcarse en diferentes niveles para que, a medida que los usuarios adquieran experiencia, puedan obtener puntos y subir de nivel.

Además de los elementos orientados al logro y a la progresión, esta tesis doctoral demuestra que los elementos orientados a la inmersión fomentan los sentimientos de relación entre los usuarios. Por ejemplo, dar la opción de crear un avatar puede animar a los usuarios a relacionarse entre sí, lo que a su vez fomentará el compromiso con la aplicación móvil.

Por último, los diseñadores de aplicaciones móviles deben prestar atención a la hora de implementar elementos sociales. Incluir este tipo de elementos es importante cuando el objetivo es fomentar el sentimiento de relación. Por ejemplo, los desarrolladores de las aplicaciones móviles deben fomentar la creación de una comunidad dentro de la aplicación para compartir información con otros usuarios. Esto puede aplicarse fácilmente en las aplicaciones de deporte, donde las rutinas de ejercicio y los entrenamientos pueden compartirse fácilmente con los demás. Los desarrolladores también pueden establecer retos que impliquen competir o colaborar con otros. Sin

embargo, la interacción con esta categoría de elementos de juego debe ser voluntaria, puesto que los resultados de esta tesis doctoral demuestran que estos elementos de juego también pueden reducir los sentimientos de autonomía y ser percibidos como controladores y, por lo tanto, afectar negativamente al compromiso de los usuarios.

En segundo lugar, los resultados de esta tesis doctoral también indican que la motivación de los usuarios es fundamental en la decisión de adoptar y seguir utilizando una aplicación móvil. Por lo tanto, para aumentar la motivación autónoma entre los usuarios, los diseñadores y desarrolladores de las aplicaciones móviles deberían incorporar elementos de juego que promuevan los sentimientos de competencia y autonomía. En el caso concreto de las aplicaciones móviles de gestión de finanzas personales, esto implicaría que además de almacenar información financiera, estas aplicaciones deberían aumentar sus funcionalidades y ofrecer más opciones a los usuarios. En particular, para promover sentimientos de competencia y autonomía, las aplicaciones de gestión de finanzas personales deberían permitir a los usuarios establecer objetivos presupuestarios en diferentes categorías de gasto, realizar un seguimiento del dinero a través de gráficos de rendimiento, recibir *feedback* sobre sus logros mediante una puntuación y enviando alertas y notificaciones (por ejemplo, gastos o próximas facturas...). Además, para mejorar la actitud de los usuarios hacia este tipo de aplicaciones móviles y, por lo tanto, aumentar la intención de seguir utilizándolas, las aplicaciones móviles gamificadas deben diseñarse de forma que los usuarios las encuentren fáciles e intuitivas de usar, así como útiles.

Por último, la presente tesis doctoral también aporta importantes implicaciones para los directivos de las organizaciones a la hora de aplicar la gamificación interna, es decir, la gamificación dirigida a los empleados de una organización. Los resultados ponen de manifiesto la importancia de la formación de los empleados para mejorar sus comportamientos en seguridad de la información. Además, los resultados muestran cómo la gamificación puede facilitar este proceso de formación, aumentando el éxito de los sistemas de formación online y generando una mayor autoeficacia de los empleados en materia de seguridad de la información, es decir, una mayor conciencia de los comportamientos relacionados con la seguridad de la información y percepción de ser capaz de actuar correctamente. Los diseñadores y desarrolladores de sistemas de formación en seguridad de la información deberían considerar la inclusión de diferentes

elementos de juego para mejorar la calidad de la información y del sistema, así como el disfrute de los empleados, lo que a su vez aumenta la percepción de utilidad y satisfacción. Según los resultados, la satisfacción y la utilidad de los empleados pueden aumentar la autoeficacia de los empleados en materia de seguridad de la información. Por lo tanto, los retos en forma de ejercicios prácticos, como rompecabezas o ejercicios de "arrastrar y soltar", pueden mejorar la experiencia de formación. Del mismo modo, presentar objetivos claros y proporcionar un *feedback* continuo, a través de mensajes instantáneos, puntos o mostrando el progreso, puede guiar el proceso de formación. Por último, enmarcar toda la experiencia de formación en un contexto narrativo es un elemento de juego importante para aumentar el éxito de los sistemas de formación online.

La tabla 6.1 resume las principales contribuciones teóricas e implicaciones prácticas derivadas de los estudios empíricos incluidos en los capítulos anteriores.

Tabla 6.1. Resumen de las contribuciones teóricas e implicaciones prácticas

Capítulo	Contribuciones teóricas	Implicaciones prácticas
Capítulo II	• Contribuciones a la literatura sobre el compromiso (*engagement)* de los usuarios: o Proporciona nuevos conocimientos sobre el efecto del compromiso de los usuarios en el contexto de las aplicaciones móviles gamificadas. o Examina la escala para medir el compromiso del usuario desarrollada por O'Brien et al.'s (2018) (UES-SF) en un nuevo contexto: aplicaciones móviles gamificadas. • Contribuciones a la literatura sobre gamificación: o Propone y analiza un modelo basado en el modelo de auto-sistema de desarrollo motivacional (SSMMD) para analizar la gamificación como un proceso continuo, es decir, cómo los elementos del juego influyen en la actitudes y comportamientos de los individuos. o Analiza el impacto de las tres categorías de elementos de juego más comunes y que se encuentran en los sistemas gamificados sobre las necesidades psicológicas básicas y el compromiso de los usuarios. o Realiza un estudio empírico en un contexto gamificado real.	• El diseño de las aplicaciones móviles debe integrar diferentes categorías de elementos de juego para aumentar el compromiso de los usuarios, la intención de un uso continuado, la intención de recomendación y las valoraciones hacia las aplicaciones móviles. • Los diseñadores de aplicaciones móviles deberían incluir principalmente elementos orientados al logro y a la progresión para fomentar las necesidades psicológicas básicas de las personas, así como el compromiso de los usuarios. • Los elementos de juego orientados a la inmersión y los elementos sociales también deberían incluirse en las aplicaciones móviles con el objetivo de fomentar el sentimiento de relación de los usuarios. Sin embargo, la interacción con elementos sociales debe ser voluntaria para los usuarios, puesto que disminuye el sentimiento de autonomía.

Tabla 6.1. Resumen de las contribuciones teóricas e implicaciones prácticas (continuación)

Capítulo	Contribuciones teóricas	Implicaciones prácticas
Capítulo III	• Aporta nuevos conocimientos sobre la eficacia de la gamificación externa dirigida a clientes, en particular, sobre el uso de la gamificación en las aplicaciones móviles financieras. • Proporciona nuevos conocimientos sobre cómo la interacción de los usuarios con los elementos de juego integrados en las aplicaciones móviles de gestión de las finanzas personales aumenta la motivación de los usuarios y el uso de dichas aplicaciones móviles. • Propone y analiza un modelo que combina la teoría de la auto-determinación y el modelo de aceptación de la tecnología para explicar los antecedentes de la actitud de los usuarios hacia las aplicaciones móviles gamificadas de gestión de las finanzas personales. • Realiza un estudio empírico sobre la aceptación de aplicaciones móviles gamificadas de gestión de las finanzas personales en un contexto gamificado real.	• El diseño de las aplicaciones debería apoyar la motivación autónoma de los usuarios integrando elementos de juego que promuevan sentimientos de competencia y autonomía. • Los diseñadores de aplicaciones móviles deberían incluir elementos de juego para que los usuarios puedan interactuar con ellos. En el caso concreto de las aplicaciones móviles de gestión de las finanzas personales, se podría incluir la posibilidad de fijar objetivos personales en relación con sus finanzas, hacer un seguimiento del dinero en tiempo real, recibir alertas de gasto o próximas facturas, y recibir puntos. • Las aplicaciones móviles deben percibirse como fáciles de usar y útiles para promover actitudes favorables hacia ellas.

Tabla 6.1. Resumen de las contribuciones teóricas e implicaciones prácticas (continuación)

Capítulo	Contribuciones teóricas	Implicaciones prácticas
Capítulo IV	• Contribuciones a la literatura sobre gamificación: o Proporciona nuevos conocimientos sobre la eficacia de la gamificación interna dirigida a los empleados, en particular, sobre el uso de sistemas de formación online gamificados en seguridad de la información. o Propone y analiza un modelo para analizar cómo los elementos de juego promueven el éxito de los sistemas de formación online y mejoran la autoeficacia de los empleados en materia de seguridad de la información. o Analiza tanto las percepciones de los empleados como sus comportamientos reales. o Realiza un estudio empírico en un contexto gamificado real. • Contribuciones a la literatura sobre sistemas de información: o Analiza la gamificación como antecedente del éxito de los sistemas de información.	• Los responsables sobre la ciberseguridad de las empresas deben ser conscientes de la importancia de la formación de los empleados para mejorar sus comportamientos de seguridad de la información y, por lo tanto, proteger los activos de información. • Los desarrolladores y proveedores de sistemas de formación online sobre seguridad de la información deberían incluir la gamificación, como desafíos, un sistema de *feedback* continuo, objetivos claros y un contexto narrativo, con el fin de aumentar el éxito de los sistemas de formación online y la autoeficacia de los empleados en materia de seguridad de la información.

LIMITACIONES Y FUTURAS LÍNEAS DE INVESTIGACIÓN

La presente tesis doctoral desarrolla diferentes estudios empíricos centrados en el uso de la gamificación externa, es decir, dirigida a clientes o potenciales clientes y relacionada con fines de marketing, así como en el uso de la gamificación interna, dirigida a los empleados de las organizaciones. Por tanto, estos estudios suponen un avance en el conocimiento sobre el uso e implementación de estrategias de gamificación en diferentes contextos. Sin embargo, como se ha mencionado en cada uno de los capítulos, estos estudios también presentan limitaciones específicas que pueden ofrecer futuras líneas de investigación. En este sentido, el presente apartado pretende exponer las limitaciones más significativas de esta tesis doctoral, así como proponer futuras líneas de investigación.

En primer lugar, esta tesis doctoral analiza la gamificación en diferentes contextos y dirigida a diferentes tipos de usuarios, como usuarios de aplicaciones móviles, consumidores y empleados. Sin embargo, en el contexto de la gamificación externa sólo se han analizado dos aplicaciones móviles específicas, mientras que en el contexto de la gamificación interna sólo se ha estudiado un sistema de formación concreto implantado en una organización específica. Por lo tanto, aunque los estudios presentan una alta validez ecológica porque se han desarrollado en contextos reales, las investigaciones futuras deberían considerar otras categorías de aplicaciones móviles (por ejemplo, aplicaciones móviles de aprendizaje, aplicaciones móviles de turismo) para el análisis, así como otros tipos de sistemas de formación online o *e-trainings* (por ejemplo, formación sobre competencias técnicas, formación sobre competencias interpersonales, etc.) implementados en diferentes organizaciones e industrias. Además, aunque el contexto en el que se utiliza la gamificación puede desempeñar un papel importante en su efectividad, las investigaciones futuras también deberían tener en cuenta las características individuales de los usuarios, como los tipos de personalidad o los diferentes tipos de jugadores, para analizar si estos factores influyen en los resultados de la gamificación. Por ejemplo, la tipología propuesta por Bartle (1996) distingue entre cuatro tipos de jugadores: triunfadores, exploradores, *"killers"* y socializadores. También se utiliza con frecuencia la tipología Hexad (Marczewski, 2015), que distingue seis tipos de jugadores al interactuar con aplicaciones

gamificadas (triunfadores, disruptores, espíritus libres, filántropos, jugadores y socializadores). Por lo tanto, un análisis de estas tipologías y rasgos de personalidad permitiría adaptar los elementos del juego en función de los perfiles de los usuarios para mejorar su experiencia.

En segundo lugar, a excepción del estudio dos del Capítulo IV, los estudios empíricos son transversales. Por lo tanto, no se ha analizado la eficacia de la gamificación a largo plazo. Algunos estudios afirman que la gamificación puede tener un "efecto novedad" o "*novelty effect"* lo que significa que la gamificación puede ser eficaz al principio, pero sus resultados pueden no ser duraderos (Hamari et al., 2014). En este sentido, las investigaciones futuras deberían llevar a cabo estudios longitudinales para proporcionar nuevos conocimientos sobre sus efectos a largo plazo.

En tercer lugar, con la excepción del segundo estudio del Capítulo IV, las variables de los estudios se centraron en medidas de percepción de los usuarios, como la intención de utilizar y recomendar la aplicación móvil, la valoración que los usuarios darían a la aplicación o la autoeficacia de los empleados en materia de seguridad de la información. Por lo tanto, las investigaciones futuras también deberían considerar medidas objetivas para analizar la eficacia de la gamificación, por ejemplo, recopilando datos directamente de la aplicación móvil. Además, aunque el capítulo IV incluía tanto las percepciones de los empleados sobre los sistemas de formación online gamificados como sus comportamientos reales en materia de seguridad de la información, debido a cuestiones de privacidad, no fue posible vincular las percepciones de los empleados con las medidas objetivas de los comportamientos de los empleados. Por lo tanto, las investigaciones futuras deberán superar estas limitaciones metodológicas.

Por último, esta tesis doctoral se ha centrado en los posibles efectos positivos de la gamificación. Sin embargo, puede haber situaciones específicas en las que no sea apropiado utilizar esta estrategia. Estudios previos han encontrado un efecto negativo de la gamificación en diferentes contextos. Por ejemplo, en el contexto educativo, la gamificación se relacionó con resultados negativos, como la pérdida de rendimiento, el desencadenamiento de comportamientos no deseados, la indiferencia y los efectos decrecientes como la pérdida gradual de motivación y

compromiso (Toda et al., 2018). Esto se debe normalmente a la falta de métodos adecuados a la hora de implementar elementos de juego, como puntos, insignias y tablas de clasificación (Toda et al., 2018). El efecto negativo más común encontrado en este contexto fue la pérdida de rendimiento, es decir, en algunas situaciones se encontró que la gamificación perjudica y afecta negativamente al proceso de aprendizaje (Toda et al., 2018). Además, la gamificación en el lugar de trabajo puede percibirse como un factor externo para controlar el rendimiento de los empleados y, por lo tanto, reducir la motivación intrínseca para realizar las actividades laborales (Mitchell et al., 2020). En este sentido, Hammedi et al. (2021) descubrieron que la gamificación afecta negativamente al compromiso y al bienestar de los empleados. Sin embargo, la disposición de los empleados a utilizar la gamificación en el lugar de trabajo modera estos impactos negativos. Otros estudios centrados en el uso de la gamificación en el contexto de la gestión sanitaria descubrieron que los elementos competitivos y la interactividad que ofrece la gamificación pueden hacer que las personas sientan una invasión de su privacidad y una sobrecarga social, lo que puede provocar que pierdan el interés por la gamificación (Yang y Li, 2021). Del mismo modo, se descubrió que perder una competición afecta negativamente a la experiencia y el compromiso del cliente en el contexto de las comunidades de co-creación (Leclercq et al., 2018). Además, la mecánica de la competición puede causar conflictos entre los participantes de una comunidad y promover comportamientos oportunistas, como crear cuentas falsas o invitar a amigos a la plataforma con el objetivo de impulsar sus ideas frente a las de los demás (Leclercq et al., 2017). Por lo tanto, las investigaciones futuras también deberían considerar los posibles efectos adversos de la gamificación.

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