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Enhancing user engagement: The role of gamification in mobile apps

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ABSTRACT

Organizations are increasingly making use of gamification to enhance users' engagement with their mobile apps. However, more research into the mechanisms that facilitate user engagement and its consequences is needed. Drawing on the self-system model of motivational development, this study investigates how gamification might foster user engagement and positive marketing outcomes. Data from 276 users of a mobile gamified app were analyzed using partial least squares regression. The results showed that 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. Finally, this study provides a number of theoretical and practical implications that can help developers design more effective gamified mobile apps.

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 140.7 billion in 2016 to 204 billion in 2019 (Statista, 2020). 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). Gamification has been defined as "a process of enhancing a service with affordances for gameful experiences in order to support users' overall value creation" (Huotari & Hamari, 2017, p. 25). The concept of affordance, introduced by Gibson (1977), has been explored in fields such as marketing (e.g., de Luca et al., 2020) and human–computer interaction (HCI) (e.g., Huotari & Hamari, 2011; Jung et al., 2010). Specifically, in the gamification context, affordances have been defined as the "various elements and mechanics that structure games and aid in inducing gameful experiences within the systems" (Koivisto & Hamari, 2019, p. 193). Therefore, gamification, through the user's voluntary interaction with the system and its affordances, promotes in him/her a series of psychological outcomes, such as enhanced motivation and engagement, with the final aim of shaping his/her behaviors (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 analyze models by employing user engagement as the dependent variable. Thus, there is a need to understand better the mechanisms that explain how

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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 paper proposes a model to analyze 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 analyzed.

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). In particular, 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 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).

2. Previous research on gamification and engagement

Gamification has been defined as "the use of game design elements to enhance non-game goods and services by increasing customer value and encouraging value-creating behaviors" (Hofacker et al., 2016, p. 26). In the last few years, the popularity of gamification has skyrocketed and its associated literature has rapidly increased (Wünderlich et al., 2020), which is manifested in the growing number of fields in which gamification is applied (see Koivisto and Hamari (2019) for a literature review on gamification research).

Gamification has the potential to impact on four levels: in-game, intra-organizational, customer and transformative (Wünderlich et al., 2020). 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) 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). At all these levels gamification is linked to engagement (Syrjälä et al., 2020).

As recently 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 behavior (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 HCI (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; 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 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).

To conceptualize the user engagement construct, some authors have focused on the user-system attributes that provide an engaging

Table 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 behaviors and customer engagement emotions/-	Reward, relationship, loyalty and subversion	Netnographic approach	The study identifies key processes and outcomes of online customer engagement and behavior
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 behavioral)	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
Jang et al. (2018)	Gamified customer benefits (epistemic, social integrative and personal integrative)	-/Age and experience	Customer engagement behavior 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 toward 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
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 behavioral)
			Brand awareness and brand loyalty	Survey	

(*continued on next page*)

Table 1 (*continued*)

Reference	Independent variables	Mediator/moderator	Dependent variables	Research design	Key findings
Xi & Hamari (2020)	Immersion-, achievement- and social-related gamification features	Brand engagement (cognitive, emotional and behavioral)/-			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
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 behavioral intentions toward 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 favors engagement, stimulating intrinsic motivation in the participants
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 behavior (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

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 & Cairns, 2016; O'Brien, 2018). 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 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.

3. Theoretical framework and research hypotheses

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; Deci & Ryan, 1985), 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 behavioral 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).

3.2. Research model and proposed hypotheses

Drawing on the SSMMD, and following the gamification conceptualization of Koivisto and Hamari (2019), the research model (Fig. 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 behavioral outcomes.

First, achievement and progression-oriented affordances include the most popular game elements in gamified systems, such as badges/medals, points, leaderboards or rankings, progress bars, and increasing difficulty levels (Koivisto & Hamari, 2019). 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 behavior and performance of the users involved and allow them to compare the quantity of badges/goals achieved (Hamari & Koivisto, 2015).

Second, social-oriented affordances (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 fulfills 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 affordances 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). This game element category includes avatars, or profiles, narratives or meaningful stories, and customization (Koivisto & Hamari, 2019). These elements have been related to the satisfaction of psychological needs (Deci & Ryan, 2000). For instance, through storylines or narratives, which divide activities

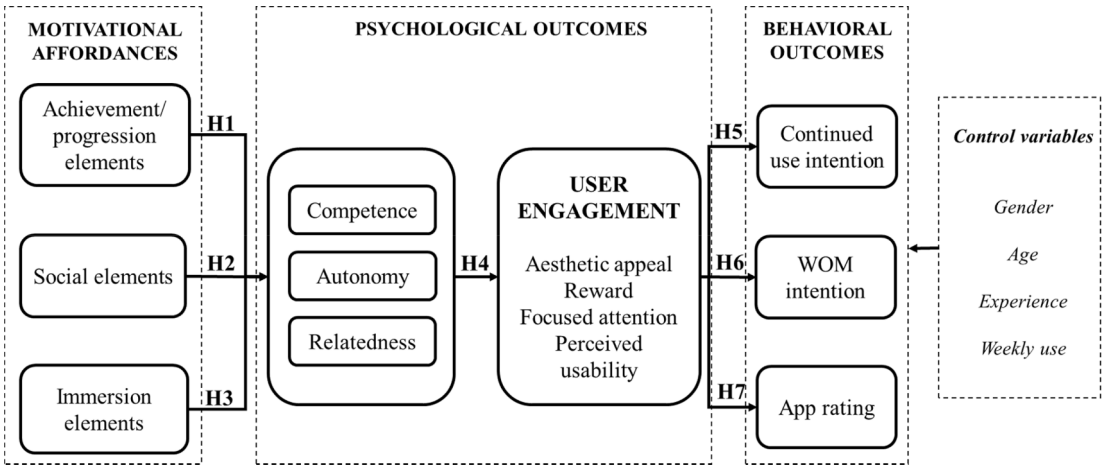

Fig. 1. Proposed model.

into small, similarly themed steps (Wee & Choong, 2019), users can easily fulfill 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., 2013). 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 behavioral 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 behavioral 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

4. Methodology

4.1. Research context

The Fitbit app, one of the best-known exercise apps, with 29.57 million active users worldwide in 2019 (Statista, 2021), 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 (see Fig. 2): 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 toward their goals. The Discover tab includes exercise and wellness programs, and challenges. Fitbit uses challenges to help its users stay motivated. These

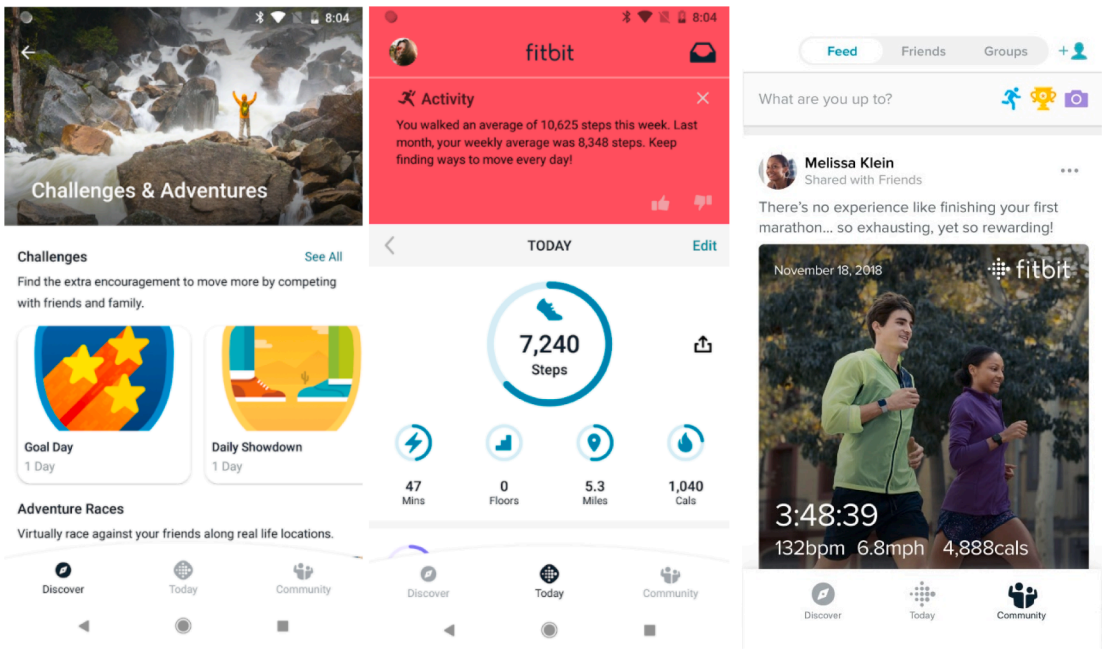

Fig. 2. Screenshots of the app. Source: fitbit.com and Google Play.

challenges include the "Daily Showdown" (who can take the most steps in 24 h), 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 toward 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).

4.2. Data collection and participants

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.

4.3. Measures

The study variables were measured using 7-point scales based on previous literature (see Appendix A). 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 use of control variables can alleviate endogeneity problems (Papies et al., 2016).

4.4. 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).

5. 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.

5.1. Analysis of the measurement model

The proposed model includes both reflective and formative constructs. First, the reflective measurement model for the first-order dimensions was assessed following the criteria proposed by Hair et al. (2017) (see Table 2). 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), and we also confirmed that the square roots of the AVEs of each construct were greater than the inter-construct correlations (Fornell & Larcker, 1981) (see Table 3).

The formative measurement model for the first-order dimensions was then assessed (see Table 4). Following previous research (e.g., Xi & Hamari, 2019), interaction with each game element 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 (s)he 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.

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, engagement was conceptualized as a second-order formative construct composed of four first-order factors: aesthetic appeal, reward, focused attention and perceived usability. Similarly, 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.

The resulting model was re-estimated and reassessed. First, following Henseler et al. (2015), we confirmed that all HTMT values were below the threshold of 0.90 (see Table 5) and that the bootstrap confidence interval did not contain the value 1. Then, 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 6). Similarly, the external validity of the formative measurement model was analyzed by assessing the indicators' weights and loadings. Although the weights of the indicators should ideally be statistically

Table 2
Reflective measurement model results.

Construct	Indicator	Mean	Standard deviation	Factor loading	AVE	Cronbach's alpha	CR
Competence	COM1	5.54	1.12	0.835	0.639	0.811	0.876
	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
	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
	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
	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
	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
	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
	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
	CUI2	5.89	1.20	0.916			
WOM intention	WOM1	5.66	1.26	0.931	0.870	0.851	0.931
	WOM2	5.71	1.17	0.935			
App rating	RAT	5.93	0.90	1.000	n.a.	n.a.	n.a.

Table 3
Fornell-Larcker test.

	1	2	3	4	5	6	7	8	9	10
1. Competence	**0.800**									
2. Autonomy	0.667	**0.803**								
3. Relatedness	0.494	0.149	**0.909**							
4. Aesthetic appeal	0.727	0.632	0.470	**0.844**						
5. Reward	0.721	0.702	0.332	0.674	**0.841**					
6. Focused attention	0.436	0.116	0.609	0.355	0.295	**0.875**				
7. Perceived usability	0.137	0.375	−0.259	0.221	0.314	−0.344	**0.955**			
8. Continued use	0.621	0.710	0.191	0.651	0.731	0.158	0.415	**0.919**		
9. WOM	0.660	0.650	0.332	0.643	0.759	0.299	0.312	0.737	**0.933**	
10. Rating	0.533	0.445	0.336	0.556	0.580	0.278	0.203	0.550	0.564	**n.a.**

Note: The values on the diagonal are the square roots of the AVEs. Values below the diagonal are construct correlations.

Table 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

Table 5
Heterotrait-monotrait (HTMT) ratios.

	Competence	Autonomy	Relatedness	Continued use	WOM
Autonomy	0.818				
	[0.724; 0.904]				
Relatedness	0.571	0.209			
	[0.444; 0.682]	[0.150; 0.310]			
Continued use	0.756	0.866	0.218		
	[0.649; 0.857]	[0.775; 0.962]	[0.096; 0.351]		
WOM	0.793	0.775	0.374	0.883	
	[0.692; 0.886]	[0.670; 0.870]	[0.237; 0.502]	[0.774; 0.979]	
Rating	0.592	0.489	0.348	0.609	0.611
	[0.481; 0.686]	[0.380; 0.586]	[0.227; 0.456]	[0.489; 0.716]	[0.504; 0.710]

Note: The values in brackets represent the 95% bias-corrected and accelerated confidence interval of the HTMT values

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.

5.2. Analysis of the structural model

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,

Table 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

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.

The results of the structural model are summarized in Table 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 (β = 0.646; t = 11.462), autonomy (β = 0.670; t = 11.336) and relatedness (β = 0.189; t = 2.713). Similarly, interaction with social-oriented game elements in the app is positively associated with relatedness need satisfaction (β = 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.

Table 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.

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 analyzes 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 8.

The results suggested that the user's interaction with achievement and progression-oriented game 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 game elements 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 analyzed the total effect of interaction with social-oriented game 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 game elements does not promote

Table 8
Mediation analysis.

	Direct effects		Indirect effects		Mediation	Total effects	
	β	*t-value*	β	*t-value*		β	*t-value*
Achievement → Competence → Engagement	0.235	3.788	0.223	5.174	Partial	0.670	11.903
Achievement → Autonomy → Engagement			0.182	4.636	Partial		
Achievement → Relatedness → Engagement			0.031	1.968	Partial		
Social → Competence → Engagement	−0.185	3.563	0.042	2.070	Partial	−0.139	2.606
Social → Autonomy → Engagement			−0.090	3.111	Partial		
Social → Relatedness → Engagement			0.094	3.094	Partial		
Immersion → Competence → Engagement	−0.056	1.018	0.045	1.755	No	0.077	1.073
Immersion → Autonomy → Engagement			0.051	1.589	No		
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

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 game 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 game 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 game 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 game 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.

5.4. Endogeneity testing

Endogeneity is likely to be present in the model. Therefore, following Hult et al. (2018), the authors first checked whether the requirement to apply the Gaussian copula approach (Park and Gupta, 2012) was met. This approach "controls for endogeneity by directly modeling the correlation between the endogenous variable and the error term by means of a copula" (Sarstedt et al., 2020, p. 8) and can only be adopted if the composite scores of the endogenous constructs are non-normally distributed. The Kolmogorov-Smirnoff test, with the Lilliefors correction, was used. The results showed that two of the constructs (i.e., interaction with achievement and progression-oriented elements, and user engagement) had normally distributed scores. Thus, the authors could not proceed with this approach. Hult et al.'s (2018) procedure advises using a control-variable approach. As previously explained, the study includes control variables (i.e., gender, age, experience and how much time the user devotes to the app each week). 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). While this approach might help address the issue of endogeneity in the model (Papies et al., 2016), the authors acknowledge that, even using these control variables, it is unlikely that the endogeneity problems can be completely eliminated. Therefore, it is recognized that this is a limitation of the study.

6. Discussion

Drawing on the SSMMD this study proposes and tests a model to explain how game elements 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 element 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 game elements 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.

6.1. Theoretical contributions

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 analyzing user engagement in the context of gamified mobile apps. In particular, it examines the processes through which users' interaction with three game element 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 the authors' 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 game elements on various psychological outcomes, such as basic psychological need satisfaction and user engagement, and their subsequent effects on behavioral 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 paper to the gamification literature is that it analyzes the impact of the three most common 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.

6.2. Practical 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 game elements are those oriented toward 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 game 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 game elements should be voluntary, and secondary, so that they do not interfere with users' autonomy and, consequently, decrease user engagement with the app.

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, although control variables can reduce endogeneity (Hult et al., 2018), a statistical approach, in this case, the Gaussian copula procedure, could not be applied to identify whether endogeneity existed, as the requirement to use the method was not met. Therefore, the results about the relationships tested in this study should be treated with caution. Third, the data were collected based on one specific mobile app. While this app includes most of the game elements embedded in gamified apps, future research should replicate this model using other gamified mobile apps in different categories (e.g., learning apps, tourism apps). Fourth, 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. Finally, drawing on the important concept of the human-in-the-loop, the aim of which is "to use human knowledge and skills in order to improve the quality of automatic approaches" (Holzinger et al., 2019, p. 2402), future studies might explore how gamification can be used to increase user engagement in this context.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix A. Constructs, items, and sources

Construct and source	Items
Interaction with achievement and progression-oriented elements Xi & Hamari (2019)	The frequency of interacting with scores The frequency of interacting with performance graphs The frequency of interacting with challenges The frequency of interacting with badges/trophies The frequency of interacting with progress bars The frequency of interacting with rankings/leaderboards The importance of interacting with scores The importance of interacting with performance graphs The importance of interacting with challenges The importance of interacting with badges/trophies The importance of interacting with progress bars The importance of interacting with rankings/leaderboards
Interaction with social-oriented elements Xi & Hamari (2019)	The frequency of interacting with competition The frequency of interacting with social networking features The frequency of interacting with cooperation The importance of interacting with competition The importance of interacting with social networking features The importance of interacting with cooperation
Interaction with immersion-oriented elements Xi & Hamari (2019)	The frequency of interacting with profile/virtual identity/avatar The frequency of interacting with personalization The frequency of interacting with virtual world/3D world The importance of interacting with profile/virtual identity/avatar The importance of interacting with personalization 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

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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.

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