

# DESIGN QUALITY, RELATIONSHIP INTIMACY AND CONTINUANCE INTENTION OF MOBILE APPS: AN EXTENSION TO THE IS SUCCESS MODEL

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## ABSTRACT

Mobile applications (apps) cover a large variety of domains; people spend more time daily on apps to manage their jobs. A significant reason for app success is its unique characteristics, which can be attributed to app design and its content features. However, there is less evidence and guidelines to show how app design and its content features affect continuance intention. In this empirical study, we use the perspective of IS effectiveness to evaluate relative factors. We grouped three quality variables to influence intimacy and continuance intention: design quality, information quality, and service quality. The IS success model has been proposed to explain the effect of user behavior on mobile apps. Our findings suggest that design quality, information quality, and service quality impact intimacy, which in turn affects continuance intention. The findings imply that providing design quality and enhancing intimacy is the key to app success.

Keywords: Design quality; Information quality; Service quality; Intimacy; Information systems success model

## 1. Introduction

Mobile applications (apps) are software programs designed to be used on mobile devices, such as mobile phones and tablet computers. On average, users install 40 apps on their mobile phones, but they commonly use only a relatively small percentage (Simform, 2020). That is, many apps installed on the phone are rarely used or even not used, which shows a bridge between designers and users, and there must be key factors that affect their use.

Designing a popular app is not an easy task. Several key factors must be considered. A good app must provide an adequate level of worth, utility, and importance to meet users' jobs to be done in a given circumstance (Clayton et al., 2016). Hence, Sweeney et al. (1996) categorized consumption concerns into three aspects: functional, social, and emotional values. Hsu and Lin (2015) proposed an expectation-confirmation model for mobile apps that emphasizes

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that the three perceived values and purchase intention are closely linked. Mohammad et al. (2020) organized and distinguished functional and emotional values from the structure of user-generated content. Therefore, it is important to create value for the design and use of apps. In order to be portable, mobile phones are usually designed to be small and exquisite. Because of limits on screen size, it is not easy for mobile phone users to select objects and enter text. Therefore, for mobile applications, user interface design is relatively important. In addition, mobile apps are different from web apps because they are not limited by browser features and can be designed to be more personalized, interesting, and friendly. For example, even if the users are offline, their behavior can be easily tracked by mobile apps, and notifications can be sent promptly. Although mobile apps are not as easy to operate as traditional systems, they can bring different values through user experience. Consequently, user experience is the key to the success of the app.

Given the popularity of app usage, a large number of studies have examined theories that can explain how apps are used by users. Existing research adopts three main perspectives to predict the effects of mobile apps on user behavior. One perspective is based on the assumption of habit/automaticity. For example, Liu et al. (2018) studied the effect of repetition of past behavior and sense of belonging on continuance behavior. By adopting the theory of reasoned action and the theory of planned behavior, the researchers found that the frequency of past behavior positively influences usage habits on continuance behavior. Hence, user habits and frequency of past behavior are the main reasons why app usage is popular among customers. The second is the relation–utility perspective. Tseng and Lee (2018) adopted the parasocial interaction theory and proposed a dual-route perspective. One route is the relationship route, which provides brand benefits to trigger interactions between users and apps. The other route is utility, which dictates the effect of information systems (IS) quality on users' perception of usefulness. Both affective and utilitarian factors facilitate the continuance intention of app usage.

The third perspective is IS effectiveness. Apps are computer-based IS. A well-known theory on IS effectiveness is the IS success model proposed by DeLone and McLean (2003), which includes information quality, system quality, and service quality as three key dimensions determining user satisfaction, intention to use, and net benefits. Our concern for adopting the IS success model is its quality elements that fit the app context. First, system quality refers to the Internet environment. An app design should be used in such an environment to communicate, interact, transact, download, and upload. Second, an information system refers to the content feature issue. The app content feature should be personalized, multilateral, easy to operate, and secure. Service quality refers to overall service support from the operating process to the performance outcome. Another concern is that although the app interface is different and unique compared to website design, the primary uses and utility of the app framework are similar to other web-based systems. Therefore, the IS success model can be extended to measure app success (Wang et al., 2009).

Although the IS success model has provided three key factors, it does not highlight the importance of non-pragmatic factors, such as aesthetics and enjoyment, nor does it include relational factors. Recently, the overall user experience when using an application system has been regarded as a vital indicator for evaluating the success of a system (Brade et al., 2017; Distler et al., 2019; Hassenzahl & Tractinsky, 2006; Law & Van, 2010; Sutcliffe & Hart, 2017). It is important to enhance a better user experience when using an app, not only how it works, but also how it feels and what it looks like (Hassenzahl, 2003; Hassenzahl & Tractinsky, 2006; Minge & Thüning, 2018). The three key factors in the IS success model (i.e., system quality, information quality, and service quality) mainly focus on functional and technical elements—important for users to complete their tasks on a system—while ignoring other hedonic elements that may influence users' feelings when using the system. Recent studies have indicated that design quality is very important for IS. Good app design can meet user preferences and their needs for a better service experience. For instance, a recent app usage survey indicated that well-designed apps are popular and viewed as useful tools. Good design can increase the apps' daily uses (e.g., Americans 3 hours, UK 2.8 hours, Korean 3.6 hours, and Japanese 3.3 hours) (Iqbal, 2020). Khalid et al. (2014) depicted that app quality is reflected on ratings and reviews that affect the app's popularity and revenue. Therefore, it is important to explore how design factors (e.g., aesthetics, enjoyment, interactivity, and mobility) may foster relationships with users and persuade them to continue using the apps.

In addition to going beyond usability, user experience also emphasizes establishing interactions to stay connected with users (Hassenzahl & Tractinsky, 2006; Sutcliffe & Hart, 2017). In other words, when examining the success of an app from the perspective of user experience, the impact of relationship bonds should also be considered. A typical relationship assessment in marketing is relationship quality. However, it is inadequate to measure the very close relationship between users and their mobile devices. Recent studies indicate that the relationship between users and their mobile devices is beyond that between humans and products. For instance, Konok et al. (2016) found that “young people readily develop attachment toward their phone: they seek the proximity of it and experience distress on separation.” Konok et al. (2017) called this phenomenon “mobile attachment”—humans form attachment toward their mobile, similar to their social attachment. Hence, new concepts need to be introduced when studying human-mobile

relationships. In such a service relationship, Stern (1997) proposed that intimacy can be used to evaluate relationships with users. Intimacy, the feeling of closeness, includes five dimensions to highlight the importance of responding users' needs. These five dimensions are communication, caring, trust, comfort, and commitment; they bring about a better user experience, rather than just measuring exchange relationship. When examining the success of an app from a user experience perspective, it is appropriate to use intimacy in the IS success model. The main purpose of this study is to adopt the antecedents associated with system design from the IS success model, but not the outcome variables, such as net benefits. Further, the impact of app design can be fully understood in terms of the relationship between intimacy and continuance intention. Therefore, satisfaction, net benefit, and the relationship between the two constructs are not our concerns in the theoretical model.

Given the above background, two innovative concepts are introduced in this paper: one is "intimacy," which is frequently used for close human relationships (Liang, 2009). The other concept is the extension of the IS success model with the design quality. This study intends to answer the following questions: (1) Can intimacy be an effective measure of human-mobile relationships?; (2) Can design quality induce intimacy?; and (3) Does intimacy have a positive effect on continuance intention?

The remainder of this paper is organized as follows. The next section reviews the literature on IS success model, design quality, and intimacy. This is followed by the research model and the hypotheses in Section 3. Research methods and data analysis are provided in sections 4 and 5, respectively. The sixth section reports the contributions, implications, and limitations of this study. Finally, the seventh section concludes the paper.

## 2. Literature Review

### 2.1. Information Systems Success Model

The overarching theory of this research is the IS success model developed by DeLone and McLean (1992) to analyze the effectiveness of IS artifacts. The original model includes six constructs that drive IS success: system quality, information quality, use, user satisfaction, individual impact, and organizational impact. DeLone and McLean (2003) replaced individual and organizational impacts with "service quality" and "net benefits." The refined model posits that information quality, system quality, and service quality enhance user satisfaction and intention to use, which strongly contribute to net system benefits (DeLone & McLean, 2003). DeLone and McLean (2004) applied the model to investigate e-commerce businesses, including Barnes & Noble and ME Electronics, to show that the IS success model is a useful framework and theoretical base for investigating quality factors that influence technology use.

The IS success model is important for technology use, as it has been frequently adopted in the IS literature, showing its wide applicability. Previous studies explained that users found functional value from quality factors (Hsu & Chen, 2007), and such quality factors enhance the trust that strengthens continuance intention for technology use (Teo et al., 2008). Moreover, user satisfaction and intention lead to actual technology use (Mohammadi, 2015). These prior studies show the importance of IS quality, suggesting the usefulness of the IS success model in explaining how quality factors impact technology use.

Quality factors strengthen the perceived value (Wang et al., 2019), perceived switching value (Lin et al., 2017), perceived enjoyment (Cheng, 2012), perceived usefulness, and perceived ease of use (Zhou et al., 2018) that affect continuance intention. In addition, some prior research has focused on how quality factors influence personal experiences and habits. Flow (Lee & Kim, 2017) and inertia (Wang et al., 2019) motivated by quality factors were found to influence continuance intention. Moreover, the relationship factors are also impacted by quality factors. Information quality, system quality, and service quality increase trust (Gao & Waechter, 2017) and commitment (Wang et al., 2016) in the context of technology use. The influence of quality factors on satisfaction with website design (Valaei & Baroto, 2017) and shopping platform (Chen, 2018) was also found to affect continuance intention.

Among these identified factors, design quality was not included. This new dimension is important as apps on mobile devices are highly attached to the user. Contrary to traditional IS software that focuses on functionality, well-designed apps are more likely to attract eyeballs and are more enjoyable by the user. Hence, it is necessary to add design quality as a new dimension when applying the model to study mobile apps.

### 2.2. Design Quality as an Important Dimension of User Experience

Apps are software applications on mobile devices; they offer personalized services. Studies have shown the importance of design quality in mobile apps. For example, Jung (2017) found that design quality can directly influence users' usability and intention to use the app. As long as users perceive app design as useful and enjoyable, they will increase their intention to continue its usage (Hsiao et al., 2016). In other words, app usage is an important factor in investigating usage behavior, and design quality can build close relationships between users and apps. Therefore, the design factors of app usage have a significant influence on use behavior. The existing literature has shown the role of well-designed apps and their effect on the intention to adopt apps (Hoehle & Venkatesh, 2015). The design quality is

different from the traditional view of system quality in that it focuses on user experience that covers both utilitarian and hedonic purposes (Fang et al., 2017). For mobile apps, in addition to system quality, certain design features associated with the mobile context and user experience must also be included.

User experience goes beyond usability and refers to a user's perceptions after using a product, system, or service [ISO 9241-210 2010]. Human-computer interaction (HCI) has become an important factor for exploring the interactions between a system and its users (Brade et al., 2017; Hassenzahl & Tractinsky, 2006; Minge & Thüring, 2018). Hassenzahl (2003) argued that when using an information system, users will perceive two qualities: pragmatic quality and hedonic quality. Pragmatic quality is related to instrumental features, such as a system's features or usability. Hedonic quality is related to pleasure features, such as the enjoyment of a system. In addition to system quality, which may be related to user interface design, key elements in the user experience should also be considered, including aesthetics, enjoyment, mobility, and interactivity (Zarour & Alharbi, 2017).

*Design aesthetics.* Design aesthetics, also known as a visual design (Cyr et al., 2006), visual aesthetics (Bhandari et al., 2017), and aesthetic experience (Hekkert, 2006), can be defined as the pleasurable perception of beauty and art (Hekkert, 2006). In the IS literature, design aesthetics is thus defined as a general arrangement of visual design to a human-computer interface. The IS literature suggests four dimensions of design aesthetics: coherence, complexity, legibility, and mystery (Rosen & Purinton, 2004). Coherence refers to the elements of the design landscape gathered together. Complexity refers to elements that create richness in a setting. Legibility refers to the degree to which it is clear to read or see. Mystery refers to a design landscape that is strange and interesting. Therefore, creating high levels of design aesthetics requires making user perceptions unique, rich, clear, and interesting. High levels of design aesthetics imply that there is a greater positive outcome for IS experience. When design aesthetics is high, playfulness and satisfaction are greater (Coursaris & Osch, 2016). Design aesthetics involves the meaning of pleasure attached to beauty or art. Therefore, design aesthetics can foster greater enjoyment and engagement (Suh et al., 2015). In this sense, users prefer specific aesthetic systems to others. In other words, individuals feel the usefulness and user-friendliness of aesthetic systems (Cyr et al., 2006). As a result, trust between users and technology systems has been enhanced through design aesthetics (Li & Yeh, 2010).

*Enjoyment.* Enjoyment is a popular construct for predicting loyalty and is a key element in marketing and psychology. It refers to the process of gaining joyful experiences using information technology (Shao, 2018). In other words, the feeling of enjoyment is attached to the interaction with technology. The design and quality of websites are important factors that influence enjoyment (Hwang & Kim, 2007). Cheng (2012) found that service quality, system quality, information quality, and instructor quality enhance enjoyment and further increase usage intention in the e-learning context. Therefore, enjoyment plays a key role in the design and quality of IS. Previous studies have included enjoyment in extending technology adoption models. For instance, the extended expectation-confirmation model argues that enjoyment is one of the main factors that trigger IT continuance usage (Thong et al., 2006). Integration of the technology acceptance model and IS success model shows that enjoyment may increase the intention to use e-learning (Cheng 2012). Personality theory argues that two Big Five factors (i.e., neuroticism and agreeableness) have direct effects on enjoyment and influence on satisfaction and continuance intention in technology use (Wang et al., 2012). Such IS literature shows that enjoyment plays an important role in human-technology interaction and has been used to extend existing theoretical models.

*Mobility.* Mobility refers to the extent to which users perceive value from the quality of mobile services and systems (Park et al., 2014). In mobile services, the value of mobility emphasizes real-time information, convenience, and reduced limitations by time and space. These advantages indicate that mobility strengthens the connection with the world, resources, and individuals via mobile services (Kwon et al., 2014). Therefore, mobility can motivate users' intention to search for information and react to contextual stimuli. Previous studies have suggested that mobility tends to be more ubiquitous, instantly connected, portable, and linked with many positive factors. For instance, IS studies found that mobility with perceived enjoyment and satisfaction jointly explain post-usage attitudes (Lu et al., 2017). Furthermore, mobility plays a moderating role in ease of use and continuance usage (Li et al., 2019). In the extended technology acceptance model, mobility can influence continuance intention via usefulness and ease of use (Wang et al., 2014). Moreover, the level of mobility influences users' cognition, causing different behavioral modes of technology usage (Bell et al., 2009). In other words, prior studies are consistent with the fact that mobility is important for IS continuance use.

*Interactivity.* Interactivity has received much attention and is a key construct in human-computer interaction. Interactivity refers to the mental state that an individual experience in allowing information to be passed mutually between technological media and the individual using it (Hoffman & Novak, 1996). The concept of interactivity focuses mainly on the perception of users using technological media in communication (Ziegele et al., 2014). In other words, technological media and communication form are two key elements that influence levels of interactivity, reflecting whether users' perceptions may affect attitude and behavior intention. Previous studies on interactivity have

found a positive impact on communication. For example, Koolstra and Bos (2009) found that high interactivity is more helpful for information processing. In information exchange, frequent interactivity motivates high involvement and forms attitudes toward using websites (McMillan et al., 2003). Li et al. (2015) found that website interactivity has a positive effect on consumer attitudes toward mobile advertising. Some studies have argued that technological media influences interactivity. Speed, mapping, and range explained how quickly, precisely, and broadly the content shows in the mediated environment, thereby strengthening interactivity (Yim et al., 2017). Such technology use increases interactivity clearly and effectively and shifts the understanding of the communication process.

### 2.3. Intimacy – A Relationship Mediator

Since mobile devices have become close partners in the daily lives of modern users, the relationship between mobile services and users is critical to their usage. Hence, we further enhance the IS success model by introducing a relationship mediator, intimacy. The design factors that affect system usage through customer–object relationships have long attracted attention in relationship marketing (Aaker et al., 2004; Ahuvia, 2005; Fournier, 1998; Novak & Hoffman, 2019; Shimp & Madden, 1988). Novak and Hoffman (2019) identified four consumer–object relationships, including master–servant relationships (two types), partner relationships, and unstable relationships. Shimp and Madden (1988) argued that the emotional connections between a consumer and an object are similar to connections with people.

Relationships have been used as a popular construct in marketing research. For example, Fournier (1998) regarded brands as relationship partners and proposed a model of brand relationship quality, in which six factors combine to produce relationship strength and durability, including love/passion, intimacy, commitment, interdependence, self-connection, and brand partner quality. In addition, Aaker et al. (2004) contended that the relationship between consumers and an online brand might be composed of four factors: intimacy, commitment, satisfaction, and self-connection. These factors capture the noteworthy conceptualization of interpersonal literature. However, Sarkar et al. (2012) highlighted the importance of deriving the structure of the consumer–object relationship from Sternberg’s (1986) triangular theory of love. They proposed that intimacy and passion are the two main components of romantic brand love. Commitment was not included in their scale because it was derived from cognition rather than emotional connections. Based on the above discussion, existing research has different views on the dimensions of relational bonding between consumers and objects. It seems that intimacy is the intersection of all arguments. Gradually, intimacy has become a popular construct to explore consumer–object relationships, especially the relationship between consumers and smart IT artifacts (Kim et al., 2015; Lee & Kwon, 2011; Liang et al., 2009).

Intimacy can be defined as a state of closeness in a relationship (Liang et al., 2009). This relationship can be referred to as interpersonal, involving family, friends, and acquaintances. IS research has extended intimate relationships with human–computer, human-brand, and human-technology in different contexts. In a service relationship, intimacy can be categorized into five key components: communication, caring, trust, comfort, and commitment (Stern, 1997). The five components can be considered indicators of relationship quality between customers and service providers (Liang et al., 2009). Communication refers to customers’ perceptions of their needs or desires to be understood. Caring implies that customers feel taken care of. These two concepts emphasize the importance of considering customers’ needs and wishes during interactions. This is the main feature of communal relationships representing relationship closeness (Clark & Mills, 1979). Liang et al. (2009) combined these two factors. Commitment refers to a customer’s psychological attachment to maintain the relationship. Affective commitment is different from the cognitive commitment commonly used in relationship quality literature (Morgan & Hunt, 1994). Affective commitment is more appropriate than cognitive commitment when exploring emotional bonding with customers (Sternberg, 1986). Moreover, comfort refers to an emotional state evoked by the overall evaluation of a service relationship. Finally, trust refers to the customers’ feeling that the online retailer is honest and benevolent. These five components of emotional intimacy are shared by all intimate relationships and contribute to relationship quality. In this sense, the study adopts components to measure intimacy.

Intimacy is a mutual development from strangeness to familiarity between users and technology use. In other words, unfamiliarity gradually develops into intimate interactions and cumulates intimate behavior and experience (Prager, 1995). Such intimate behavior and experience form a positive relationship between customers and businesses. For example, trust enhances customer intimacy, hence it increases customer loyalty (Tabrani et al., 2018). Furthermore, uniqueness and hedonic values influence intimacy, resulting in a premium price (Kang, 2018). Intimacy strengthens word-of-mouth, repurchase intentions, and information sharing (Brock & Zhu, 2012). In this sense, post-intimacy behavior can form positive results and benefits to businesses.

### 3. Research Model and Hypothesis

This section presents our research model, which customizes the traditional IS success model for mobile apps. The mobile phone is a carry-on item and is limited by screen size. A more intimate interface design is required to provide

better user experience. Hassenzahl (2003) argued that the wonderful user experience comes not only from pragmatic features but also hedonic features. However, the three antecedents of the IS success model lack suitable hedonic features. Design quality includes both utilitarian and hedonic factors that may make up this part and create a greater user experience (Fang et al., 2017). In addition, meaningful interactions created based on user experience design may help develop users' bonding to mobile services (Konok et al., 2016). Such a relationship goes beyond the traditional exchange relationship and is similar to a close relationship with users. Stern (1997) argued that intimacy is a holistic factor that can be used to investigate close relationships with users. Applying this factor to the IS success model will emphasize the importance of user experience. Therefore, key extensions include: (1) defining and adding design quality as a new antecedent for measuring the continuous use of mobile apps; and (2) defining and adding intimacy as the mediator between antecedents and outcome variables. The emotional bonding factor—intimacy mediates the effect of user experience on the intention to continue using apps. Both pragmatic and hedonic attributes of user experience are included. Design quality includes system quality, and several designs features represent pragmatic and hedonic attributes, while the information quality and service quality proposed in the IS success model represent pragmatic attributes. Figure 1 illustrates the research model. The corresponding hypotheses are as follows.

3.1. The Effect of Design Quality

Design quality refers to the general arrangement of the different parts of the IS interface. The design quality comprises five elements. Aesthetics indicates pleasure in the sense of sight (Hekkert, 2006). In the app context, design aesthetics can bring pleasure to individuals who appreciate the beauty of app content. Such visual effects can help leave a good impression on them and produce better interactive experiences, thereby building an intimate bond with them (Seo et al., 2016). In addition, high design quality can bring pleasure during or after activities (Shao, 2018). Users feel excited when interacting with the app's function and content during app use. Therefore, users' positive feelings and experiences contribute to forming emotional bonds with the apps (Kim, 2017).

Mobility refers to the convenience of app services that can be used anywhere at any time (Park et al., 2014). When mobility is high, individuals can use app services to meet their needs without considering time and space, indicating high design quality. Interactivity refers to mutual communication that allows information to be passed between individuals and the computer (Hoffman & Novak, 1996). In the app context, when interactivity is high, information exchange is frequent and enduring, indicating good design quality. Mobility and interactivity bring a better user experience when using the apps, making it easy for users to feel close to the apps (Lin et al., 2017).

Finally, system quality refers to a system that can easily exchange information with features of accessibility, flexibility, integration, reliability, and quick response time (DeLone & McLean, 2003). In the app context, high system quality allows users to easily access and integrate flexible use of information processing and sharing, indicating that such a system is reliable and therefore enhances the state of reducing psychological distance (Liang et al., 2009; Sun, 2010; Zhou & Jia, 2018). Hence, the following hypothesis is posited:

**H1: Design quality is positively related to intimacy.**

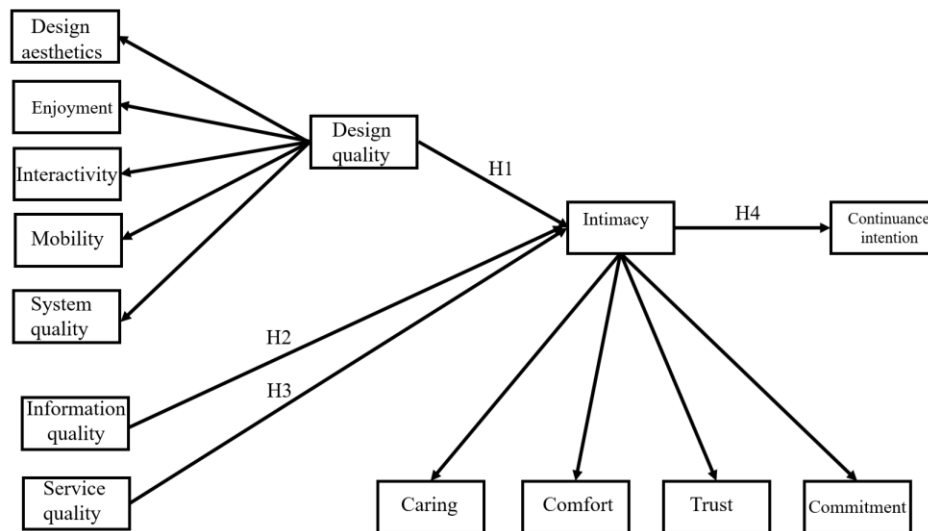


Figure 1: The Research Model

### 3.2. The Effect of Information Quality and Service Quality

Information quality refers to the relevance, accuracy, timeliness, and completeness of information processing (DeLone & McLean, 2003). In the app context, information display is the main method through which apps communicate or respond to users. Therefore, high information quality can be considered as effective communication or response in interactions with users. Such interaction experiences would form the foundation of relationship building and are the key factors for users to consider when maintaining relationships with mobile apps (Canevello & Crocker, 2010; Ponder et al., 2016; Reis et al., 2004).

Moreover, when the information presented by apps is relevant, accurate, recent, and complete, it would be useful to users and may bring value or benefits to them. Research in relationship marketing has highlighted the importance of perceived value and perceived benefit to relationship quality (Hennig-Thurau et al., 2002; Moliner et al., 2007; Morgan & Hunt, 1994; Sun, 2010). High information quality allows individuals to perceive the effectiveness of the app and increase operating frequency. Frequent contact can be a state of close relationships (Liang et al., 2009). Thus, we hypothesized the following:

***H2: Information quality is positively related to intimacy.***

Service quality refers to information services, such as reliability, responsiveness, assurance, and personalization (DeLone & McLean, 2003). In the app context, providing high service quality reflects reliable service and tailored responses to users, which can build up intimacy with users (Canevello & Crocker, 2010; Reis et al., 2004). When the services provided by mobile apps meet the needs of users and help them achieve their goals, they may convey understanding and warmth to users. These high-quality services may give users a sense of understanding, caring, comfort, trust, and commitment, and bring users a pleasant interactive experience (Liang et al., 2009; Stern, 1997). Thus, we hypothesized the following:

***H3: Service quality is positively related to intimacy.***

### 3.3. The Effect of Intimacy

Continuance intention refers to the intention to repeat use or long-term technology use (Bhattacharjee, 2001). Continuance intention implies that users intend to increase or strengthen their technology use after the initial experience of use. In other words, post-use performance impacts continuance intention (Chou & Chen, 2009). For example, in information and communication technology, interaction factors such as social presence and interaction quality are key determinants of continuance intention (Mirkovski et al., 2017; Wang et al., 2019). In addition, from the perspective of user experience design, the factors that result from the interaction experiences with a service are vital predictors of a user's continuance intention (Hassenzahl & Tractinsky, 2006; Sutcliffe & Hart, 2017).

Intimacy generated by interaction experiences refers to a state of closeness between both sides (Liang et al., 2009). High intimacy can strengthen close relationships, which build up frequent connections and form the long-lasting binding. Many studies have shown the effect of intimacy on IT services. Lee and Kwon (2011) demonstrated that intimacy with web-based services affected users' intention to continue using these services. In addition, Kim et al. (2015) argued that the intimacy of m-shopping could enhance consumers' perception of the utilitarian value and hedonic value of m-shopping and further contribute to their use. In the app context, long-lasting and repeated use of an app is an essential part of emotional bonding. Thus, we hypothesized the following:

***H4: Intimacy is positively related to continuance intention.***

## 4. Methods

### 4.1. Sample and Data Collection Processes

Using an online questionnaire survey to collect data, we invited participants to self-report personal information on app design quality, information quality, service quality, intimacy, and continuance intention. We disseminated the link to Facebook and PTT (Taiwan's largest bulletin board system). Therefore, social networking users should characterize the sample population. 440 questionnaires were collected. Two criteria were used to identify and exclude invalid responses. First, we excluded responses with the same consecutive answers for more than one-fifth of the questionnaire items. Second, we removed incomplete responses, obvious random answers, and duplicate participation. The remaining valid responses were 434. Table 1 summarizes the sample profiles. To increase the willingness of the participants to fill in, we gave away free movie tickets to 30 participants from the valid questionnaires and US\$5 of supermarket coupons to 20 participants. In addition, valid questionnaire participants in PTT were given 100p coins as a reward. The total reward was worth US\$350.

Table 1: Summary of the Sample Profile

Variable	Category	Number	Percentage
<b>Gender</b>	Male	217	50%
	Female	217	50%
<b>Age</b>	15-17 years old	12	2.8%
	18-20 years old	106	24.4%
	21-30 years old	296	68.2%
	31-55 years old	20	4.6%
<b>Type of App</b>	Games	49	11.2%
	Photo	19	4.3%
	Social media	352	81.1%
	Production	14	3.2%
<b>Platform used to app</b>	Cell phone	390	89.8%
	Personal P.C.	39	8.9%
	Tablet	5	1.1%
<b>Daily hours of use of the app</b>	Below 1 hour	21	4.8%
	1-3 hours	156	35.9%
	3.1-5 hours	163	37.5%
	5.1-7 hours	58	13.3%
	Above 7.1 hours	36	8.2%

#### 4.2. Measurement

Most measurement items were adapted from the existing literature. The measurement of design aesthetics was taken from Cyr et al. (2006). Items measuring enjoyment were taken from Van der Heijden (2004). Three items measuring mobility were taken from Park et al. (2014). Five items measuring interactivity were derived from Wu and Wu (2006). The three items measuring system quality were obtained from Zhou (2011). Three items measuring information and service quality were obtained from Zhou (2011). The items measuring intimacy were from Liang et al. (2009). Items measuring continuance intention were obtained from Bhattacharjee (2001). All questions were answered on a Likert scale ranging from 1 (strongly disagree) to 7 (strongly agree). Table 2 presents the constructs and items.

A recent study demonstrated four criteria of reflective models for Partial least squares (PLS) in IS research. The four criteria of reflective models suggest that “(1) Reflective indicators are manifestations of the construct. (2) Reflective indicators should have the same or similar content that shares a common theme. (3) Reflective indicators must be varied. (4) Reflective indicators are required to have the same antecedents and consequences.” (Urbach & Ahlemann, 2010). In terms of intimacy in our reflective model, intimacy theory (Stern, 1997) has been used to explain the quality of human relationships in which communication, caring, commitment, comfort, and trust have been chosen to operationalize the concept. As for design quality, Palmer and Griffith (1998) suggested that IS design should contain technical characteristics and marketing functions. Furthermore, Liu and Amett (2000) identified the critical success of website design, including playfulness, system quality, information quality, service quality, and system use. Several studies have added navigation, aesthetic quality, and interactivity as design features of apps (Faisal et al., 2020; Jiang et al., 2010). Therefore, two reflective second-order constructs were proposed according to the reflective criteria, related theory, and previous literature.



Table 2: Constructs and Items

Construct/Dimension	Measurement Items	Item sources
Design aesthetics	<ul style="list-style-type: none"> <li>● The app design (i.e., colors, boxes, menus, etc.) is attractive.</li> <li>● The overall look and feel of the app are visually appealing.</li> <li>● The app graphics are meaningful.</li> </ul>	Cyr et al. (2006)
Enjoyment	Use of this app is <ul style="list-style-type: none"> <li>● Interesting – boring</li> <li>● Enjoyable – disgusting</li> <li>● Exciting – dull</li> <li>● Pleasant – unpleasant</li> </ul>	Van der Heijden (2004)
Mobility	<ul style="list-style-type: none"> <li>● App mobility is an outstanding advantage of carrying.</li> <li>● App mobility makes it possible to get real-time data.</li> <li>● It is convenient to use this app anytime and anywhere.</li> </ul>	Park et al. (2014)
Interactivity	<ul style="list-style-type: none"> <li>● I could communicate with the app directly for further questions if I wanted to.</li> <li>● I feel autonomous when using the app.</li> <li>● I can easily use the app functions and interface if I wanted.</li> <li>● The app had the ability to respond to my specific questions quickly and efficiently.</li> <li>● I perceived the app to be sensitive to my needs for information.</li> </ul>	Wu and Wu (2006)
System quality	<ul style="list-style-type: none"> <li>● The app is reliable.</li> <li>● The navigation of the app is effective.</li> <li>● The layout of the app is easy to use.</li> </ul>	Zhou (2011)
Information quality	<ul style="list-style-type: none"> <li>● The information provided by the app is up-to-date.</li> <li>● The information provided by the app is comprehensive.</li> <li>● The information provided by the app is accurate.</li> </ul>	Zhou (2011)
Service quality	<ul style="list-style-type: none"> <li>● The app provides timely service.</li> <li>● The app provides professional responses to my questions.</li> <li>● The app provides personalized services.</li> </ul>	Zhou (2011)
Intimacy	Caring: I feel <ul style="list-style-type: none"> <li>● The app knows my preference.</li> <li>● The app knows my needs for service and information.</li> <li>● The app cares and can satisfy my demands.</li> <li>● The app concerns my demands.</li> <li>● The app can analyze and understand my demands.</li> </ul> Comfort: When I interact with the app, <ul style="list-style-type: none"> <li>● I feel relaxed.</li> <li>● I feel peaceful.</li> <li>● I feel comfortable.</li> </ul> Trust <ul style="list-style-type: none"> <li>● I feel the use of the app is secure.</li> <li>● I feel the app provider can be trustworthy.</li> <li>● I feel the app provider has high integrity.</li> </ul> Commitment <ul style="list-style-type: none"> <li>● I feel content if I have a chance to continue using the app.</li> <li>● I feel happy if I have a chance to continue using the app.</li> <li>● I have a sense of identity with the app.</li> </ul>	Liang et al. (2009)
Continuance intention	<ul style="list-style-type: none"> <li>● I intend to continue using the app rather than discontinue its use.</li> <li>● If I could, I would like to continue my use of this app.</li> <li>● My intention is to continue using the app than use any alternative app.</li> </ul>	Bhattacharjee (2001)

## 5. Data Analysis

### 5.1. Reliability and Validity Testing

PLS and SPSS 24 were adopted to examine the reliability, convergent validity, and discriminant validity to measure the fitness of this model. Items assessing each construct had a Cronbach's alpha  $> .78$  and composite reliability  $> .87$ , showing sufficient reliability. The average variance extracted (AVE) for each dimension was  $> .69$ , showing acceptable reliability. Table 3 presents the results of reliability testing.

In the validity analysis, all items had factor loadings  $> .73$ , displaying acceptable convergent validity (Hair et al., 1998). In addition, the square root of AVE for each construct is larger than the correlation coefficients among any pair of constructs in the associated column and row, indicating acceptable discriminant validity (Fornell & Larcker, 1981). In the cross-loading matrix, each item's correlation coefficient is larger than the other factor loadings in other dimensions, showing sufficient discriminant validity (Chin, 1998). Tables 4 and 5 present the results.

Table 3: Results of Cronbach's Alpha, Composite Reliability, AVE

Construct/dimension	Items	Cronbach's Alpha	Composite Reliability	AVE
Design aesthetics	3	0.916	0.947	0.873
Enjoyment	4	0.888	0.923	0.758
Interactivity	5	0.859	0.894	0.520
Mobility	3	0.854	0.911	0.810
System quality	3	0.808	0.887	0.767
Information quality	3	0.797	0.881	0.612
Service quality	3	0.780	0.872	0.678
Caring	5	0.916	0.936	0.785
Comfort	3	0.950	0.968	0.904
Trust	3	0.890	0.932	0.833
Commitment	3	0.861	0.915	0.809
Continuance intention	3	0.839	0.903	0.761

Table 4: Correlations among Constructs

	DS	EN	IC	INFQ	SER	CA	CF	CM	INT	MP	SYSQ
DS											
EN	0.495										
IC	0.368	0.404									
INFQ	0.342	0.412	0.611								
SER	0.266	0.230	0.521	0.520							
CA	0.301	0.307	0.498	0.528	0.570						
CF	0.443	0.562	0.516	0.557	0.466	0.442					
CM	0.361	0.437	0.396	0.493	0.359	0.367	0.554				
INT	0.429	0.470	0.502	0.537	0.346	0.332	0.622	0.705			
MP	0.223	0.347	0.422	0.370	0.250	0.260	0.300	0.193	0.328		
SYSQ	0.465	0.409	0.655	0.617	0.472	0.407	0.567	0.524	0.620	0.366	
TT	0.456	0.298	0.353	0.410	0.389	0.353	0.545	0.482	0.495	0.088	0.541

**Note.** CF: comfort; CM: commitment; DS: design aesthetics; EN: enjoyment; IC: interactivity; INFQ: information quality; INT: continuance intention; MP: mobility; SER: service quality; SYSQ: system quality; TT: trust; CA: caring.

Table 5: Cross Loadings

	CA	IC	TT	EN	CM	INT	SER	CF	MP	SYSQ	DS	INFQ
CA1	0.824	0.393	0.140	0.312	0.234	0.218	0.393	0.335	0.328	0.300	0.250	0.471
CA2	0.882	0.444	0.257	0.302	0.286	0.281	0.477	0.359	0.327	0.359	0.258	0.508
CA3	0.863	0.477	0.446	0.284	0.395	0.388	0.554	0.449	0.184	0.441	0.325	0.467
CA4	0.876	0.450	0.410	0.223	0.370	0.305	0.559	0.420	0.136	0.347	0.276	0.421
CA5	0.874	0.370	0.209	0.214	0.265	0.211	0.446	0.320	0.178	0.285	0.172	0.418
IC1	0.318	0.689	0.133	0.191	0.185	0.347	0.239	0.262	0.435	0.444	0.206	0.386
IC2	0.350	0.743	0.212	0.268	0.218	0.352	0.316	0.356	0.340	0.374	0.218	0.389
IC3	0.352	0.828	0.326	0.398	0.361	0.478	0.422	0.505	0.382	0.557	0.288	0.524
IC4	0.360	0.805	0.314	0.366	0.371	0.417	0.393	0.421	0.320	0.593	0.364	0.499
IC5	0.458	0.777	0.335	0.345	0.365	0.416	0.493	0.447	0.272	0.567	0.311	0.596
TT1	0.284	0.307	0.915	0.234	0.410	0.436	0.341	0.470	0.053	0.492	0.397	0.341
TT2	0.328	0.289	0.925	0.246	0.407	0.406	0.369	0.489	0.046	0.440	0.400	0.339
TT3	0.345	0.359	0.874	0.323	0.490	0.499	0.346	0.518	0.136	0.533	0.438	0.430
EN1	0.256	0.368	0.214	0.910	0.357	0.420	0.172	0.480	0.375	0.378	0.424	0.385
EN2	0.286	0.350	0.299	0.901	0.377	0.389	0.221	0.514	0.286	0.337	0.502	0.335
EN3	0.297	0.367	0.222	0.860	0.368	0.399	0.142	0.440	0.269	0.334	0.369	0.391
EN4	0.224	0.314	0.300	0.792	0.417	0.425	0.265	0.517	0.269	0.369	0.419	0.316
CM1	0.319	0.327	0.391	0.406	0.897	0.676	0.310	0.508	0.200	0.451	0.283	0.441
CM2	0.296	0.288	0.400	0.340	0.911	0.592	0.271	0.428	0.103	0.394	0.265	0.358
CM3	0.354	0.427	0.483	0.409	0.845	0.599	0.367	0.527	0.203	0.537	0.403	0.502
INT1	0.275	0.415	0.410	0.485	0.593	0.874	0.265	0.540	0.328	0.556	0.431	0.472
INT2	0.290	0.452	0.462	0.432	0.642	0.915	0.317	0.605	0.293	0.556	0.358	0.506
INT3	0.304	0.442	0.419	0.308	0.605	0.820	0.322	0.474	0.234	0.507	0.332	0.422
SER1	0.422	0.418	0.314	0.186	0.225	0.248	0.856	0.410	0.239	0.336	0.148	0.386
SER2	0.543	0.508	0.404	0.189	0.378	0.364	0.882	0.406	0.179	0.473	0.303	0.479
SER3	0.448	0.362	0.235	0.203	0.279	0.237	0.757	0.349	0.218	0.354	0.195	0.428
MP1	0.194	0.381	0.078	0.356	0.135	0.284	0.228	0.264	0.879	0.343	0.220	0.318
MP2	0.264	0.348	0.061	0.260	0.166	0.246	0.196	0.237	0.854	0.272	0.168	0.284
MP3	0.235	0.381	0.092	0.292	0.211	0.330	0.232	0.288	0.904	0.345	0.196	0.370
SYSQ1	0.359	0.553	0.564	0.295	0.457	0.515	0.470	0.467	0.220	0.858	0.436	0.539
SYSQ2	0.360	0.574	0.461	0.361	0.468	0.539	0.417	0.507	0.281	0.894	0.408	0.525
SYSQ3	0.318	0.543	0.353	0.388	0.411	0.529	0.315	0.473	0.439	0.799	0.340	0.512
CF1	0.418	0.486	0.511	0.549	0.534	0.608	0.403	0.952	0.299	0.525	0.416	0.539
CF2	0.408	0.478	0.499	0.523	0.520	0.572	0.461	0.948	0.277	0.536	0.424	0.510
CF3	0.437	0.512	0.548	0.536	0.531	0.599	0.470	0.961	0.282	0.562	0.427	0.542
DS1	0.265	0.299	0.363	0.463	0.282	0.346	0.197	0.385	0.198	0.378	0.918	0.253
DS2	0.287	0.336	0.422	0.432	0.308	0.375	0.265	0.378	0.195	0.431	0.941	0.287
DS3	0.283	0.381	0.474	0.478	0.405	0.462	0.274	0.462	0.225	0.476	0.917	0.402
INFQ1	0.370	0.495	0.465	0.401	0.457	0.481	0.387	0.539	0.207	0.535	0.354	0.797
INFQ2	0.491	0.516	0.303	0.312	0.401	0.456	0.462	0.445	0.389	0.521	0.247	0.876
INFQ3	0.481	0.535	0.251	0.320	0.381	0.415	0.469	0.411	0.350	0.499	0.255	0.856

To examine whether collinearity exists, this study followed Hair et al.’s (2012) techniques to calculate the variance inflation factors (VIF). SPSS 24 was used to examine VIF; the value of VIF was below 1.34, showing that this study meets the standards of Hair et al. (2012). Therefore, this study did not address the problem of collinearity.

Following the suggestions provided by Podsakoff et al. (2003), this study employed a statistical remedy to detect whether common method variance (CMV) existed. We included a latent marker variable (theoretically unrelated variables) in the hypothesized model and calculated the correlation between the unrelated variables and the study variables. Consequently, the results show that: (1) all paths from the marker variables are statistically nonsignificant to the rest of the variables in the model; (2) the path coefficients are slightly different but consistent with the original model; and (3) in comparison with the original model, all path coefficients in the model with marker variables have worse fit, except for design quality and intimacy. Therefore, CMV is not a serious issue in this research model.

We assessed whether the impact of non-response bias occurred in the sample data. We distinguished early respondents (first wave of response) and late respondents (last wave of response) and test in SPSS to compare differences in terms of gender, age, types of apps, daily hours of app use, and platforms used for apps (Armstrong & Overton 1977). In our analysis, we found that the last-wave respondents were not significantly different from the first-wave respondents. The results of the test were as follows: gender ( $p = 0.275$ ), age ( $p = 0.128$ ), types of apps ( $p = 0.129$ ), daily hours of app use ( $p = 0.378$ ), and platforms used for apps ( $p = 0.141$ ). Therefore, non-response bias is unlikely to distort our findings.

### 5.2. Path Analysis

SmartPLS and SPSS 24 were used to examine the research model and hypotheses. We found support for all hypotheses. Figure 2 shows the results from bootstrapping,  $t$  values, and  $R^2$  for all paths. All five dimensions of design quality have significant effects on design quality. The four dimensions also have significant effects on intimacy. The effect of intimacy on continuance intention was statistically significant. Owing to the modeling design quality and intimacy as reflective second-order constructs, we built a more parsimonious model. In addition, the path clarifies the relationship between the two second-order constructs and first-order variables on continuance intention. Specifically, all paths between the first-order and second-order constructs exhibited  $p$ -values less than 0.05. That is, design quality contributes to system quality, design aesthetics, enjoyment, interactivity, and mobility, while intimacy enhances caring, commitment, comfort, and trust. Furthermore, the theoretical model accounted for 47.3% of the variance continuance intention. Consequently, our model validates the theoretical basis of design quality and intimacy and outperforms the original model in terms of the abstraction level. Therefore, the overall model is fairly good.

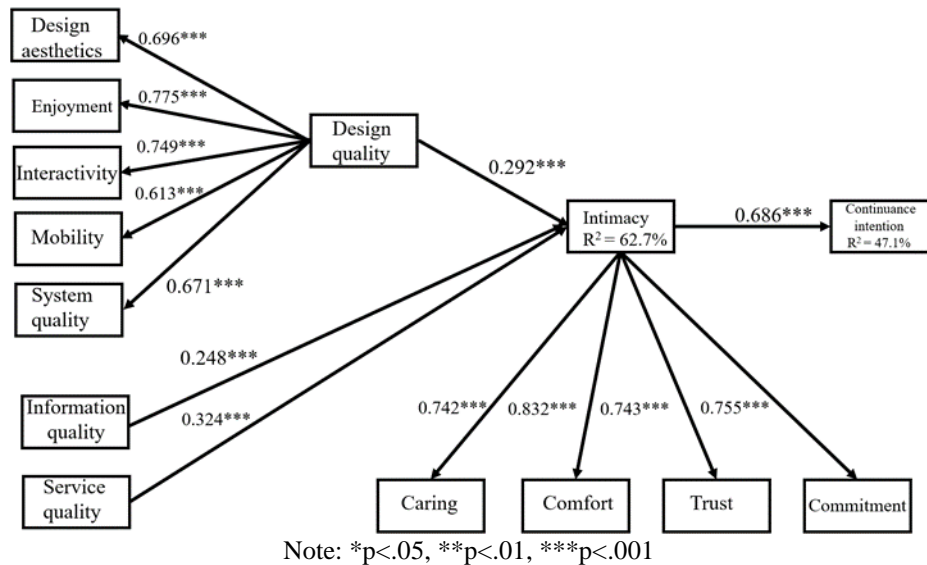


Figure 2: The Result of Path Analysis

### 5.3. Moderation Analysis

To further analyze whether the effects in the model may hold in different contexts, we conducted moderation analyses on three potential moderators. The dataset was categorized into subgroups by app type, gender, and the average length of usage (hours) as follows: (1) game versus social apps; (2) male versus female; (3) average daily usage time less than an hour versus that of 3–5 hours.

We categorized subgroups into gender, app type, and length of usage. First, increasing evidence suggests that males and females are intrinsically different in terms of adopting technology. For example, men and women respond to different behavior preferences in social media and m-commerce settings (Lim et al., 2021). Further, gender schema theory clearly defines gender schemas that have a strong impact on people’s behavior and information processing (Bem, 1981). Second, engagement research identifies that engagement plays an important role in marketing and technology adoption. For example, people who attract and hold attention due to the influence of apps spend more time on apps, leading to greater intention to use (Bitrián et al., 2021). Therefore, we concluded that efforts to classify the three subgroups are meaningful and practical. Third, the Big Five personality traits can explain the adoption of app types. For example, users with less extraversion are more likely to adopt gaming apps, whereas less conscientious

people frequently adopt social apps (Xu et al., 2016). Social and game apps were chosen because of their popularity in mobile apps. We found that users rarely use mobile apps for office work or other functional tasks. Another concern is that both social and game apps can be used to build social networks and share real-life connections, which increases the opportunity for interactivity. Therefore, lifestyle, productivity, and other types of apps were not considered in this study.

The results of the moderation analysis are presented in Tables 6, 7, and 8. Regarding app type, the results showed certain differences. In particular, the coefficient difference of intimacy on continuance intention is statistically significant and shows more influence of intimacy on game apps. The reason may be that social apps only provide a platform for people to regularly make connection with friends. Therefore, the emotional attachment of intimacy with game apps on continuance intention is higher than that of social apps.

Table 6: Different Effect between Games and Social Apps

	$\Delta$ Path Coefficient	p-Value
Design quality $\rightarrow$ intimacy	-0.044	0.721
Service quality $\rightarrow$ intimacy	0.094	0.195
Information quality $\rightarrow$ intimacy	-0.483	0.805
Intimacy $\rightarrow$ continuance intention	0.697	0.007*

Note:  $\Delta$ Path Coefficient = coeff (game)-coeff (social).

Table 7: Difference between Male and Female

	$\Delta$ Path Coefficient	p-Value
Design quality $\rightarrow$ intimacy	0.079	0.381
Service quality $\rightarrow$ intimacy	-0.073	0.466
Information quality $\rightarrow$ intimacy	-0.019	0.859
Intimacy $\rightarrow$ continuance intention	0.083	0.114

Note:  $\Delta$ Path Coefficient = coeff (male)-coeff (female).

Table 8: Difference between Frequent and Occasional Users

	Path Coefficient	p-Value
Design quality $\rightarrow$ intimacy	0.051	0.791
Service quality $\rightarrow$ intimacy	-0.15	0.509
Information quality $\rightarrow$ intimacy	0.088	0.674
Intimacy $\rightarrow$ continuance intention	0.158	0.240

Note:  $\Delta$ Path Coefficient = coeff (frequent)-coeff (occasional)

## 6. Discussions

### 6.1. Main Findings and Contributions

This study has demonstrated that intimacy plays a mediating role between app attributes that affect app success and continuous intention by building relational bonding associated with user experience in app usage. Our results show that design quality, information quality, and service quality are all positively related to intimacy, and intimacy also has a significant impact on the continuance intention to use apps. Effects in the general model may be moderated by the nature of apps. Design quality can be measured by aesthetics, enjoyment, interactivity, mobility, and system quality, while intimacy can be measured by four associated subconstructs: caring, comfort, trust, and commitment.

This study contributes to the mobile application literature in several ways. First, Wang et al. (2019) explored the impact of interaction quality, environmental quality, and outcome quality on continuance intention through user satisfaction and inertia in the context of mobile applications. Furthermore, Wang et al. (2019) adopted the mobile service quality perspective as a framework to test continuance intention. This study adopts the IS success model perspective and adds design quality to the IS success model to supplement the hedonic factors in the mobile app context. The three quality factors (i.e., information quality, service quality, and design quality) fully reflect the user experience of an app. In particular, mobility included in design quality represents the major feature of an app that is different from a traditional information system. Design quality not only makes the IS success model more comprehensive but also more suitable for apps.

Second, Thakur (2018) examined how post-adoption experience influences continuance intention. Specifically, Thakur (2018) investigated how aesthetics, navigability, and service experience impact self-efficacy. Moreover, the look, feel, and interactivity of the apps are important elements that affect user experience. A good user journey depends on the quality of app design. The design factor (i.e., design quality) cannot be ignored in the IS success model when

examining mobile apps' success. This study is in line with Thakur (2018) in examining aesthetics and service experience but is new in adding design quality and IS success factors to contain more post-adoption factors to investigate continuance intention to use mobile apps.

Third, Fang et al. (2017) investigated how app attributes influence attitudes and behavior. Specifically, Fang et al. (2017) used the Stimulus-Organism-Response (S-O-R) model to explore how app design and app performance influence continuance intention. This study also explores how app attributes influence continuance intention. However, this study emphasizes the quality factors of user experience that are unique to extending the IS success model in the mobile app context.

Fourth, continuance intention refers to the intention of the user to make further connections. From a long-term perspective, relationships with users are an important foundation for connecting with them. When examining a mobile app's success from the user experience, the relationship factor should be considered. This study used intimacy as a mediating factor to explore the relationship between users and mobile apps and examined its effect on users' continuance intention. Intimacy, which includes four dimensions (i.e., caring, comfort, trust, and commitment), is a key factor that presents the user's feelings after interactions. The relationship is based on interactive experiences. When emphasizing user experience in the mobile app context, intimacy can play a more comprehensive mediating role than satisfaction in the IS success model, especially for game apps.

## 6.2. Implications

The findings of this study have several theoretical implications. First, previous research found that improving the behavior of employees (de Waal & van der Heijden, 2016), trust-commitment relationships (Ponder et al., 2016), confirmation, and familiarity (Lee & Kwon, 2011) can increase intimacy and loyalty. Our findings show that app design quality and antecedents of the IS success model can increase intimacy and continuance intention to use mobile apps. Specifically, improving the design quality of apps and IS quality is more intuitively understandable and closer to real-world situations in the app context. Second, our model defines and incorporates the construct of intimacy to examine the continuous intention to use apps from the emotional relationship perspective. Brock and Zhou (2012) indicated that intimacy is a second-order construct with three dimensions: mutual understanding, closeness, and value perception.

Moreover, Ponder et al. (2016) found that intimacy is characterized by interactive communication and social bonds, both acting as full mediators of the trust-commitment relationship and further impact loyalty. Consistent with prior research, this study also adopts intimacy as a second-order construct. However, this study introduces four reflective dimensions (caring, confronting, trust, and commitment) to explain how app design and IS quality factors influence intimacy and further prove its impact on continuance intention in the mobile app context. Third, previous studies indicate that factors of the IS success model (i.e., system quality, information quality, and service quality) significantly influence attitude and satisfaction, and further influence intention to use (Rana et al., 2015). This study extends the previous model by adding design quality and enhancing the IS success model to interpret continuance intention in the mobile domain. To our knowledge, this study is the first to combine app design and IS quality factors in interpreting continuance intention by building intimate relationships with mobile apps. It contributes to understanding how intimacy theory and the IS success model can be properly integrated to become a more powerful model for interpreting continuance intention.

This study has several important implications for practitioners. First, app developers should focus more on the quality of app design. It is not only the functional quality of the system, such as timely and accurate information, but also the aesthetics, enjoyment, interactivity, and mobility of the app design. Special attention needs to be paid to how the design quality can enhance a more intimate relationship with the user. The longer an individual uses apps each day, the greater the impact of design quality on their intimacy. Second, user-centered design is the main foundation for the success of an app. Intimacy plays an important mediating role in the relationship between an app's quality and users' continuance intention. Such positive feelings are caused by meaningful interactions that provide users with better solutions. In other words, satisfying user needs in the interactions is the most important factor in developing an app so that users can advocate it. Third, offering informative feedback is another way to improve the service experience. Interactivity is an important element of design quality. In addition, intimacy usually results from meaningful interaction experiences, such as the experience of perceived response in an interaction. Therefore, interactive elements such as icons, buttons, message boxes, and other functions must be carefully designed.

## 6.3. Research Limitations and Future Research Directions

This study has some limitations that need to be addressed. First, our main goal is to explore the role of intimacy and how the mediator variable influences continuance intention in mobile apps. However, we do not claim that intimacy is the only mediator in the extended IS success model. Further, we did not compare the original IS success model, which may also serve as a potentially interesting topic for future research. Moreover, while we examine the role of intimacy and offer evidence to support the IS success model, we did not examine intimacy on more

sophisticated technologies within other IT environments. Therefore, future studies could extend our study by further examining other mediators, compare them with the original model, and access the user's perception of intimacy and quality variables in other IT environments.

Our study also focuses on social, gaming, and productivity apps associated with intimacy between mobile apps and users. Therefore, a further limitation is that our findings cannot be generalized to all mobile apps. There are many potential applications for mobility. We understand that intimacy is related to personal mobility devices and may be important for game apps. Every app type has different features and functions. Therefore, future work could explore how other app types yield a positive impact on continuance intention.

From the app feature perspective, we have chosen to measure higher-level features generic to many applications rather than features specific to certain applications. Therefore, it is possible that other factors affecting continuance intention may not be included and assessed in this study. Future studies may focus explicitly on the unique features of mobile apps, such as location-based services. Location-based services have been widely used in diverse computer systems and in integration with other applications. More research should explore their applications and directly address the underlying determinants of technology adoption in IS.

However, intimacy is defined as a state of closeness in a relationship (Liang et al., 2009), it may have different definitions in different contexts. This limitation also applies to design quality, information quality, and service quality. Therefore, future research should define these terms in different definitions according to their research field to meet their literature requirements.

## 7. Conclusion

Our study contributes to IS research by adapting the IS success model to mobile apps, as well as redefining and adopting new constructs such as design quality and intimacy. Our results yield important findings, one of which suggests that intimacy differs from user satisfaction in the IS success model and can also be closely related to quality variables. Further, we demonstrate that intimacy is an important mediating factor between quality variables and continuance intention. We hope our work leads to more IS studies conducting technology adoption that examine the implications of the proposed model according to the empirical study's findings. Hence, our research provides valuable insights that are not available in the literature.

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