



Factors influencing the behavioral intention to adopt a technological innovation from a developing country context: The case of mobile augmented reality games

Khaled M.S. Faqih

Department of Information Systems, Al Al-Bayt University, Jordan

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ABSTRACT

Augmented reality (AR) has become a promising technology in the gaming industry. However, few research studies have examined users' perspectives towards mobile AR games. To address this issue, the present study proposed a research model to better understand the factors determining and shaping users' behavioral intention to adopt mobile AR games from a developing country environment. Based on a literature review, nine factors have been expected to determine and shape individuals' intention towards the acceptance and adoption of mobile AR games. Using WarpPLS software, the model was empirically tested with a survey of 240 non-adopter respondents collected via an online survey questionnaire. The model was found statistically robust in terms of measurement quality criteria: reliability, validity, multicollinearity, and goodness of fit. The analysis revealed that perceived ease-of-use, social norms, privacy, perceived enjoyment, perceived competition, perceived inspiration, perceived image, and perceived innovativeness affect users' behavioral intention to adopt mobile AR games. However, the hypothesized moderating impact of perceived physical risk on the relationships connecting perceived ease-of-use, perceived enjoyment, perceived competition, and perceived inspiration with the intention to adopt was found to have little statistical significance. The result showed that perceived innovativeness was the strongest criterion to affect intention, and perceived ease-of-use was found to be the least important criterion in impacting users' intention. Interestingly, the model explains 76% of the variance in behavioral intention to adopt mobile AR games. This study offers theoretical and practical implications for its findings.

1. Introduction

The innovative use of information technology (IT) has been attributed to enabling companies and organizations to develop and evolve as well as achieve and maintain sustainable competitive advantage [1,2]. Indeed, innovation in IT has stimulated pioneering new developments in the business environment and communication channels, dramatically transforming many business processes and practices across a wide array of industries and disciplines, redefining business models, and reducing product life cycle [3], whereby gaming is no exception. In effect, given the computational power of digital technological innovations, gaming is undergoing unprecedented growth, expansion, and transformation. As a result, technology such as augmented reality has dramatically enabled gaming to appear closer to reality.

The unprecedented explosion in augmented reality (AR) technologies is radically changing the way gaming is conducted and experienced and giving birth to new gaming formats. However, these unceasing

changes in gaming industry culture and outlook have remained vibrant over the years. Certainly, the worldwide booming interest in mobile computing has been on the rise in recent years. Mobile-based technologies have brought about a dramatic change to the meaning of gaming culture and perspective. The gaming and entertainment industry has enjoyed a greater level of explosive growth, tremendous development, huge popularity, and success since the inception of augmented reality technologies because this innovative technological development has largely contributed to bring about a revolutionary change in the gaming industry [4]. In effect, augmented reality has exceeded expectations and is becoming a revolutionary technology in the gaming and entertainment industry. The most commonly used definition of augmented reality is "the technology in which digital objects are blended with the real world," so AR blurs the boundaries between the real world and the digital world. This promising technology is rapidly advancing and bound to redefine the gaming industry. The adoption of AR technologies has been on the rise, particularly since the emergence of the

E-mail address: km_faqih@aabu.edu.jo.

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phenomenon of the Pokemon Go game in 2016 that took the world by storm [5,6]. As a result, the adoption of augmented reality has led the gaming industry to grow and flourish to a level that corresponds well to the satisfaction, desires, aspirations, and needs of gamers. Therefore, unlocking the power of AR technology has become a core driver for gaming industry businesses to pursue transformation and growth. Undoubtedly, the effective use of the AR technology paradigm can provide the game industry ecosystem with the competence and the capacity to drive and leverage continuous improvements and strengths in performance and quality. According to a recent report, the AR gaming market is expected to grow and expand in the coming years [7].

The adoption of AR technologies and applications is at its infancy in Jordan. However, the low acceptance and adoption levels of AR technologies and applications have been attributed to a varying number of reasons [8–10]. Firstly, a lack of awareness and knowledge of the expected benefits that may be realized from using these emerging technological innovations has been the primary reason for not embracing augmented reality technology. Secondly, the literature review carried out in the present analysis clearly shows that there are inadequate research studies carried out regarding the acceptance and adoption of mobile AR games in developing countries. Thirdly, augmented reality and its applications are emerging technological paradigms, and yet a number of critically significant aspects have not fully matured, and therefore, people in developing cultures may not be willing to adopt these technological applications. Finally, this study believes that the absence of laws and regulations governing the implementation and usage of augmented reality might have contributed to the lack of interest in the acceptance and adoption of augmented reality technologies and applications in gaming, such as mobile AR games.

Technology adoption research has been a dominant IS research theme over the last three decades, involving many acceptance, adoption, and diffusion theories and models. The adoption or rejection of innovation has been attributed to an array of factors that vary across different technologies and contexts. To serve the objective of this study, the study intends to explore the following perspectives. First, the technology acceptance model (TAM) proposes that perceived ease-of-use is a key attribute in driving technology adoption and in particular new technologies. With regard to the context of this study, the importance of perceived ease-of-use becomes a primary concern because implementing AR applications is a difficult issue to manage seamlessly. However, contemporary research has been inconsistent regarding the role of perceived ease-of-use in the adoption of mobile AR games [11,19], leaving a research gap to be addressed. Second, one of the most prominent issues is that the adoption of many technologies and media has been associated with societal controversies, especially as a result of the inclusion of AR technologies in mobile games, causing negative social consequences that lead to social non-acceptance by society [6,12,13]. Indeed, there are many social implications associated with newly introduced innovations such as AR technologies and applications. For example, convincing an individual to wear an AR system in public raises many issues. Therefore, it is highly important to reveal the social constraints and challenges responsible for hampering the successful introduction of AR technology in mobile games to better comprehend the role of social psychological determinants in enhancing the social acceptance of the technology [14]. Indeed, having guaranteed that the innovation or innovative application is technologically sound and superior, economically attractive, practically applicable, unparalleled in quality, and commercially prepared. Notwithstanding all the above mentioned encouraging features, characteristics, and attributes, the innovation will not be as widely adopted and socially accepted as anticipated. No innovation springs from production to immediate usage without having to provide an adequate level of social expectations. An innovation has to meet specific social acceptance criteria before it becomes a commonplace technology [12,13]. There have been only a few studies to date have examined the importance of social norms in the adoption behavior of mobile AR games in developed countries. The findings of these studies

demonstrated that social norms was an influential predictor of behavioral intention to adopt Pokémon Go [6,15]. However, one of the first attempts to investigate the impact of social norms on the intention to adopt mobile AR games in a developing country environment using non-adopter respondents reported that social norms was an important determinant in the adoption of location-based AR games [20]. Nevertheless, there is a paucity of research that addresses the role of social norms in the adoption behavior of mobile AR games. Therefore, there is a pressing need to explore further the role of social norms in the adoption process of mobile AR games.

Third, privacy concerns and physical risk in AR usage in gaming have been recognized to exert a negative effect on the social acceptance of AR technology. Effectively, the extent of the negative consequences of privacy issues and physical risk is threatening the social acceptance of AR technologies, especially in gaming [6,15–17]. Furthermore, many studies have concluded that people in developing country contexts are more wary of privacy issues and concerns raised by online environments than developing countries (e.g. Ref. [18]). Therefore, the aspect of privacy and its association with technology adoption in developing countries requires greater research attention and deserves closer scrutiny to clarify its influence on the adoption behavior of mobile AR games. However, a few studies concluded that the aspects of privacy exert no impact on the behavioral intention to adopt mobile AR games for both adopters and non-adopters of the technology [6,19,20]. The state of knowledge of how privacy influences the impact of privacy on the adoption process of mobile AR games is ambiguous, further research is called for to better reinforce the role of privacy in the adoption behavior of the technology in question. Fourth, this study will include certain gratification factors (perceived enjoyment and perceived competition) that have been expected to play a key role in influencing the behavioral intention to adopt mobile AR games. Several studies conducted in both developed and developing country contexts highlighted the importance of perceived enjoyment in positively affecting behavioral intention to adopt mobile AR games [19–21,56]. However, none of these studies were carried out in this part of the world. However, perceived competition has not been widely examined in the context of this study. Therefore, given the scarcity of research, it is therefore essential to explore the impact of perceived enjoyment and perceived competition on the adoption behavior of mobile AR games. Fifth, the perceptions of image and innovativeness are important in shaping the adoption behaviors of mobile AR games. However, little research has paid attention to studying these perceptions in relation to the adoption and acceptance of mobile AR games.

Sixth, this study believes that contemporary literature has not incorporated the influence of some AR-specific variables that can be fundamentally essential in enhancing the behavioral intention to adopt mobile AR games. For example, the inspirational strength of AR technologies is unparalleled and provides a medium that can rivet users' attention in a unique fashion, and creating an environment filled with novelties and varieties, leading to inspiring users to adopt AR technologies. Thus, the perceptions of inspiration can be expected to positively influence the adoption behavior of mobile AR games, especially their impact on enhancing the behavioral intention towards the adoption of mobile AR games. Finally, augmented reality games can be played in the real world and therefore necessitate a certain level of interaction with the outside world. In this respect, players are faced with physical risk that can endanger their wellbeing [22]. Thus, the physical risk has become a worrying problem in the context of AR mobile gaming. It is therefore necessary to study the effect of perceived physical risk on the adoption dynamics of mobile AR games, especially the influence on the behavioral intention to adopt mobile AR games. One of the first attempts to investigate the influence of perceived physical risk on the adoption behavior of mobile AR games reported an insignificant correlation between perceived physical risk and the attitude towards the adoption of mobile AR games [6], indicating that further empirical exploration is needed to establish the role perceived physical risk in the adoption

process of mobile AR games. Finally, the current work will expand the influence of perceived physical risk on the adoption process of the technology under analysis by exploring its moderating effect on the relationships linking perceived ease-of-use, enjoyment, competition, and inspiration with behavioral intention to accept mobile-based augmented reality games.

The current study aims to enhance the existing literature by conducting a more specific examination of factors acknowledged to influence the behavioral intention to adopt mobile AR games. Nonetheless, to the best of my understanding, no comparable research has been carried out in the context of the Arab world in general and Jordan in particular. Meanwhile, the majority of related literature studies carried out to explore the adoption of augmented reality technologies and applications have been primarily implemented in developed nations. However, little research in that respect has been conducted in developing nations. Basically, findings and conclusions obtained by empirical investigations performed in developed countries are not necessarily applicable to developing country contexts. It is therefore essentially important to conduct more comprehensive research studies to improve our understanding of the adoption dynamics of mobile augmented reality games in developing countries. As already mentioned, very little research attention has been devoted to examining the adoption dynamics of AR technologies and applications in Jordan [10]. In fact, this area of research, especially studying the adoption of mobile AR games, has not been widely explored in this part of the world. The paucity of empirical studies has been responsible for impeding the acceptance and adoption of mobile AR games. This study is an attempt to investigate and understand the factors accountable for the adoption of mobile AR games in Jordan. Therefore, this type of analysis addresses a knowledge gap in the current literature. Overall, the current analysis contributes to enriching our knowledge, broadening our horizons, strengthening our vision, and acknowledging our limitations in this emerging field of study, particularly with regard to developing country contexts.

2. Theoretical background

2.1. Mobile gaming and augmented reality

Nowadays, gaming, particularly online gaming, is growing at an unprecedented rate and exploding beyond comprehension. With the introduction of AR technology to the gaming landscape, gaming has entered a new era of advanced mobile gaming by creating a playing zone within the existing artificial environment. Realizing the immersive power of AR technologies, game designers and developers have successfully developed a truly unique gaming environment, leading to a paradigm shift in how mobile game is played. Indeed, AR has resulted in the biggest technology trend in the gaming industry. However, further improvements and developments are required in many areas of gaming such as safe platforms to offer positive playing experiences. Consequently, pressures are mounting on gaming practitioners and researchers around the globe to arrive at socially acceptable gaming experiences and cultures.

Mobile technologies such as smart phones and tablets have become simplistic, inexpensive, and ubiquitous. These technologies are expanding in terms of capabilities, capacities, and functionalities. In addition, smartphones and tablets are technically and operationally equipped to use varying technologies to track location and identify images as well as measure location and orientation [23]. In the meantime, smartphones and tablets have become highly compatible with other emerging and ground-breaking technological innovations such as AR technologies, causing a revolutionary change in gaming practices, preferences, and perspectives. In other words, the rich combination of mobile-based computing technologies and AR technologies has opened new avenues for the gaming industry to flourish and become more mature to deliver an optimal gaming experience. Indeed, such a combination has become a catalyst for innovation and creativity regarding

gaming development and growth.

Several mobile AR games have been developed and released over recent years. However, the first seriously popular mobile-based AR games were Ingress and Pokemon Go. Before that, many innovative mobile AR games were launched commercially for use in an outdoor environment. For example, Falcon Gunner was developed and launched to allow players to protect their position and destroy the tie fighters by placing the player in the gunner chair. This game operates on two modes: the first mode blends graphical objects by capturing the view via a mobile-based camera, and the second model is purely virtual [24]. Moreover, Zombies, Run! was released in 2012, and this game emphasized the transformative outlook of gameplay and demonstrated the requirement for a form of immersion. According to Southerton [25], Zombies, Run! is “a smartphone application that mixes exercise with video gaming, provides a fascinating example of a hybrid game form that brings together certain elements of labor and leisure.” Furthermore, Ingress is a highly popular mobile AR game that was developed and released by Niantic in 2012. Ingress was the first mobile location-based AR game to be launched on a wide scale. Technically, the central elements of Ingress are called portals, and those specific locations (portals) are important for players to defend against attacks from opposing groups and portals are scattered all over the place. Every player needs to cooperate with another group, leading to the creation of community like groups, and players require strong cooperation among themselves to achieve in-game success [26].

Furthermore, the emergence of Pokémon GO in 2016 has taken the world by surprise. Therefore, people’s perspective of augmented reality has dramatically changed to the effect that AR technologies have gone mainstream. Technically, a mobile AR gaming system such as Pokémon GO operates in such a way that “it combines geo-spatial elements along with gamification practices to incentivize users’ movement in the physical world” [27]. This type of gaming system is referred to as a location-based mobile AR game, which is equipped with the necessary technologies and software tools to generate a real-time map of the actual physical environment surrounding the player, offering players a real-life environment using GPS tracking technology. These games overlay computer-generated virtual objects on users’ views of the real-world environment. The real challenge encountering mobile AR players is how to capture these digital objects in real-world settings through a mobile device camera [28]. Since players have to move in the physical world to catch the digital objects, therefore, interacting with the physical world has been observed to involve potential safety hazards to players [16]. Still, the outdoor activity associated with playing Pokémon GO has been acknowledged to effectively promote physical health and social interaction [29]. Finally, after the introduction of Pokémon GO, many successful mobile AR games emerged such as [Monsterball Go](#) and [Draconius Go](#) and many others.

2.2. Social acceptance of AR technologies and applications

The significance of considering the social acceptance aspects of new technology into account is highly recognized. It is extremely essential to assess the social implications that would arise as a result of deploying and implementing innovation in social environments [30,31]. Many technological innovations involve social implications that deter their social acceptance. Definitely, AR technology has been associated with a variety of social implications. For example, convincing an individual to wear AR systems in public raises many fundamental issues that adversely impact its social acceptance. Studies have reported that social acceptance is one of the bottlenecks to the widespread acceptance and use of augmented reality technology [30,32]. There are multiple issues that pose threatening challenges to the social acceptance of augmented reality technologies and applications among potential users.

AR technologies generate new behavioral interactions, patterns, and features that are not consistent with established social norms (e.g. Ref. [33]). AR technologies with their unique ability to fuse the real

world with virtual elements have challenged existing norms of behavior because social interactions among multiple users taking place in the process of sharing the same AR environment may contribute to increasing tension among users [33]. Consequently, the aspect of social norms in a shared AR environment comes into the equation as a critical dimension for investigation before any attempt to design new technology for social interaction and use. Several studies have underlined that the disruption of established social norms can lead to the development of significant challenging behaviors to the acceptance of an innovation, particularly AR-related technologies [13,33]. This state of affairs normally leads to a lack of interest in accepting AR technologies and applications such as AR mobile games.

According to many researchers, the usage context of an innovation is the primary driver for selecting and accepting an innovation [17,86]. The usage context of a particular technology, such as AR-related technologies and applications, is important for determining its social acceptance. Augmented reality has a unique environment that impacts its social acceptance process. Furthermore, the deployment and implementation of AR services normally take place in different social contexts that cause social controversies and implications to rise, which increases the complexity of the working environment and their social acceptance becomes critically more challenging and more demanding [30,34]. AR technology functions in a variety of usage contexts as it is implemented in private and in public such as mobile gaming, making the technology vulnerable to social anxiety. In addition, fashion has been lately linked to AR and has become an integral part in the process of implementing the technology [35]. Indeed, the successful introduction and usage of wearable devices in AR technologies has exacerbated and expanded the scope of its social acceptance to be influenced by the underlying characteristics of three perspectives: media, fashion, and technology [36].

3. Research model development

3.1. Perceived ease-of-use

In accordance with the established technology acceptance model (TAM) that has been widely applied in the adoption processes of information technology and information system products and services, it is well-recognized that technology characteristics (such as ease-of-use) have an important effect on the adoption and usage processes, especially in cases of emerging and new technologies and innovations such as mobile AR games. The rationale behind the importance of ease-of-use is that users will not be enthusiastic to adopt the technology if they perceive it to be difficult to use [37]. From the perspective of this study, perceived ease-of-use is a significant determinant influencing user adoption of mobile AR games because implementing augmented reality applications is difficult to apply in almost every domain [38]. The difficulty arises due to the nature of AR, whereby augmented reality delivers its information (real and virtual concepts) in unconventional manners and with a unique level of contextuality. However, implementing AR technology within the mobile environment poses many challenges, barriers, and difficulties. Thus, the concept of perceived ease-of-use becomes extremely essential for users to accept and use mobile AR games. For example, in a study carried out in applying mobile AR games in an educational context, the key recommendation was that the technology must be easy to use [39]. Notably, using AR in mobile-based gaming involves the implementation of both real-world and virtual world in one single interface which makes the playing process close to reality. The implementation process involves increasingly sophisticated technologies and knowledge about many objects, areas, and concepts. Thus, these informational elements impose a high level of cognitive load on users, and thus users will find it uncomfortable to handle when playing AR mobile games. With regard to the perspective of the current analysis, perceived ease-of-use refers to “the level to which a user believes that the mobile augmented reality games will be easy to play”. Consequently, if users perceive mobile AR games easy to

play, they will be motivated to embrace the adoption of mobile games enabled by AR technologies. Many studies have verified the critical role played by perceptions of ease-of-use in boosting behavioral intention in the adoption dynamics of different IS areas and domains in developing countries like Jordan [40–42]. With regard to the context of this study, an imperial study investigated the factors driving people to play mobile AR games, it was concluded that perceived ease-of-use was an important determinant in predicting behavioral intention to adopt mobile AR games [19]. Another study conducted to explore the technology acceptance factors of Pokémon Go reported the same findings [11]. Based on earlier findings, the following hypothesis is suggested.

H1. Perceived ease-of-use will have a positive effect on the intention to adopt mobile AR games.

3.2. Social norms

The concept of social influence (social norms) was first proposed in the adoption of new technology by the theory of reasoned action [43], and it refers to “the individual’s perception that most people who are important to him think he should or should not perform the behavior in question.” The aspect of social norms (SN) has been generally linked to the adoption dynamics of different digitized and non-digitized technologies because of their influence in shaping human behavior and perceptions [30,44,45]. Consequently, social norms has been acknowledged as a primary component in affecting users’ behavior towards technology acceptance and use. From the perspective of the current analysis, social norms is defined as “the degree to which a user believes that other people expect him or her to use a specific mobile AR game” [34]. In the meantime, according to social theory, important others can be effective in encouraging behavior change. Rauschnabel & Ro [34] found that social norms was the most prominent predictor to influence positively the intentional behavior towards the adoption of wearable smart Google Glasses. Miller et al. [30] concluded that the AR environment poses unique challenges to the users’ norms of nonverbal behavior in relation to the intermingling between virtual and real humans interacting in the physical environment. Also, further empirical analyses have focused on the significance of social norms on the adoption of AR technology, providing evidence of the commanding role played by social norms in the adoption of AR smart glasses [6,13]. One of the first attempts to investigate the adoption behavior of the Pokémon Go mobile game among mobile gamers concluded that social norms was an influential predictor of both attitude and intention to adopt Pokémon Go [6]. Furthermore, a study exploring the factors influencing the behavioral intention to use mobile AR games demonstrated that social influence was an important determinant for predicting behavior intention [15]. Lately, an empirical investigation implemented in a developing country environment using non-adopter respondents reported that social norms was an important determinant in enhancing behavioral intention to adopt location-based AR games [20]. Based on earlier findings, the following hypothesis is suggested.

H2. Social norms will have a positive effect on the intention to adopt mobile AR games.

3.3. Privacy

Privacy concerns have been a controversial issue long before the beginning of the information technology era. However, privacy concerns have been highlighted as a major challenge for the digital world. Previous research has definitely recognized that personal data privacy is an issue of growing significance, particularly in online contexts [46]. Indeed, the open nature of Internet-enabled systems has been responsible for a considerable erosion in privacy-related matters. Privacy concerns have become a more alarming, challenging, and problematic issue in gaming environments because the majority of gaming platforms are normally connected to the Internet. This draws considerable

attention from the research community to come up with innovative measures to dampen the negative impact on the adoption of gaming applications. In contemporary literature, there are many definitions associated with the privacy dimension that have been proposed by academic scholars. For example, Malhotra, Kim, & Agarwal [47] conceptualized privacy concerns as “a risk factor that reflects users’ inherent worries about the possible loss of personal information from using a particular medium or technology.” Privacy drives trust, and trust is a critical prerequisite to establishing a strong online relationship. Lack of trust would positively fuel uncertainty and apprehension among users, leading to a lower level of user engagement.

The issue of privacy has been labeled to have a leading role in the adoption of AR technologies and applications because mobile AR technologies operate in a way that may grant access to users’ personal information [17]. Several researchers have argued that the extent of the negative consequences of privacy issues is threatening the adoption of AR technologies [15,17,48]. A comprehensive study was recently conducted to investigate whether mobile games potentially expose personal data and sensitive information to privacy violations, the study reported that a large proportion of mobile-based gaming applications collected users’ personal data and also granted that access to third parties, and even some gaming applications were equipped to modify users’ profile data [49]. Privacy concerns have normally been known to reduce users’ intention to adopt a technology (e.g. Ref. [50]). Several studies [20,51,57] concluded that the aspects of privacy exert a negative influence on the adoption process of AR technologies. Therefore.

H3. Privacy will have a negative effect on the intention to adopt mobile AR games.

3.4. Perceived enjoyment

The use of enjoyment as a factor in studying behavioral intention was introduced and theorized to investigate and capture the influence of the hedonism dimension on the acceptance process of technological innovations. Enjoyment is one of many hedonic benefits normally pursued and achieved by users while playing mobile digital games. Indeed, the element of enjoyment is deemed essential in playing games. Notably, individuals are more inclined to adopt new mobile-based technologies if they find the technology pleasurable, rewarding, and delightful. The elements of enjoyment have been recognized to have a significant role in enhancing the acceptance and adoption of technological innovation, particularly with respect to gaming technologies [52]. Moreover, several empirical analyses have categorically confirmed that the enjoyment dimension is a significant determinant of intention across a wide range of information technologies [53,54]. Many definitions have been proposed to describe the concept of enjoyment. Nonetheless, enjoyment is a complex intangible concept and is difficult to operationalize and quantify. From the perspective of the present study, perceived enjoyment is defined as “the degree to which users perceive playing mobile AR games as enjoyable” [6]. A study was carried out to examine the primary psychological factors that drive users to play AR mobile games such as Pokémon Go. Enjoyment was the most important factor impacting the adoption behavior of mobile-based AR games [6]. A recent study demonstrated the effect of enjoyment on users’ perceptions to adopt mobile augmented reality games [55]. Recent studies have demonstrated the positive effect of perceived enjoyment on the behavioral intention to adopt mobile AR games. For example, an empirical analysis investigating the motivations to use mobile AR games provided strong empirical evidence of the importance of perceived enjoyment in positively affecting behavioral intention [56]. Further, an empirical investigation demonstrated the effect of perceived enjoyment on the intention to play location-based AR games [19]. Finally, Thongmak [20] and Thongmak [21] provided empirical evidence of the importance of perceived enjoyment in positively influencing perceptions of enjoyment in a developing country context. Based on earlier findings, the following

hypothesis is suggested.

H4. Perceived enjoyment will have a positive effect on the intention to adopt mobile AR games.

3.5. Perceived competition

It is understood that the competition dimension can significantly enhance motivation, which promotes the willingness of users to defeat others and win [56,57]. In addition, perceived competition drives innovation and generates challenges, leading to a satisfaction level that enhances the adoption process of digital games [58]. It is noteworthy that perceived competition is an important motivating force and a key driver for the development of a mindset for competitiveness and sustainability to win a game. The competitive nature of human beings plays an important role in driving users to play games. In the meantime, the competitive merit of mobile AR games fuels competition motives and behavior that influence users’ preferences and perceptions towards acceptance of mobile AR games [56]. Yet, the impact of perceived competition on intentional behavior to accept mobile-based AR games has not been extensively tested. However, study that investigated what factors drive people to play mobile AR games highlighted the empirical impact of perceived competition on the adoption behavior of mobile AR games [19], and in particular, the significance of perceived competition in driving in-app purchase intention for mobile AR games. However, to further understand the impact of perceived competition, the current empirical investigation will explore the influence of perceived competition on the intention to adopt mobile-based AR games. Therefore:

H5. Perceived competition will have a positive effect on the intention to adopt mobile AR games.

3.6. Perceived inspiration

It is worth noting that augmented reality technologies and applications have the capacity and power to inspire users both psychologically and behaviorally to accept and adopt an innovation [59,60]. Inspiration is defined as “a motivational state that compels individuals to bring ideas into fruition” [61]. Today, conventional media struggles and stands no chance against AR capabilities, whereby AR provides a medium that can rivet users’ attention in the way AR delivers pictures and videos with seeable AR apps, offering engagement, delightfulness, and benefits and turning the scene into an environment filled with novelties and varieties, leading to motivational behaviors that can inspire users towards the acceptance and adoption of innovations such as mobile AR games. Moreover, the motivational and inspirational effects that are normally brought about by the power of AR technology can build people’s resilience and inspire them to adopt a new idea or a new technology [59,60]. The inspirational strength and creativity of AR technologies can be most clearly observed in many fields, especially marketing, gaming, and tourism. Indeed, the potential of AR technologies, especially AR mobile gaming applications, has brought about a paradigm shift in marketing tactics and techniques that is undisputedly unchallenged among marketing patterns and formats. A recent study underlines the importance of AR marketing applications [59] in inspiring users, particularly in attracting users’ attention to appreciate the values, merits, and benefits of a specific product or service that will fill their needs, thereby leading to enhancing behavioral attitude and intention towards the final adoption of the product. However, there is a lack of studies empirically examining the impact of perceived inspiration on the adoption behavior towards accepting and using mobile AR games. One of the studies implemented in technology adoption research [62] demonstrated the importance of perceived inspiration in affecting the intentional behavior to adopt digitized patient record technology. Therefore.

H6. Perceived Inspiration will have a positive effect on the intention to

adopt mobile AR games.

3.7. Perceived image

For certain types of technological innovations, users tend to value highly the social status and prestige they might gain from using the innovation. Thus, user-image perceptions could be considered as a primary social factor that effectively drives the acceptance and adoption of a specific innovation. Numerous studies have confirmed that perceptions of image play a critical role in enhancing the adoption dynamics of various IT domains in developing countries [42,63,64]. The image was initially introduced to the IT adoption research by Moore and Benbasat [65]. According to Moore & Benbasat [65], image is defined as “the degree an individual perceives that the use of innovation will boost his or her image and will achieve a higher social status in society,” recognizing the importance of individual-image perceptions in influencing behavioral intention to adopt information technology innovation. With regard to the context of this study, image can be defined as “the degree to which an individual perceives that playing a mobile AR game will enhance his or her status in his or her social system” [6]. With respect to the mobile AR games adoption process, the influence of self-image was investigated by Rauschnabel et al. [6], they demonstrated that players’ self-image was an essential factor in the adoption dynamics of Pokémon Go, especially in enhancing players’ attitude and intention to keep on playing the game. Recently, an empirical analysis was carried out to explore the role of several determinants in predicting the intention to play mobile AR games (Pokémon Go) among non-adopters, the findings provided empirical evidence of the positive impact of social value attributes (perceived image) on the behavioral intention to play Pokémon Go among non-adopters in developing country of Thailand [21]. Therefore.

H7. : Perceived image will have a positive effect on the intention to adopt mobile AR games.

3.8. Perceived innovativeness

The adoption literature has emphasized that an individual’s innovativeness plays an influential role in shaping adoption behaviors towards new technology. Indeed, users with a high level of innovativeness tend to be more innovative towards accepting new technological innovations. The perceived innovativeness (PIN) construct was first introduced by Agarwal & Prasad [66] in an attempt to better understand and gauge the influence of perceptions of innovativeness on individuals’ behavior towards the acceptance and adoption of emerging IT artifacts. Based on the assumption that innovative users are inclined to have a lower risk perception towards adoption of new technology, Agarwal & Prasad [66] have strongly argued that when exploring the adoption of new technology, the aspects of innovativeness should be integrated in the framework proposed to examine the adoption dynamics of the technology under investigation.

Many definitions have been proposed in the literature to describe the innovativeness concept. For example, Rogers [67] defined the concept as “the degree of speed of an individual to adopt new ideas in relation to other members of the system.” Later, Agarwal & Prasad [66] defined the concept as “the degree to which an individual is responsive to new ideas and adopts innovative decisions freely and earlier than others.” Agarwal & Prasad’s [66] definition has been academically more popular as being more conceptual and more operational definition in describing individual innovativeness in relation to the acceptance and adoption dynamics of information technology domains. Mobile AR games are an emerging technological innovation. Therefore, investigating the effect of individual innovativeness on the adoption of mobile AR games is an important argument for better understanding gaming behavior. Certainly, many studies have confirmed the impact of individual innovativeness on the intention of the adoption of AR applications [68–70].

However, individual innovativeness is a crucial aspect to explore with respect to the adoption process of mobile-based AR games. Therefore.

H8. Individual innovativeness will have a positive effect on the intention to adopt mobile AR games.

3.9. Perceived physical risk

Technology adoption literature has long considered the risk of using technology, particularly physical risk. The new wave of emerging pervasive applications has a health-risk behavior, especially those applications that are driven by AR technologies such as mobile AR games. In this respect, new risk challenges are prevalent in using location-based AR mobile games because these games require a certain level of interaction with reality. For example, studies have documented the potential safety hazards involved in playing Pokémon Go [6,16,22,71]. Therefore, physical risk has become a worrying issue for game developers. For the context of this study, the physical risk is described as “the potential physical risk that may be caused while playing AR mobile games.” Studies have demonstrated that although playing Pokémon Go might promote an individual’s health, there are possible physical health hazards and distractions associated with how the game affects physical activity [71]. Indeed, since using mobile AR games involves potential physical risk, therefore such an unfavorable situation may negatively influence the adoption behavior of the technology under investigation. Nevertheless, exploring the moderating impact of perceived physical risk on the acceptance and adoption of mobile AR games is not a common research theme.

The current study recognizes the moderating effect of all types of risks associated with newly introduced IT products and services that has been extensively investigated to understand how they moderate the relationships between many variables relevant to technology adoption processes and behavioral intention, and the perceived physical risk as a whole is no exception [72]. Certainly, the intensity of relationships connecting factors driving the adoption and acceptance processes of emerging technologies with behavioral intention is sensitive to the level of perceived risk (high versus low perceived physical risk) among potential adopters. The moderation perspective enables to understand what factors strengthen or weaken a relationship with behavioral intention. This study has carefully identified a set of relevant factors to include in this study (perceived enjoyment, perceived competition, perceived inspiration, and perceived ease-of-use). In the presence of perceived physical risk, the intensity of the relationships between these factors and behavioral intention could be weakened, leading to a decrease in the acceptance of mobile AR games among potential players. Furthermore, the rationale for recognizing the importance of including perceived physical risk as a moderator in the current study is to examine the interacting effects of the perceptions of physical risk on the relationships connecting these factors with behavioral intention to adopt mobile AR games. Meanwhile, the study expects that there will be certain levels of variation in the perception of physical risk among respondents. For these reasons, introducing the moderating effect of perceived physical risk to the current study is more likely to be a valid argument. Thus, the current analysis will explore the moderating effect of the relationships linking the perceptions of ease-of-use, enjoyment, competition, and inspiration with the behavioral intention to adopt mobile-enabled AR games. Therefore:

H9. Perceived physical risk has a negative moderating impact on the relationship between perceived ease-of-use and intention to adopt mobile AR games.

H10. Perceived physical risk has a negative moderating impact on the relationship linking perceived enjoyment with the intention to adopt mobile AR games.

H11. Perceived physical risk has a negative moderating impact on the relationship linking perceived competition with intention to adopt

mobile AR games.

H12. Perceived physical risk has a negative moderating impact on the relationship linking perceived inspiration with the intention to adopt mobile AR games.

Fig. 1 shows the search model.

4. Research methodology

The present study aims to examine what factors enhance the intention to adopt mobile AR games in a developing country environment. A research model is developed to realize the intention of the current empirical investigation (Fig. 1). The model includes nine latent variables and thirty-six manifest indicators to measure latent variables. To test the research model, the study will follow a quantitative approach, which requires data to be collected. The present method applied a questionnaire survey approach to gather relevant data. The survey was developed to capture the relevant data. The questionnaire was initially developed in English using questions that had already been validated and used in prior published studies, and certain rewordings were performed to suit the perspective of the current analysis (Appendix A). The survey was translated from the English language into Arabic by the author and checked to guarantee that the translation successfully conveyed the original meaning without ambiguity. The Likert scale is applied for this study, where the Likert scale has been considered as one of the most commonly used psychometric tools in MIS research. 7-point scale items were used to operationalize each construct (1 signifies “strongly disagree” and 7 signifies “strongly agree”).

To capture the pertinent data, the study targeted university students who study various IT-based disciplines at the University of Al al-Bayt (Jordan) as they are well knowledgeable of the concept of mobile AR games. In the meantime, students are generally technically savvy. The questionnaire was posted online using Google Form Survey via Moodle and WhatsApp platforms. 240 responses (Table 1) were carried forward for analysis. Finally, WarpPLS was applied to statistically test and validate the proposed model. The underlying principles for selecting WarpPLS in the current study are due to several motivational themes: (1) WarpPLS is a user-friendly software tool, (2) WarpPLS has become a leading SEM-based analysis method, and (3) WarpPLS is a leading statistical software and has grown in popularity and gained academic acceptance over the years, especially in various MIS research domains.

Table 1

Demographic profile of respondents.

Profiles	Classification	Number of Respondents	Percentage of Respondents
Gender	Female	128	53.3
	Male	112	46.7
Age (years)	<20	72	30
	20–22	131	54.6
	>22	37	15.4
Academic Study Level	First Year	10	4.2
	Second Year	62	25.8
	Third Year	101	42.1
	Fourth Year	30	12.5
	Others	37	15.4

4.1. Measurement model evaluation

Measurement model evaluation is a fundamental component prior to testing the proposed model hypotheses. It is theoretically a statistical requirement to ensure that there is a fit between the proposed model and the empirical data. Traditionally, the validation criterion recommended to be fulfilled in the process of measurement model evaluation is to validate construct reliability and construct validity using a set of quality criteria that are proposed to satisfy construct reliability and validity requirements. Construct reliability is defined as “the degree to which a set of measurement items are consistent in their measurement” [73]. Cronbach’s alpha and composite reliability (CR) coefficients are used to provide valuable evidence to establish construct reliability. Empirical research normally accepts values for Cronbach’s alpha coefficient exceeding 0.6 for exploratory research [74] as in the case of this study. However, values exceeding 0.7 are desirable as recommended by Nunnally [75]. The results reported in this study for the alpha coefficient exceeding 0.7 for all constructs included in this study (Table 2), ranging between 0.819 and 0.923. Another reliability index, called composite reliability was developed by Chin & Gopal [76]. Composite reliability has become a more popular alternative than Cronbach’s alpha because it is a more rigorous and a better indicator of internal consistency reliability. WarpPLS is equipped with the analytical power to provide accurate estimates of the composite reliability index. The calculated results are tabulated in Table 2 and all the results obtained are well above the suggested recommended value of 0.7 for all constructs [77],

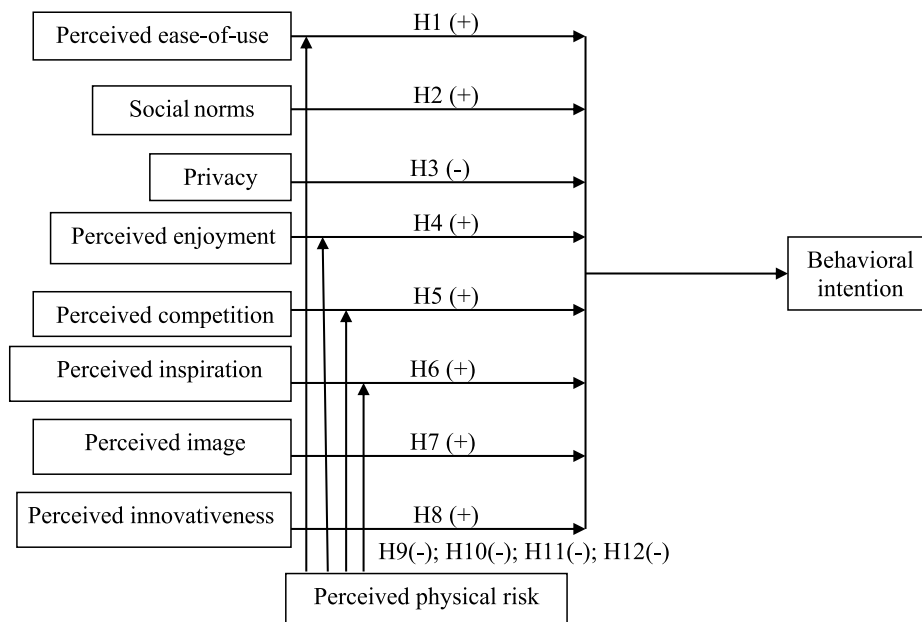


Fig. 1. The research model.

Table 2
Validity and reliability of constructs.

Constructs	Cronbach's Alpha	Composite Reliability	AVE
Perceived ease-of-use (PEoU)	0.863	0.907	0.709
Social norms (SN)	0.912	0.934	0.740
Privacy (PRV)	0.869	0.897	0.721
Enjoyment (Enjoy)	0.913	0.946	0.853
Competition (Comp)	0.895	0.935	0.827
Perceived inspiration (PINS)	0.819	0.893	0.735
Perceived image (PIM)	0.882	0.927	0.809
Perceived innovativeness (PIN)	0.877	0.916	0.733
Perceived physical risks (PPR)	0.827	0.897	0.743
Behavioral intention (BI)	0.923	0.946	0.813

ranging between 0.893 and 0.946. Therefore, the results obtained for Cronbach's alpha and composite reliability indexes provide strong evidence that each construct incorporated in the current study has sufficient internal reliability consistency.

Construct validity refers to as “the extent to which an instrument measures what it is intended to measure” [73]. To assess construct validity, two quality criteria are normally used and these are the average variance explained (AVE) and factor loadings to assess convergent validity and discriminant validity. Convergent validity is defined as “the statistical validation process that each measurement item correlates strongly with its assumed theoretical construct”. To evaluate convergent validity, both the AVE and the loading factor have to meet certain statistical requirements. The findings show that the lowest loading factor was found to be 0.755, indicating that the results for all measurement items are well above the minimum recommended cut-off value of 0.6 [73] (Appendix A), and the minimum value for AVE was found to be 0.721 (Table 2), signifying that the results obtained are well exceeding the suggested threshold value of 0.5 for all constructs [78]. Therefore, based on the results obtained in the current analysis for both AVE and loading factor, the model can be considered to exhibit an acceptable level of convergent validity. Furthermore, to assess discriminant validity, Fornell & Larcker [79] developed a widely adopted criterion to establish evidence of discriminant validity and the process should be applied at item-level and construct-level. Discriminant validity refers to as “the statistical validation process that each measurement item correlates more strongly with its theoretically associated construct than other constructs” [80]. With regard to the evaluation of discriminant validity, Appendix B reveals that all measurement items are loading more strongly on their theoretically associated construct than on any other construct [79], demonstrating that the results provide an adequate level of discriminant validity at the item-level. Moreover, to verify the discriminant validity at the construct-level, in accordance with Fornell & Larcker [79], evidence of discriminant validity is demonstrated at the construct-level if the square root of the AVE of each construct (shown in bold in Table 3) exceeds the correlations with any other construct. Based

Table 3
VIF and correlation of constructs values.

		VIFs	1	2	3	4	5	6	7	8	9	10
1	PEoU	1.941	0.842									
2	SN	3.173	0.495	0.860								
3	PRV	2.123	0.176	0.180	0.849							
4	Enjoy	3.069	0.592	0.556	0.232	0.923						
5	Comp	3.101	0.572	0.525	0.204	0.754	0.909					
6	PINS	3.206	0.574	0.711	0.233	0.622	0.623	0.857				
7	PIM	2.53	0.403	0.720	0.123	0.416	0.453	0.675	0.900			
8	PIN	3.014	0.583	0.553	0.305	0.624	0.683	0.629	0.410	0.856		
9	PPR	2.114	0.233	0.057	0.686	0.230	0.246	0.146	0.006	0.271	0.862	
10	BI	3.689	0.512	0.735	0.142	0.629	0.638	0.717	0.629	0.717	0.070	0.902

Note: Square roots of the AVE are the bolded diagonal values.

on Fornell & Larcker [79] criteria, the results displayed in Table 3 provide adequate proof to support the presence of a discriminant validity requirement at the construct-level. In brief, the findings attained in the present research offer strong evidence that the proposed research model exhibits an adequate level of construct reliability and construct validity.

4.2. Structural model evaluation

The findings of the measurement model assessment offer statistical evidence for the existence of construct reliability and validity, indicating that the model is statistically robust and qualifies for the hypothesis testing procedure. However, there are several statistical considerations that need to be looked at before hypothesis testing to guarantee that the research model exhibits a sufficient level of model-data fit. Firstly, the model needs to be free of multicollinearity problems because this problem causes misleading statistical outcomes such as inflation of the variances of regression coefficients that lead to unreliable hypothesis testing [81]. Multicollinearity may occur when correlations among variables exceed 0.7. The presence of multicollinearity in data can be detected by means of a variance inflation factor (VIF) for each construct incorporated in the research model. According to Kock & Lynn [82], a value of more than 5.0 for VIF may indicate the presence of multicollinearity problem. The results of VIF values obtained here for all constructs are displayed in Table 3, these results vary between 1.941 and 3.689, which indicates the nonexistence of multicollinearity problem in the research model. Secondly, the quality of fit of the structural model was judged by computing the total variance explained (R^2 values) by the endogenous variable. The present study explains 76% of the variance in behavioral intention to adopt mobile augmented reality games, demonstrating a good validity of the structural model. Thirdly, WarpPLS offers ten model fit and quality indices [83]. These indices are capable of determining comprehensively the validity of the structure model. Table 4 shows the results of these indices. The results are in harmony with the cut-off values recommended by Kock & Lynn [82], signifying

Table 4
Model Fit and quality indices [83].

Measure	Value	p-values
Average path coefficient (APC) (<0.05)	0.118	P = 0.007
Average R-squared (ARS) (<0.05)	0.762	p < 0.001
Average adjusted R-squared (AARS)	0.750	p < 0.001
Average block VIF (AVIF)	3.289	Good if ≤ 5 , ideally ≤ 3.3
Average full collinearity VIF (AFVIF)	3.036	Acceptable if ≤ 5 , ideally ≤ 3.3
Tenenhous GoF (GoF)	0.747	Small ≥ 0.1 , medium ≥ 0.25 , large ≥ 0.36
Sympson's paradox ratio (SPR)	0.750	Acceptable if ≥ 0.7 , ideally = 1
R-squared contribution ratio (RSCR)	0.940	Acceptable if ≥ 0.9 , ideally = 1
Statistical suppression ratio (SSR)	1.000	Acceptable if ≥ 0.7
Nonlinear bivariate causality direction ratio	1.000	Acceptable if ≥ 0.7

that the proposed model has good structural validity. Finally, the global validity of the model is an essential requirement before implementing hypothesis testing. An approach was proposed by Tenenhaus et al. [84] based on the goodness-of-fit (GoF) principle to allow testing the global validity of the model. WarpPLS estimated a value of 0.747 for the GoF value and is exceeding the recommended threshold value of 0.36 [84] for high R^2 values, signifying that the model can be satisfactorily accepted. In conclusion, the statistical results related to the structural model clearly confirm that the model can be satisfactorily applicable for testing the hypotheses.

4.3. Hypothesis testing

The findings obtained in the preceding section for both measurement and structural models reveal that the model qualifies for the hypothesis testing procedure. The multivariate WarpPLS software was used to perform the hypothesis testing. The hypothesis testing results revealed that all eight hypotheses formulated in the present analysis to explore the impact of perceived ease-of-use, social norms, privacy, perceived enjoyment, perceived competition, perceived inspiration, perceived image, and perceived innovativeness on intention to adopt mobile AR games (H1-H8) were found significant. In the meantime, the empirical data failed to support the four moderating hypotheses included in this study research to examine the moderating effect of perceived physical risk on relationships linking ease-of-use, enjoyment, competition, and inspiration with intentional behavior (H9-H12). The results of the hypothesis testing are displayed in Table 5.

5. Discussion

The present paper proposes a conceptual model to study the adoption of mobile AR games in a developing country environment. Based on a literature review, the author identified nine factors that could impact users' intention towards the adoption of mobile augmented reality games such as Pokémon Go. To the knowledge of the author, there are not many studies that have been carried out to empirically explore the adoption of mobile AR games in developing country situation. Therefore, it will be very difficult to make significant comparisons between current findings and earlier evidence and conclusions. Still, comparisons can be made against findings from the relevant literature, especially studies carried out in developing country contexts. The findings of the

current analysis generate highly important theoretical and practical contributions for better understanding the adoption dynamics of mobile AR games. This study tested 12 hypotheses identified in the proposed model on a dataset of 240 responses collected through an online questionnaire survey by means of multivariate statistical analysis techniques (WarpPLS software). The findings drawn from this study supported eight hypotheses (H1-H8) and the moderating hypothesis (H9-H12) are not supported by the data (Fig. 2 and Table 5). The current results offer statistical evidence that the proposed research model achieved a high degree of explanatory power to explain variation in intention ($R^2 = 76\%$) to adopt mobile AR games, indicating that the proposed model incorporates useful variables.

The current findings show that the perceptions of ease-of-use exert a positive impact on the intentional behavior to adopt mobile AR games (H1: $\beta = 0.091$, $p < 0.05$). Surprisingly, among all the factors, the impact of perceived ease-of-use was empirically deemed to be the least significant criterion in positively affecting the intention to adopt mobile augmented reality games. These results are in harmony with earlier studies conducted in the acceptance of AR applications [39,85]. Also, these findings are consistent with earlier empirical studies that examined factors driving the behavioral intention to adopt mobile AR games [11,19]. The results show that users will be extremely motivated to accept mobile AR games if they perceive it as easy to play. In contrast, an empirical analysis implemented from a developing country perspective concluded that the perceptions of ease-of-use exert a negative influence on behavioral intention to play a location-based mobile AR game [20].

The present findings also provide strong evidence that social norms is an influential factor in influencing behavioral intention to adopt mobile AR games (H2: $\beta = 0.269$, $p < 0.001$). This finding informs that respondents of this study are significantly exposed to social pressure. The current conclusion reinforces the importance of social systems such as family, friends, and peers in driving and encouraging behavior change. The result of the current analysis is in harmony with previous empirical analysis carried out in the context of Pokémon GO [6,15]. More interestingly, the current findings are in harmony with conclusions reported by an empirical study implemented in a developing country environment using non-adopters respondents [20]. Moreover, contrary to what the current study reported, an empirical analysis highlighted that social influence is not correlated to the intention to adopt mobile AR games [11]. According to current findings, social norms (injunctive norms) can be labeled as a significant factor in impacting users' intention to adopt and use AR mobile games.

Moreover, the finding of the current empirical investigation demonstrated that the aspect of privacy has a negative effect on the intentional behavior to adopt mobile AR games (H3: $\beta = -0.100$, $p < 0.05$), indicating that respondents in Jordan are wary of potential privacy violations of personal data when using mobile AR games. Similar findings were reported by previous empirical analyses conducted on the adoption of different augmented reality technologies, tools, and applications [17,20,49]. Indeed, the current finding is in contrast with previous empirical studies, whereby the correlation between privacy and behavioral intention was found to be statistically insignificant [6,19,20]. However, according to the current findings, individuals will not be inclined to adopt AR technologies for gaming unless they are fully comfortable that their privacy is not compromised and well preserved.

The current results confirm the positive empirical correlation between perceived enjoyment and the intention to adopt mobile augmented AR (H4: $\beta = 0.106$, $p < 0.05$). This indicates that the greater the amount of enjoyment a player receives from playing the game, the higher the intention to adopt mobile AR games. Indeed, the results of this analysis conform to the fact that enjoyment usually acts as a positive stimulus to drive users' intention toward playing mobile games. The current findings are in harmony with the findings of several previous studies [6,11,19,55,56]. In the meantime, two studies conducted from a developing country perspective confirmed the importance of perceived enjoyment in predicting the behavioral intention to adopt mobile AR

Table 5
Results of hypothesis testing.

Path	Path Coefficient (β)	p-values	Result
H1: Perceived ease-of-use \rightarrow Behavioral intention	0.091	0.047	Supported
H2: Social norms \rightarrow Behavioral intention	0.269	<0.001	Supported
H3: Privacy \rightarrow Behavioral intention	-0.100	0.034	Supported
H4: Perceived enjoyment \rightarrow Behavioral intention	0.106	0.026	Supported
H5: Perceived competition \rightarrow Behavioral intention	0.101	0.032	Supported
H6: Perceived inspiration \rightarrow Behavioral intention	0.142	0.005	Supported
H7: Perceived image \rightarrow Behavioral intention	0.146	0.004	Supported
H8: Perceived innovativeness \rightarrow Behavioral intention	0.317	<0.001	Supported
H9: Perceived ease-of-use \times Perceived physical risks \rightarrow Behavioral intention	-0.048	0.187	Rejected
H10: Perceived enjoyment \times Perceived physical risks \rightarrow Behavioral intention	0.047	0.195	Rejected
H11: Perceived competition \times Perceived physical risks \rightarrow Intention to adopt	0.044	0.208	Rejected
H12: Perceived inspiration \times Perceived physical risks \rightarrow Behavioral intention	0.010	0.430	Rejected

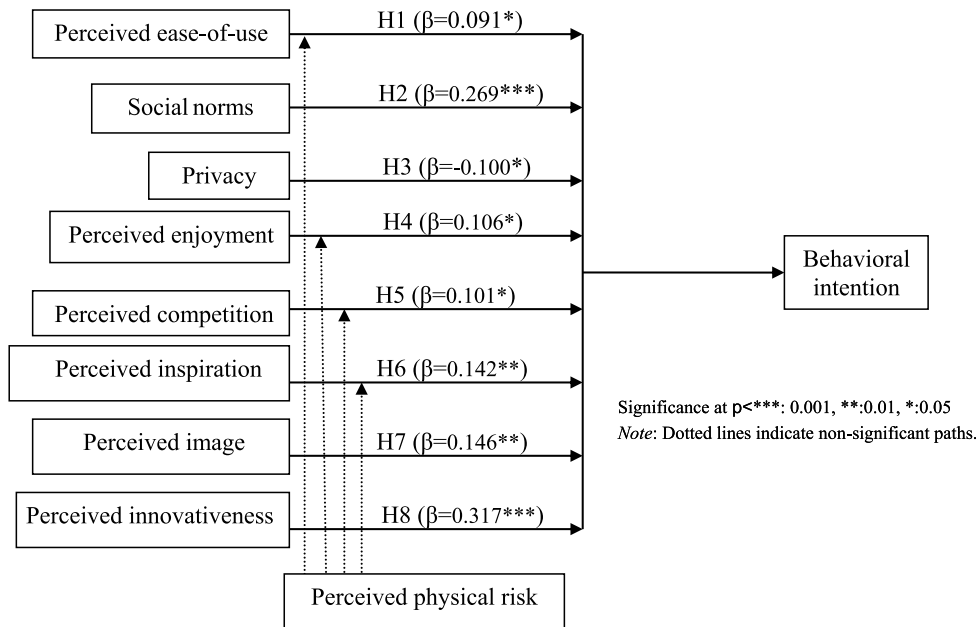


Fig. 2. Results of hypothesis testing.

games [20,21]. This search also provides evidence that perceived competition exerts a positive impact on the intention to adopt mobile AR games (H5: $\beta = 0.101$, $p < 0.05$), indicating that the greater the individual competition strength, the greater the intention towards the adoption of mobile AR games. This means that the competitive nature of individual players exerts a positive influence on the adoption of mobile AR games. The current finding is in harmony with prior findings conducted in various areas of digital gaming technologies [56,86]. In contrast with our expectations, a study concluded that perceived competition is not positively correlated with the intention to reuse mobile AR games, but the study emphasized the significance of perceived enjoyment on in-purchase behavioral intention for playing mobile AR games [19].

Furthermore, the current study found that perceived inspiration has a significant impact on intentional behavior to adopt mobile-based AR games (H6: $\beta = 0.142$, $p = 0.01$). This indicates that the higher the intensity of perceived inspiration, the higher the intentional behavior towards the adoption of mobile AR games. A similar finding was reported in studying the adoption of digitized patient record technology [62]. The present finding points to the fact that if users perceive AR mobile gaming technology as capable of triggering their psychological inspiration, therefore they will be subsequently motivated to adopt and use mobile AR games. Indeed, the novelty of AR technology stems from its ability to drive and generate greater engagement, eliciting positive sensational reactions, emotions, and effects that are easily realized by individuals [59], and leading to inspiring results toward brand acceptance and adoption.

The present study provides strong empirical evidence that user-image perceptions positively enhance intentional behavior to adopt mobile AR games (H7: $\beta = 0.146$, $p < 0.01$). This informs that the greater the image perceptions of gamers, the higher the intention to adopt mobile AR games. Similar conclusions were observed in a study carried out on the adoption of Pokémon Go [6]. Further, an empirical investigation demonstrated the positive role of social value attributes (perceived image) in predicting the intention to play mobile AR games [21]. Without a doubt, the current study reinforces the significance of image attributes in the acceptance and adoption behavior of technological innovation such as mobile AR games. Furthermore, the finding of the current analysis shows that innovativeness exerts a positive statistical effect on an individual's behavioral intention, emphasizing the

significance of innovativeness in the adoption process of mobile AR games (H8: $\beta = 0.317$, $p < 0.001$). This indicates that the greater the individual's innovativeness level, the greater the intention to adopt mobile AR games. The current finding is compatible with findings related to the adoption behavior of various AR-based applications [68–70]. However, among all the factors incorporated in this research, the impact of innovativeness was empirically considered to be the largest in enhancing the intention to adopt mobile AR games, demonstrating that the elements of innovativeness are significant in influencing individuals towards the adoption of mobile AR games. In contrast to the current study's findings, Thongmak [21] emphasized that for both adopters and non-adopters, perceived innovativeness is not positively associated with behavioral intention to play mobile AR games.

Finally, the current results offer statistical evidence that perceived physical risk had no moderating effects on the intensity of the relationships connecting ease-of-use, enjoyment, competition, and inspiration with intention (H9: $\beta = 0.048$, $p = 0.187$; H10: $\beta = 0.047$, $p = 0.195$; H11: $\beta = 0.044$, $p = 0.208$; H12: $\beta = 0.010$, $p = 0.430$). This implies that perceptions of physical risk did not exert any moderating role as hypothesized in the current model. From a statistical perspective, the possible explanation for not detecting any moderating effect of perceived physical risk on the relationships depicted in this model can be made. This study has been conducted using IT university students as a sample, and they should be aware of the potential physical hazards expected while playing mobile-based AR games. Surprisingly, respondents seemed to be unaware of physical risks (Mean = 3.87), given that the standard deviation was 1.60, which computes the coefficient of variation (defined as the ratio of the standard deviation to the mean) to be 0.41, statistically indicating a low variation [87]. The low variation in the perceptions of physical risk among respondents is statistically unlikely to capture any significant moderating effect in this study, indicating that respondents are not sensitive to the issue of physical hazards and risks associated with playing AR games in public spaces.

5.1. Theoretical contributions

This study provides several valuable contributions that strengthen our knowledge concerning the acceptance and adoption dynamics of mobile AR games from a developing country perspective. It is expected that to understand what motivates people to accept and adopt emerging

technological applications such as mobile AR games, there is a need to include several themes of concern to understand this complex phenomenon. First, to the knowledge of the author, this is one of the first research attempts to study the adoption process of mobile AR games from the context of a developing country. Thus, significantly contributing to scholarly knowledge in the domain of gaming. Current findings contribute largely to promoting the understanding of the complex phenomenon of applying AR to drive highly interactive and engaging games. Second, this study draws attention to specific variables in exploring the emerging phenomenon of mobile AR games, but some of these variables have not been investigated in prior research in both developed and developing nations, especially the impact of these variables on behavioral intention to adopt mobile AR games. The IS literature falls short of finding a relevant set of prominent variables that influence the acceptance and adoption of mobile augmented reality games. This study generates new quantitative knowledge concerning the factors that influence the intentional behavior to adopt mobile AR games in the developing country of Jordan. Third, this research has incorporated nine highly relevant determinants in a single model to predict the behavioral intention to adopt mobile augmented reality games, extending IS adoption research into more relevant modeling frontiers by developing a specifically theory-driven model that explains significantly 76% of the variance in intention to adopt mobile-enabled AR games.

Fourth, the present findings highlight the importance of the perceptions of ease-of-use, image, and innovativeness in enhancing the intentional behavior towards the adoption dynamics of AR mobile games. These findings conform to and are in compliance with conclusions established by empirical analysis carried out in the adoption, acceptance, and diffusion of varying technological innovations in various contexts and settings. However, the perceptions of ease-of-use, image, and innovativeness have not been heavily investigated in the adoption process of AR mobile games, in particular developing countries. Therefore, the findings reported by the current research add to the current body of knowledge about the impact of the aspects of ease-of-use, image, and innovativeness on the acceptance and adoption behavior of mobile AR games. Fifth, the finding underlines the importance of social norms in the adoption of mobile AR games in a developing country environment. The role of social norms in the adoption of AR mobile games is interesting in the sense that the aspects of social norms prevailing as an influential factor in promoting positive behavioral change in intention in the context of the emerging technology of mobile AR games. Even though the unique and challenging gaming environments of AR mobile games, still individuals' adherence to social norms in the adoption process of AR gaming technologies is effective. Nevertheless, given the limited evidence of the role of social norms in the adoption behavior of mobile AR games makes the current conclusions are an important addition to the present body of scholarly knowledge. Sixth, the study concluded that privacy concerns negatively impact the intention to adopt mobile augmented reality games, whereby privacy concerns have a long tradition in the literature to be associated with negativity towards the adoption dynamics of technological innovations, particularly online technologies. Seventh, perceived image is an important adoption driver of mobile AR games, reinforcing the significance of perceptions of image in driving technology adoption behavior of mobile AR games. Eighth, the findings of the current analysis offer statistical evidence that hedonic enjoyment, as well as the aspects of competition and innovativeness are prominent drivers in intensifying the level of intention to adopt AR mobile games. However, in relation to the adoption of mobile AR gaming, these types of findings are absent from related IS literature. The current findings powerfully connote that the aspects of enjoyment, competition, and innovativeness are primarily important drivers in enhancing intention toward the adoption of AR mobile games. Finally, the current analysis provides crucial contributions to the IS literature by introducing the aspects of perceived inspiration as a prominent dimension in predicting the intention to adopt mobile AR games. Perceived inspiration has been

rarely examined in prior research in the context of this study. Indeed, the findings of the current research recognize the importance of the inspiration attribute as a core driver in the adoption of mobile AR games.

5.2. Practical implications

The fundamental purpose of the current analysis is to explore the motivations and benefits that induce users to adopt mobile AR games in developing countries. The findings of the current analysis provide insightful implications for mobile augmented reality game designers and developers, marketing managers, and practitioners. Based on the conclusions of the present study, the ease-of-use attribute is an essential criterion for enhancing intention towards the adoption of mobile AR games. Drawing on these findings, game designers and developers should pay attention to ways and methods to facilitate the usage and mastery of mobile AR games. In the meantime, mobile AR games are technologically highly advanced systems, so mobile AR game designers should make these games easy to learn and play by creating an easy to navigate and manage system user-interface as well as reinforcing appealing qualities in terms of content, appearance, and simplicity. Moreover, according to current findings, increasing the role of social norms is an imperative issue for enhancing the intention of users toward the adoption of mobile AR games in a developing country situation like Jordan, where culture is primarily collectivistic in nature. The collective culture has the characteristics to yield to social-environmental pressures and adhere to community-specific behavior patterns. Therefore, marketing managers should make use of the power of social norms in promoting positive intention towards the adoption of mobile AR games. Effectively, the power of social networks can be utilized to reach out to potential users and promote mobile AR games to a global audience, especially the tech-savvy millennial generation. Besides, placing greater emphasis on the importance of reference groups such as influential individuals, family members, friends, peers, and colleagues is beneficial to positively influence the behavioral intention to adopt mobile AR games.

According to current findings, privacy perceptions negatively impact intention towards the adoption of mobile AR games, indicating that mobile AR games exacerbate privacy concerns. Based on these findings, helping to minimize privacy leakage, violations, and threats in mobile AR games, policymakers should secure appropriate and approved mechanisms to guarantee full compliance with personal privacy regulations and policies and transparency requirements. Furthermore, policymakers should make sure that interacting (downloading and playing) with this type of technology does not place personal and gaming data in the hands of third-parties, and the use and sharing of personal information should be implemented with the permission of the users to guarantee that users and their privacy are better handled. This empirical analysis provides statistical evidence that perceived enjoyment is a positive predictor of intentional behavior, highlighting that perceived enjoyment is a primary driver for technology adoption of mobile AR games. These findings necessitate that game developers should find novel ways to reinforce different patterns and aspects of enjoyment across gaming contexts in order to maximize users' levels of enjoyment, engagement, and entertainment. For example, in order to develop an entertaining gaming experience, game developers should focus on including certain features to enhance game flow. In the meantime, game developers need to guarantee that players remain engaged to make playing mobile AR games an exciting and fun gaming experience, potentially leading to greater gaming enjoyment.

Furthermore, according to current findings, the competition attribute is a key motivating driver for gaming. Thus, reinforcing the aspects of individual competitiveness is fundamental for enhancing the intention to adopt mobile AR games. Game designers and developers should place greater emphasis on developing games that trigger individual competitiveness to establish strong momentum towards the adoption of mobile AR games. Therefore, game developers should give emphasis on how to provide users with a competing virtual environment to enhance

users' motivations and challenges to master the game and defeat the opponent.

Besides, this study examined the impact of perceived inspiration on the intention to adopt mobile augmented reality games. The outcomes of this research provide indisputable empirical evidence that inspiration leads to a higher intensity of intention to engage in mobile AR games. Previous research on AR applications supports this view, particularly with respect to marketing tactics and techniques [59,60]. Therefore, mobile AR games should be carefully designed to trigger psychological inspiration to enhance augmentation quality, and this can be achieved by creating entertaining and realistic content that leads to behavioral change [60]. In the meantime, one of the most interesting aspects of inspiration is that it unfolds over time and is temporary in nature [59], implying that an individual's inspiration can be stimulated through the power of AR technologies, particularly in relation to gaming experience. Furthermore, the current study reveals that perceived image positively affects the adoption intention of mobile AR games. From practical perspectives, these findings encourage marketing managers to promote the significance of playing mobile AR games in enhancing the social prestige and status of potential users in their respective social circles. Finally, the present findings provide statistical evidence that individual innovativeness plays a vital role in enhancing the intention towards the adoption of AR mobile games. Therefore, game designers should primarily place great emphasis on improving game aesthetics [20]. Game developers need to exploit the ability of AR to promote innovation awareness and engagement by triggering an individual's inspiration that leads to increase in innovation attitude and intention and consequently subsequent acceptance of the innovation [59].

6. Conclusions

The novelty of augmented reality technology has been responsible

for advancing many application domains such as gaming. AR has the potential to revolutionize gaming practices and mobility. Without a doubt, the current empirical investigation is one of the first attempts to explore the adoption of mobile AR games from a developing country's viewpoint. This article has considerably contributed to the body of knowledge in the domain of gaming. The outcomes of this study reveal that the adoption of this new gaming format is motivated by various factors such as technology characteristics, hedonic motivations, emotional stimuli, innovativeness, perceptions of image and competence, and social norms but is limited by privacy concerns. Finally, the current study will hopefully open the scene for new research avenues and directions since this promising research in an emerging technology domain merits further academic attention and investigation.

6.1. Limitations and future studies

Despite the contributions drawn from the current study, there are various fundamental issues and themes that could provide fruitful avenues for further future research prospects. First, addressing the difference in perceptions between mobile AR game adopters and non-adopters can provide important theoretical and practical outcomes. Second, including other potential factors, demographic variables, and in-country cultural differences could provide interesting findings in investigating the adoption of mobile AR games. Third, sample expansion in terms of size and geography improves the generalisability of the findings. Fourth, the study can be replicated using a sample of both players and non-players. Finally, the inclusion of other types of respondents can enrich and deepen our knowledge of the perceptions of the acceptance and adoption of the technological innovation of AR gaming from a variety of perspectives, viewpoints, and interests.

Appendix A. Measures and factor loadings

Construct (Sources)	Item Code	Items	Factor loading
Perceived ease-of-use (Davis, 1989)	PEoU1	I think it is easy to play Mobile AR games.	0.867
	PEoU2	Mobile AR games are easy to play.	0.835
	PEoU3	It is very easy for me to learn to play mobile AR games.	0.860
	PEoU4	Mobile AR games are clear and understandable.	0.806
Social norms (et al., 2012)	SN1	People who influence my behavior think I should play mobile AR games.	0.845
	SN2	People whose opinions I value encourage me to play mobile AR games.	0.887
	SN3	People who are important to me (my family) expect me to play mobile AR games.	0.809
	SN4	My close friends expect me to play mobile AR games.	0.890
	SN5	My colleagues expect me to play mobile AR games.	0.867
Privacy (Malhotra et al., 2004)	PRV1	I think mobile AR games will collect too much personal information about me.	0.763
	PRV2	I will worry that mobile AR games leak my personal information to irrelevant third-parties.	0.863
	PRV3	If I were to download and use an mobile AR game, I would be concerned that the game would violate my privacy.	0.892
	PRV4	If I were to download and a mobile AR game, I would be concerned that the game would misuse my personal information.	0.871
Perceived enjoyment (Venkatesh et al., 2012)	Enjoy1	Playing mobile AR games is entertaining	0.922
	Enjoy2	Playing mobile AR games is fun.	0.942
	Enjoy3	Playing mobile AR games is exciting	0.906
Perceived competition (Demetrovics et al., 2011)	Comp1	I enjoy competing with others.	0.899
	Comp2	I like to win.	0.926
	Comp3	It is good to feel that I am better than others.	0.903
Perceived inspiration (Rauschnabel et al., 2019)	PINS1	Mobile AR games inspire me in a way.	0.856
	PINS2	Mobile AR games stimulate my thinking.	0.873
	PINS3	Mobile AR games give me new ideas and view.	0.842
Perceived image (Moore & Benbasat, 1991)	PIM1	People who play mobile AR games have more prestige than those who do not.	0.881
	PIM2	People who play mobile AR games have a high profile in their social system.	0.940
	PIM3	Playing mobile AR games is a symbol of social status	0.877
Perceived innovativeness (Agarwal & Prasad, 1998)	PIN1	I am sure I will be one of the firsts who will try to play mobile AR game	0.755
	PIN2	I am really keen into exploring new technologies such as mobile AR games.	0.905
	PIN3	I always try to learn as much as possible regarding new technologies such as mobile AR games.	0.891
	PIN4	In general, I am not hesitant to try out new information technologies such as mobile AR games.	0.864

(continued on next page)

(continued)

Construct (Sources)	Item Code	Items	Factor loading
Perceived physical risksh (Rauschnabel et al., 2017)	PPR1	I fear that I recognize risks in the real world too late while playing mobile AR games.	0.839
	PPR2	Mobile AR games distract me from immediate danger around me.	0.899
	PPR3	One risk of playing mobile AR games is being distracted.	0.847
Behavioral Intention (Venkatesh et al., 2012)	BI1	I intend to play mobile AR games	0.901
	BI2	I predict I will play mobile AR games.	0.913
	BI3	I plan to play mobile AR games in the future.	0.919
	BI4	In the future, I will play mobile AR games significantly more often than other online games.	0.874

Appendix B. Cross-loadings matrix

	PEoU	SN	PRV	Enjoy	C	PINS	PIM	PIN	PPR	BI
PEoU1	0.867	0.007	0.060	−0.005	0.023	−0.011	−0.019	0.062	−0.005	−0.077
PEoU2	0.835	−0.154	0.097	−0.292	0.070	0.000	0.003	−0.221	−0.045	0.280
PEoU3	0.860	0.141	−0.127	0.026	−0.077	0.006	0.068	0.216	0.064	−0.166
PEoU4	0.806	0.001	−0.030	0.280	−0.015	0.005	−0.055	−0.067	−0.017	−0.030
SN1	0.111	0.845	−0.091	−0.104	0.014	0.178	0.025	0.026	0.078	−0.308
SN2	−0.021	0.887	−0.011	−0.015	0.010	0.128	−0.016	−0.077	0.023	−0.169
SN3	−0.016	0.809	0.005	0.088	−0.069	−0.184	0.226	−0.134	−0.061	0.261
SN4	−0.047	0.890	−0.020	0.030	0.042	−0.055	−0.186	0.067	0.059	0.080
SN5	−0.023	0.867	0.116	0.004	−0.002	−0.076	−0.028	0.110	−0.104	0.147
PRV1	0.103	−0.186	0.763	−0.153	0.095	0.154	−0.067	0.117	−0.253	0.186
PRV2	−0.064	−0.054	0.863	0.025	0.036	0.070	0.120	0.044	−0.084	−0.212
PRV3	0.028	0.154	0.892	−0.089	0.044	−0.105	−0.039	−0.011	0.159	−0.025
PRV4	−0.056	0.059	0.871	0.200	−0.164	−0.096	−0.020	−0.136	0.143	0.072
Enjoy1	−0.034	0.091	−0.099	0.922	0.025	0.071	−0.013	−0.002	0.044	−0.108
Enjoy2	0.012	−0.058	0.089	0.942	0.044	−0.115	0.064	−0.065	−0.058	0.078
Enjoy3	0.023	−0.033	0.007	0.906	−0.071	0.047	−0.054	0.070	0.015	0.029
Comp1	0.070	−0.064	0.025	0.048	0.899	−0.097	0.002	−0.019	−0.081	0.052
Comp2	−0.071	−0.036	−0.027	−0.026	0.926	0.114	0.003	0.002	0.054	−0.033
Comp3	0.004	0.100	0.002	−0.021	0.903	−0.021	−0.005	0.017	0.025	−0.017
PINS1	0.000	−0.101	0.096	0.106	0.038	0.856	0.033	−0.133	−0.087	0.261
PINS2	−0.067	−0.105	0.078	−0.08	0.047	0.873	−0.039	−0.006	−0.100	−0.047
PINS3	0.069	0.212	−0.179	−0.025	−0.088	0.842	0.006	0.142	0.192	−0.217
PIM1	0.087	0.008	−0.148	0.060	−0.015	0.031	0.881	−0.029	0.170	−0.122
PIM2	0.018	−0.035	0.075	−0.111	0.061	0.070	0.940	0.026	−0.094	−0.036
PIM3	−0.107	0.030	0.068	0.058	−0.050	−0.107	0.877	0.001	−0.071	0.162
PIN1	0.084	0.053	−0.020	−0.018	−0.195	0.082	0.135	0.755	−0.028	0.479
PIN2	0.054	0.064	0.094	0.027	−0.068	0.061	−0.102	0.905	−0.084	−0.153
PIN3	−0.077	−0.065	−0.097	−0.069	0.101	−0.030	0.025	0.891	0.075	−0.045
PIN4	−0.051	−0.046	0.018	0.059	0.138	−0.104	−0.038	0.864	0.035	−0.213
PPR1	0.120	0.020	0.323	0.100	−0.100	−0.111	0.043	0.041	0.839	−0.080
PPR2	0.056	0.053	−0.119	−0.042	−0.040	0.015	−0.002	−0.029	0.899	0.042
PPR3	−0.178	−0.076	−0.194	−0.055	0.141	0.094	−0.040	−0.011	0.847	0.035
BI1	−0.009	0.192	−0.007	0.071	−0.032	−0.067	−0.074	0.197	−0.014	0.901
BI2	−0.085	0.070	0.009	0.043	0.011	0.071	−0.039	−0.132	0.023	0.913
BI3	0.016	−0.06	−0.021	−0.125	0.062	0.081	−0.128	−0.127	0.055	0.919
BI4	0.082	−0.207	0.020	0.014	−0.043	−0.090	0.251	0.069	−0.067	0.874

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