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Examining metaverse game platform adoption: Insights from innovation, behavior, and coolness

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ABSTRACT

The primary objective of this study is to examine the factors influencing player acceptance of metaverse game platforms. In pursuit of this goal, we introduce an integrated adoption model for metaverse game platforms, drawing insights from four established academic frameworks: the diffusion of innovation theory, hedonic and utilitarian concepts, the theory of planned behavior, and the coolness concept. This integrated approach enhances our comprehension of the user experience. Our research involved the collection of 1447 validated samples, and we employed both structural equation modeling and confirmatory factor analysis to scrutinize the proposed research model. The statistical findings affirm the substantial roles played by compatibility, trialability, complexity, attractiveness, and subcultural influence as indirect factors, along with attitude and enjoyment as direct determinants, contributing to players' intention to use these platforms. Drawing from these implications, we put forth several theoretical and practical foundations for future investigations into metaverse game platforms, while also acknowledging certain limitations.

1. Introduction

The emergence of metaverse game platforms marks a significant shift in digital interaction, promising to redefine our engagement with technology and social dynamics [1,2]. These platforms, blending elements of virtual and augmented reality with online gaming, offer immersive universes where users can live, work, and socialize [3]. With the recent exponential growth examined by technological advancements and the desire for digital escapism and connectivity [4], understanding their impact becomes significant [5].

Central to the appeal of metaverse game platforms is the sense of community and social interaction they facilitate, akin to real-life dynamics, fostering deep connections and friendships [6]. While Second Life presented the main concept in 2003, subsequent platforms like IMVU and Kaneva followed suit, albeit facing early challenges in hardware accessibility and internet infrastructure [7–9].

Based on this trend, this study aims to comprehensively improve our understanding of metaverse game platforms and their future potential. We introduce a research model based on four user-oriented approaches – diffusion of innovation theory, coolness concept, hedonic and utilitarian concept, and theory of planned behavior – to elucidate motivational factors and potential hindrances in platform adoption. By analyzing historical evolution alongside key features and functionalities, the findings of the current study can provide several significant insights for understanding and shaping the future trajectory of these platforms.

The remainder of this study is organized as follows: Following a review of the literature and hypotheses, as well as an introduction to the research model, we present our data collection methods and approaches. Then, we analyze the statistical results. Finally, we discuss implications and limitations.

2. Literature review and hypotheses

2.1. Diffusion of innovation theory

The diffusion of innovation theory, initially proposed by Rogers and Cartano [10], is a well-established framework aimed at explaining how new ideas, technologies, and products disseminate throughout society. This theory has been widely explored and applied across various domains, including marketing, economics, and public health [11,12]. At its core, the theory posits that the adoption of an innovation follows a predictable pattern over time, with specific characteristics of the innovation and the adopters influencing the rate and extent of adoption.

Rogers [13] presented five pivotal stages within the diffusion

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process: awareness, interest, evaluation, trial, and adoption. These stages represent the sequential steps that individuals or organizations undergo when contemplating and eventually embracing an innovation. Furthermore, Rogers [13] identified several factors that shape the diffusion process, including the relative advantage of the innovation, its compatibility with existing values and practices, its complexity, the ease of trial and observability, and the communication channels employed to disseminate information about the innovation.

One of the key strengths of the diffusion of innovation theory is its capacity to elucidate adoption patterns across diverse contexts and populations. Numerous studies scrutinized the diffusion of various innovations, spanning from novel technologies to healthcare interventions, consistently finding that the theory adeptly anticipates and explains adoption rates [14]. For instance, in an examination of the adoption of new agricultural practices in India, Chakrabarti et al. [87] ascertained that ease of observability and compatibility with existing practices significantly influenced adoption.

Another substantial strength of the diffusion of innovation theory is its utility in shaping interventions designed to foster the adoption of new innovations. Researchers and practitioners successfully employed the theory to devise strategies for promoting the adoption of diverse innovations, ranging from novel healthcare interventions to sustainable energy practices [15]. Thus, by examining the diffusion process for new innovations, we can identify barriers and challenges that may impede the adoption of metaverse game platforms. These barriers could include technological limitations, cost factors, lack of awareness, or resistance to change [16]. Understanding these barriers allows us to develop targeted interventions to overcome them [17]. It can highlight the importance of continuous innovation and evolution in sustaining the adoption and growth of metaverse game platforms [18]. As user preferences and technological capabilities evolve, platform developers must adapt and innovate to meet changing demands and stay ahead of competitors.

It means that the diffusion of innovation theory remains a valuable framework for comprehending and forecasting the diffusion of innovations [19,20] As new technologies and ideas continue to emerge, the theory is likely to persist in its application and evolution, offering insights into the spread of innovations and strategies for promoting their adoption. Related to metaverse game platforms, the diffusion of innovation theory suggests that the adoption of these virtual worlds follows a predictable pattern, influenced by various factors. The platforms, with their immersive digital environments, can be analyzed through the lens of the diffusion of innovation theory to understand how users progress through the stages of awareness, interest, evaluation, trial, and adoption.

2.1.1. Compatibility

The general definition of perceived compatibility is "*the degree to which an innovation is perceived as consistent with the existing values, past experiences and needs of adopters*" [21]. Simply, it signifies how well the innovation harmonizes with the attitudes, beliefs, and practices of prospective users. Thus, in the specific domain of metaverse game platforms, perceived compatibility can exert a profound influence on users' attitudes and behaviors towards these digital environments. Users who perceive a metaverse platform as compatible with their established online gaming practices and social preferences are more inclined to exhibit a positive attitude towards the platform and a heightened motivation to immerse themselves within it.

Related to innovative technologies, there are some examples on the role of perceived compatibility in determining user behaviour. For example, Venkatesh and Bala [22], indicated that perceived compatibility of an e-learning system was found to be positively related to users' attitude toward the system and their intention to use it. Similarly, Acikgoz, Elwalda, and De Oliveira [23] showed that perceived compatibility has a positive effect on users' attitude toward cutting-edge technologies and their intention to use them. Thus, we assume that there can be a positive relationship between perceived compatibility of and attitude toward metaverse game platforms with the following hypothesis.

- **H1**. Players' perceived compatibility of metaverse game platforms has notable effects on their attitude toward the platforms.

2.1.2. Observability

Observability is mainly defined as "*the level to which the results of an innovation are visible to others*" [24]. It means that the level of observability reflects the outcomes or advantages of an innovation are readily apparent and can be communicated to others. Simply put, it pertains to how visible an innovation is and how easily potential adopters can perceive its impact. Observability is recognized as a pivotal factor shaping the likelihood of an innovation being embraced and actively employed by prospective users. An innovation that is easily observable and demonstrates clear benefits to others is inherently more likely to be accepted and put into use compared to one that remains hidden or possesses ambiguous advantages.

In the sphere of specific technologies, observability plays a crucial role in influencing users' attitudes and behaviors towards the technology in question. Users who can readily witness the benefits of a technology and its positive impact on others are more inclined to foster a positive attitude towards the technology and be motivated to engage with it. For instance, Dilotstotlhe [88] indicated that the observability of users' purchasing behavior was presented to be positively associated with users' attitude towards the community and their intention to actively participate in it. Moreover, Davis [25], the observability of a computer system was found to be positively correlated with users' attitude towards the system and their intention to use it.

It is important to acknowledge that the relationship between observability and users' attitudes towards specific technologies may not always follow a straightforward path and can be influenced by an integration of other factors. Therefore, when examining user attitudes and behaviors within the context of specific technologies, it is imperative to consider the intricate interplay between observability and these multifaceted factors.

That is, observability stands as a pivotal factor in the adoption and utilization of new technologies, products, or services. Specifically, within the domain of specific technologies, observability can wield a substantial impact on users' attitudes and behaviors. Therefore, based on the findings of the validated relationship between observability and attitude, the following hypothesis is proposed.

- **H2**. Players' perceived observability of metaverse game platforms has notable effects on their attitude toward the platforms.

2.1.3. Trialability

Trialability is defined as "*the degree to which an innovation may be experimented with on limited basis*" [24]. In general, it is one of the fundamental factors, which significantly shape users' attitudes and behaviors towards innovative technologies. When potential users have the opportunity to experiment with an innovation before fully committing to it, they are more likely to develop favorable attitudes toward the technology and become willing to adopt it [26]. It is primarily because trialability affords users the chance to directly experience the benefits of the innovation, thereby bolstering their confidence in the technology and diminishing their perceived risks [27].

In the context of distinct technologies, trialability wields a profound influence over users' attitudes and behaviors towards the technology at hand. For instance, Rogers and Shoemaker [28] indicated that the trialability of an agricultural innovation played a positive determinant of farmers' attitudes towards the innovation and their intent to embrace it. More recently, Ghazali et al. [29] showed that the trialability of innovative technologies and devices was considered to form users' attitudes towards the technologies/devices and their intentions to utilize it. Therefore, we hypothesize the relationship between the trialability of

and attitude toward metaverse game platforms, based on the findings of prior research on innovation technologies and services.

- **H3**. Players' perceived trialability of metaverse game platforms has notable effects on their attitude toward the platforms.

2.1.4. Complexity

We focus on the concept of complexity, which refers to "*the level to which an innovation is perceived as difficult to understand and use*" [13]. Several scholars consistently demonstrated that the perceived complexity of a technology plays a pivotal role in shaping users' attitudes and behaviors toward specific innovations [12]. Notably, a high-perceived complexity could engender negative attitudes and behaviors, potentially impeding the adoption and diffusion of the technology [30]. This is primarily because users may encounter difficulties in learning how to operate the technology, leading to frustration and a diminished motivation to continue using it.

Conversely, technologies, which are perceived as straightforward and user-friendly, are more likely to witness rapid adoption and diffusion. Users are prone to developing positive attitudes toward such technologies, which in turn heightens their motivation to employ the technology and recommend it to others [31]. Venkatesh and Davis [32] showed that the perceived complexity of an e-mail system exhibited a negative correlation with users' attitudes toward the system, while Karahanna et al. [33] validated the role of the perceived complexity of a group support system as a key factor of users' behavior of the system.

In conclusion, complexity stands as a critical factor influencing users' attitude toward innovative technologies [34]. In case of specific technologies, heightened perceived complexity can give rise to negative attitudes and behaviors, potentially hindering the technology's widespread adoption and diffusion. Thus, related to metaverse game platforms, we present the following hypothesis.

- **H4**. Players' perceived complexity of metaverse game platforms has notable effects on their attitude toward the platforms.

2.1.5. Relative advantage

The definition of relative advantage is "*the degree to which the innovation is perceived as being better than the alternative it supercedes*" [35]. Prior research consistently underscored the notable role of relative advantage in forming users' attitudes toward specific technologies [36]. To elaborate, technologies perceived as offering a greater relative advantage over existing alternatives tend to experience swift adoption and diffusion. This phenomenon stems from users' increased perception of the technology's utility and benefits, which, in turn, enhances their motivation to employ it and recommend it to others.

Conversely, technologies perceived as offering a lower relative advantage in comparison to existing alternatives encounter slower adoption and diffusion rates. This is largely due to users failing to perceive the technology as particularly useful or advantageous, consequently diminishing their motivation to engage with it and promote it to others [37]. For instance, Rogers [13] presented that the perceived relative advantage of cellular phones exhibited a positive correlation with users' adoption of the technology. Moreover, Venkatesh and Davis [32] pointed out the perceived relative advantage of an e-mail system as a key determinant of users' attitudes towards and intention to use the system. Recently, Kumar et al. [38] proposed an unique academic framework for providing the better understanding of the enterprise metaverse acceptance through the diffusion of innovation theory, and confirmed the significant role of relative advantages in determining users' behavioral intention to use with consideration of 214 responses in Saudi Arabia. Thus, considering the validated role of perceived relative advantage of innovative technologies/services, we present the following hypotheses.

- **H5**. Players' perceived relative advantage of metaverse game platforms has notable effects on their attitude toward the platforms.
- **H6**. Players' perceived relative advantage of metaverse game platforms has notable effects on their intention to use the platforms.

2.2. Coolness concept

The concept of "coolness" is one of the main subjects and debates across multiple disciplines, including sociology, marketing, and psychology. Coolness is often characterized as an attitude or style, which signifies a sense of cultural or social status and is associated with qualities such as confidence, independence, and authenticity. However, defining coolness is highly subjective and can vary significantly across cultures and time periods.

One of the earliest and most influential examinations of coolness was undertaken by sociologist Thorstein Veblen in the early 20th century [39]. Veblen argued that coolness represented a form of social distinction closely linked to the consumption of goods and services that signaled one's status. This idea was further developed by other sociologists who identified various indicators of coolness, including fashion, music, and slang.

Recently, several researchers focused on both psychological and neurological aspects of coolness [40,41]. For example, Dar-Nimrod & Hansen [42] indicated that users who considered themselves cool were more likely to possess certain personality traits, such as extraversion, openness to new experiences, and emotional stability. Furthermore, they revealed that those who perceived themselves as cool exhibited heightened activity in specific brain regions associated with reward processing and self-control.

Another coolness research area on coolness concentrated on its connection with consumer behavior [43]. Marketers have long recognized the potency of coolness in shaping consumer preferences and attitudes and have devised various strategies to harness coolness as a marketing tool. For example, Sundar et al. [54] highlighted the role of coolness in the success of Apple's iPod, which was marketed as a stylish and innovative device. Moreover, Eckhardt and Hirschman [44] emphasized the significance of coolness in the consumption of craft beer, which was associated with authenticity and independence. Thus, we consider the coolness concept as one of the main backgrounds in addressing players' behavior of metaverse game platforms.

2.2.1. Attractiveness

When users plan to utilize a specific service that possesses enhanced appeal, they become intrigued by its external appearance and the aesthetic components [41,45]. Despite the undeniable significance and intrinsic value of aesthetic elements in user perception, a number of user behavior researchers conducted some investigations into the impacts of these features [46]. Prominent companies introduced novel, globally successful devices, with a pronounced focus on both internal and external aspects. Consequently, attributes such as attractiveness and utility are presented as fundamental considerations for companies operating within the ICT sector [47,48]. Kim et al. [43] showed that users' perceived attractiveness of curved-screen smartphones has notable effects on their attitude toward the smartphones with consideration of 278 samples. Moreover, Kim and Park [40] explored users' behavior of interactive wearable devices, and examined that their perceived attractiveness play significant determinants of their behavior, as well as their utility. Thus, we assumed that the attractiveness in the coolness concept of innovative technologies, as well as metaverse game platforms, is positively related to the attitude toward the technologies, and proposed the following hypothesis.

- **H7**. Players' perceived attractiveness of metaverse game platforms has notable effects on their attitude toward the platforms.

2.2.2. Originality

In general, originality is defined as "*the degree of novelty and differentiation that some people achieve by performing specific actions*" [49]. Thus, related to metaverse game platforms, we examined the definition of originality as "*the level of novelty and differentiation that a player achieves by performing specific actions*". The platforms characterized by well-made designs and functions are referred as unique and outstanding [50]. It means that using such platforms allow users to have a feeling of distinctiveness, compared to traditional platforms, which have similar functions [40,43,51]. For instance, Borau et al. [52] introduced the conceptual research model for examining the role of perceived attractiveness on the attitude toward images, and validated that the attractiveness plays a direct determinant of the attitude with consideration of marketing domains. Thus, we present the following hypothesis, based on the findings of prior research on the role of attractiveness.

- **H8**. Players' perceived originality of metaverse game platforms has notable effects on their attitude toward the platforms.

2.2.3. Subcultural appeal

Users are more likely to amplify their subcultural feeling and individuality through the possession of cool 'something', which can contribute to their distinctiveness by reflecting the personal interests. Using this distinctive gadget, one-of-a-kind services can satisfy users' inherent desire for social uniqueness [53,54]. Lv et al. [47] indicated that the diffusion and users' intention to use newly introduced devices and services are mainly affected their perceived subcultural appeal with consideration more than 640 citizens in China. Moreover, Sundar et al. [54] argued that users' perceived subcultural allure of specific IT services can be a pivotal element, fostering an awareness of rarity and social differentiation. Building on this premise, the subcultural appeal of metaverse game platforms is examined as one of the significant motivations influencing users' general attitude toward the platforms. Therefore, we present the following hypothesis.

- **H9**. Players' perceived subcultural appeal of metaverse game platforms has notable effects on their attitude toward the platforms.

2.3. Hedonic and utilitarian concepts

Hedonic and utilitarian values represent fundamental concepts within the context of user experience research, frequently employed to elucidate user sentiments toward specific technologies and services [55]. Hedonic value encompasses the perceived delight or enjoyment users derive from using a service, while utilitarian value pertains to the capacity of the service to assist users in achieving their objectives or executing tasks more efficiently [56].

Numerous studies have delved into the impact of hedonic and utilitarian values on user attitudes toward a specific technology. For instance, Lee and Koubek [57] examined the usability of a digital camera, and found that both hedonic and utilitarian values exerted substantial influence on user satisfaction and attitudes toward the product. They also revealed that hedonic value was positively correlated with user satisfaction and attitude, whereas utilitarian value wielded a more pronounced influence on user satisfaction. Yuan et al. [90] also indicated that users' willingness to accept innovative technologies is mainly determined by their utilitarian and hedonic values.

Moreover, several scholars unveiled that hedonic and utilitarian values can interact, shaping user attitudes [58]. For example, Chen, Chung, and Tsai [59] observed that when users perceive a technology as possessing substantial hedonic value, utilitarian value assumes greater importance in shaping their attitudes. Conversely, when a technology is perceived as offering limited hedonic value, utilitarian value exerts a weaker impact on user attitudes.

Furthermore, the significance of hedonic and utilitarian values may fluctuate contingent on the context and the type of technology in question. For instance, in an investigation focusing on the adoption of smartwatches, Koivisto and Hamari [60] found that hedonic value held greater sway in shaping user attitudes toward smartwatches than utilitarian value. In summation, both hedonic and utilitarian values stand as pivotal factors influencing user attitudes toward technology. Designers and developers should contemplate strategies to enhance both categories of value to forge more gratifying and efficacious user experiences in metaverse game platforms.

2.3.1. Enjoyment

Because metaverse game platforms are intricate systems, which provide game services, contents and related functions [61], the perceived enjoyment derived from these games can play a substantial role in influencing other psychological constructs. Davis [25,62] showed that perceived enjoyment serves as an intrinsic motivation for the intention to use information services and systems. The general term of perceived enjoyment is "*the extent to which the activity of using a particular system is perceived to be enjoyable in its own right, aside from any performance consequences resulting from system use*" [63]. Building upon this definition, we define perceived enjoyment as "*the extent to which the activity of using metaverse game platforms is perceived to be enjoyable in its own right, apart from the instrumental value of the platforms*" [64].

Considering the platforms, they are primarily designed for players to elaborate their enjoyment from playing them. Consequently, the relationships and findings, which are presented in prior research in the context of metaverse game platforms, can be applicable. Prior research indicated that perceived enjoyment underscored its significance as a determinant of users' attitude toward and intention to use specific systems or services. For instance, Ha et al. [65] pointed out that perceived enjoyment holds the utmost importance in shaping users' attitudes toward mobile internet services. In the context of game-related services, Park et al. [66] found that users' perceived enjoyment plays a pivotal determinant of their attitude toward and intention to use mobile social network games with consideration of more than 1400 game players. Thus, based on the findings of prior research, we formulate the following hypotheses.

- **H10**. Players' perceived enjoyment of metaverse game platforms has notable effects on their attitude toward the platforms.
- **H11**. Players' perceived enjoyment of metaverse game platforms has notable effects on their intention to use the platforms.

2.4. Theory of planned behavior

The Theory of Planned Behavior (TPB) is one of the well-established theoretical frameworks, which aim to help us understand human behavior [67]. TPB, which is developed by the theory of reasoned action, is organized by three key constructs, attitudes, subjective norms, and perceived behavioral control.

A number of scholars utilized TPB to explore a wide range of behaviors, expanding areas including technology adoption, reasoning behavior and smoking habits. For example, Venkatesh, Morris, Davis, and Davis [68] discovered that individuals' attitudes, subjective norms, and perceived behavioral control were significant predictors of their behavioral intentions to adopt specific information technologies. Significantly, perceived behavioral control emerged as the most influential factor in shaping adoption intentions. In addition, Kim, Ferrin, and Rao [91] found that TPB provided a valuable framework for comprehending user behavior. Their findings revealed that attitudes, subjective norms, and perceived behavioral control were all significant predictors of individuals' intentions to embrace online grocery shopping. That is, TPB stands as a valuable theoretical framework for grasping human behavior [69]. By focusing on attitudes, subjective norms, and perceived behavioral control, researchers can pinpoint the crucial factors that influence behavior and develop interventions aimed at promoting desired behaviors.

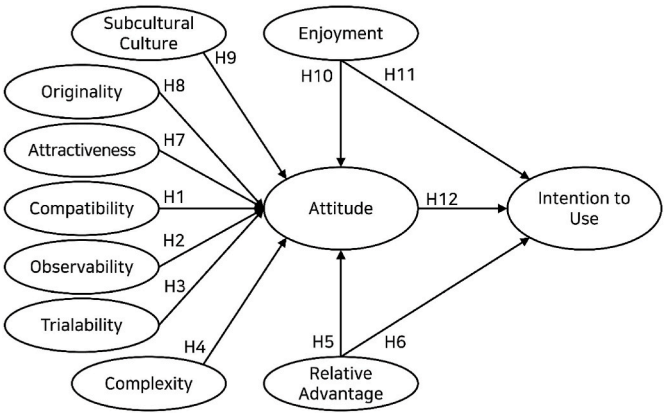

Fig. 1. The research model.

Table 1
Questionnaire items in the survey.

Construct	Items
Intention to use [55, 62]	IU1: "*I intend to use metaverse game platforms as much as possible*" IU2: "*I intend to continually use metaverse game platforms*" IU3: "*I recommend that other consumers use mataverse game platforms*"
Attitude [40,43]	AT1: "*I think using metaverse game platforms is a wise idea*" AT2: "*I have positive feelings toward metaverse game platforms*" AT3: "*I think using metaverse game platforms is better than using other devices*"
Compatibility [71,72]	CPT1: "*Using metaverse game platforms fits with my style*" CPT2: "*Metaverse game platforms are compatible with all aspects of my life*" CPT3: "*Using metaverse game platforms fits well with the way I like to play*"
Observability [73,74]	OBS1: "*My colleagues believe that metaverse game platforms are a useful technology for me*" OBS2: "*The adopters of metaverse game platforms suggest that I have to use the platforms for their innovative features*" OBS3: "*It is important for me to observe the benefits of other users playing metaverse game platforms*"
Trialability [75,76]	TRI1: "*Before deciding, I would be able to try metaverse game platforms out properly*" TRI2: "*Before deciding, I would be able to use metaverse game platforms on a trial basis*" TRI3: "*Metaverse game platforms provides chances for future usage*"
Complexity [77,78]	CPX1: "*I find metaverse game platforms are difficult to play*" CPX2: "*Using metaverse game platforms takes too much time*" CPX3: "*It takes too long to learn how to use metaverse game plaforms to make it worth the effort*"
Enjoyment [64,79]	ENJ1: "*I am not bored while using metaverse game platforms*" ENJ2: "*Playing metaverse game platforms is interesting*" ENJ3: "*Playing metaverse game platforms is enjoyable*" ENJ4: "*I have fun playing metaverse game platforms*"
Originality [43,80]	OR1: "*Metaverse game platforms are unique*" OR2: "*Metaverse game platforms are original*" OR3: "*Metaverse game platforms stand apart from other devices*"
Attractiveness [43,80]	ATT1: Metaverse game platforms are fashionable ATT2: Metaverse game platforms are stylish ATT3: Metaverse game platforms are hip
Subcultural appeal [81]	SA1: "*Using metaverse game platforms makes me stand apart from others*" SA2: "*Metaverse game platforms differentiate me from others*" SA3: "*Consumers of metaverse game platforms are unique*"
Relative advantage [40,55]	RA1: "*Metaverse game platforms are a beneficial tool for me*" RA2: "*Using Metaverse game platforms helps me effectively achieve my purpose*" RA3: "*The purpose, functions and applications of metaverse game platforms are useful*"

2.4.1. Attitude

The connection between users' attitude toward and intention to use particular services/technologies has been highlighted in both practical and academic research. Grounded in the theory of reasoned action and TPB, their attitudes emerge as influential determinants of behavioral intention, a great predictor of real-world behavior [67,70]. Attitude pertains to an individual's judgment, either negative or positive, considering his/her behavior under consideration. Generally, it is shaped by his/her convictions on the potential outcomes related to engaging in the behavior. Related to the adoption of specific technologies, users' attitude toward the technologies mirrors their perspectives toward the advantages and disadvantages, which are linked to their usage.

A number of empirical research provided evidence for the connection between users' attitude and their intention to employ particular technologies. For instance, Park [41] indicated that users' attitude toward smart televisions (smart TVs) was a notable predictor of their behavioral intention to employ smart TVs with consideration of over 1100 respondents in South Korea. Furthermore, Jeong et al. [89] validated the role of consumer attitude toward over-the-top services in determining his/her intention to use the services, based on the structural results with 1302 service users. Therefore, in metaverse game platforms, which are one of the innovative and unique services, users' attitude toward the platforms is a potential predictor of their intention to use the platforms. That is, the following hypothesis is proposed.

- **H12.** Players' attitude toward metaverse game platforms has notable effects on their intention to use the platforms.

2.5. Research model

Based on the proposed hypotheses, we introduce the research model for metaverse game platforms (Fig. 1).

3. Study methodology

3.1. Questionnaire design

To build the questionnaire items for this study, the instructions of prior research were employed [11]. Fifty questionnaire items were collected from several prior user behavior research. Five experts reviewed and corrected the questionnaire items for the purpose of the current study. Then, we examined a pilot survey session with twenty two students, who had more than three-month experience on metaverse game platforms. Cronbach's alpha levels were computed for excluding 16 items, which did not meet the criteria. The main survey was conducted with 34 items (Table 1).

3.2. Main survey

We employed two South Korean professional survey organizations for a month in 2023. We selected these organizations, because they were

Table 2
Results of descriptive analysis.

Construct	Mean (Standard deviation)	Construct	Mean (Standard deviation)
Intention to use	5.01 (0.94)	Enjoyment	5.12 (0.84)
Attitude	4.98 (0.92)	Originality	5.04 (0.82)
Compatibility	5.00 (1.04)	Attractiveness	4.89 (1.02)
Observability	4.77 (1.11)	Subcultural Appeal	5.00 (0.94)
Trialability	4.81 (1.04)	Relative advantage	5.04 (1.03)
Complexity	2.99 (0.99)		

Table 3
Results of internal reliability and convergent validity.

Construct	Cronbach's alpha (>0.7)	Factor loading (>0.7)	Composite reliability (>0.7)	Average variance extracted (>0.5)
Intention to use	0.883	0.898 0.925 0.878	0.928	0.811
Attitude	0.904	0.908 0.908 0.931	0.940	0.839
Compatibility	0.861	0.883 0.888 0.885	0.916	0.784
Observability	0.836	0.870 0.870 0.866	0.902	0.755
Trialability	0.863	0.898 0.899 0.863	0.917	0.786
Complexity	0.868	0.899 0.889 0.886	0.921	0.795
Enjoyment	0.915	0.893 0.919 0.839 0.921	0.941	0.799
Originality	0.717	0.705 0.866 0.826	0.843	0.643
Attractiveness	0.869	0.843 0.917 0.909	0.920	0.793
Subcultural appeal	0.895	0.917 0.923 0.891	0.936	0.829
Relative advantage	0.837	0.905 0.846 0.859	0.904	0.758

well-known in South Korea with a long history of conducting reliable survey research and well-distributed regional branches. They contacted 3510 South Korean users of metaverse game platforms. After eliminating incomplete responses, and excluding the samples with lower than three-month experience, we employed 1447 validated samples (41.2 %). Each respondent was required to respond each questionnaire item using a 7-point Likert scale (from 1 (strongly disagree) to 7 (strongly agree)).

4. Results

4.1. Descriptive analysis

The summary of descriptive statistics on the employed constructs is presented in Table 2. Moreover, to avoid a common method bias issue, we conducted a Harman's single factor test, and confirmed that there is no specific bias issue.

4.2. Reliability of measurements

We employed a confirmatory factor analysis with a covariance-based structural equation modeling approach to explore the research model, and investigation our employed hypotheses. We used AMOS 24.0 for addressing this analysis. To examine a set of reliability tests, Cronbach's alpha, composite reliability, average variance extracted, and factor loading levels were computed on over 200 responses [82–84]. Moreover, to satisfy the guidance of discriminant validity, the correlation levels of two constructs should be lower than the squared root levels of average variance extracted. Based on the computation, we satisfied these tests with 1447 samples ([85]; Tables 3 and 4). Moreover, as our additional analysis, we conducted a Heterotrait-monotrait analysis for this validity issue [86], and confirmed that it is satisfied.

4.3. Fit indices

We computed the fit indices for examining the feasibility of the employed models. As presented in Table 5, we met the recommended

Table 5
Fit indices [84,85]

Indices	Measurement model	Research model	Recommended levels
Root mean square error of approximation	0.079	0.080	<0.090
Adjusted Goodness-of-fit indices	0.901	0.900	>0.900
Goodness-of-fit indices	0.909	0.907	>0.900
Comparative fit indices	0.918	0.915	>0.900
Incremental fit indices	0.917	0.915	>0.900
Normed fit indices	0.908	0.907	>0.900

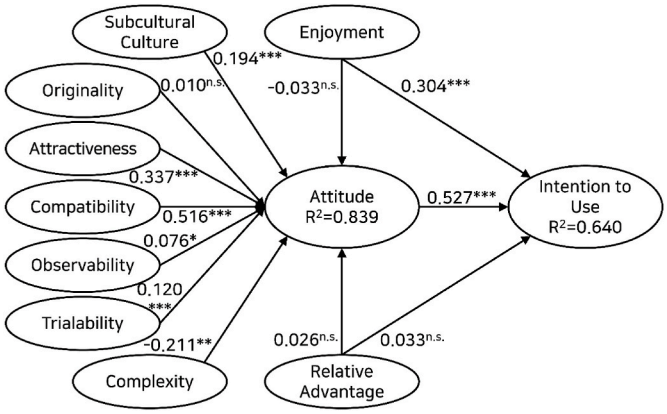

Fig. 2. Summary of the research model; ***$p < 0.001$, **$p < 0.01$, *$p < 0.05$, n.s.: no-significance.

Table 4
Results of discriminant validity.

Construct	1	2	3	4	5	6	7	8	9	10	11
1. Intention to use	0.901										
2. Attitude	0.559	0.916									
3. Compatibility	0.471	0.412	0.885								
4. Observability	0.522	0.592	0.510	0.869							
5. Trialability	0.430	0.594	0.424	0.480	0.887						
6. Complexity	0.448	0.530	0.417	0.513	0.448	0.892					
7. Enjoyment	0.018	0.142	0.050	0.019	0.204	0.193	0.894				
8. Originality	0.049	0.194	0.090	0.149	0.246	0.284	0.697	0.802			
9. Attractiveness	0.342	0.310	0.195	0.242	0.209	0.401	0.044	0.095	0.891		
10. Subcultural appeal	0.376	0.441	0.390	0.427	0.355	0.414	−0.100	−0.015	0.333	0.910	
11. Relative advantage	0.404	0.432	0.177	0.319	0.415	0.402	−0.084	−0.032	0.386	0.567	0.871

Table 6
Results of the research model.

Hypothesis	Standard Path Coefficient	*p*-value	Critical Ratio	Standard error	Results
H1. Compatibility → Attitude	0.516	<0.001	9.440	0.062	Supported
H2. Observability → Attitude	0.076	0.037	2.053	0.048	Supported
H3. Trialability → Attitude	0.120	<0.001	3.435	0.034	Supported
H4. Complexity → Attitude	−0.211	<0.001	−2.708	0.079	Supported
H5. Relative advantage → Attitude	0.026	0.295	0.408	0.072	Not supported
H6. Relative advantage → Intention to use	0.033	0.224	0.786	0.055	Not supported
H7. Attractiveness → Attitude	0.337	<0.001	7.249	0.059	Supported
H8. Originality → Attitude	0.010	0.494	0.194	0.047	Not supported
H9. Subcultural appeal → Attitude	0.194	<0.001	4.142	0.045	Supported
H10. Enjoyment → Attitude	−0.033	0.219	−0.991	0.030	Not supported
H11. Enjoyment → Intention to use	0.304	<0.001	9.520	0.034	Supported
H12. Attitude → Intention to use	0.527	<0.001	12.275	0.050	Supported

levels of fit indices on both models.

4.4. Hypothesis tests

The statistical results of the research model are presented in Fig. 2 and Table 6. Players' intention to use metaverse game platforms ($R^2 = 0.640$) is significantly determined by their perceived enjoyment (H11, beta = 0.304, CR = 9.520, $p < 0.001$), and attitude (H12, beta = 0.527, CR = 12.275, $p < 0.001$), while their perceived relative advantage does not have notable effects on the intention (H6, beta = 0.033, CR = 0.786, $p = 0.432$).

Among three coolness factors, both attractiveness (H7, beta = 0.337, CR = 7.249, $p < 0.001$) and subcultural appeal (H9, beta = 0.194, CR = 4.142, $p < 0.001$) have positive effects on players' attitude ($R^2 = 0.839$). However, no effect of originality on the attitude is presented (H8, beta = 0.010, CR = 0.194, $p = 0.846$).

Compatibility (H1, beta = 0.516, CR = 9.440, $p < 0.001$), Trialability (H3, beta = 0.120, CR = 3.435, $p < 0.001$), and Observability (H2, beta = 0.076, CR = 2.053, $p < 0.05$) have positive effects on the attitude, whereas there is a negative relationship between complexity and attitude (H4, beta = −0.211, CR = −2.708, $p < 0.01$).

We also compute total standardized effects of each factor on the intention (Table 7). We confirm the significant roles of attitude (0.527), enjoyment (0.287), compatibility in the diffusion of innovation theory (0.272), and attractiveness in the coolness concept (0.178) in determining the intention.

5. Discussion and conclusion

This study examines player adopting behavior of metaverse game platforms with the proposed research model, which is developed by four user-oriented approaches, the theory of planned behavior, hedonic and utilitarian concepts, diffusion of innovation theory, and coolness concept. With consideration of 1447 validated samples, we present some notable determinants of players' intention to use the platforms. Moreover, the computed fit indices examine the suitability of the research model.

As some theoretical implications, this study integrates four user-oriented approaches – Theory of Planned Behavior, Hedonic and Utilitarian Concepts, Diffusion of Innovation Theory, and Coolness Concept – to analyze player adoption behavior. This integration contributes to a comprehensive understanding of the determinants influencing players' intention to use metaverse game platforms. Through statistical analysis, the study identifies notable determinants affecting players' intention to use platforms, including attitudes, enjoyment, compatibility, trialability, observability, and coolness factors like attractiveness and subcultural appeal. These findings enrich existing literature by providing insights into the complex interplay of factors shaping user behavior in metaverse environments.

With our practical perspective toward the results, developers should focus on enhancing players' perceived enjoyment by creating engaging and immersive game experiences, facilitating social interactions, and incorporating features that increase enjoyment levels. Moreover, efforts should be directed towards making platforms visually attractive and culturally appealing to target users. Incorporating elements of attractiveness and subcultural appeal can enhance the platform's appeal and attract a wider audience.

Moreover, some managerial implications are examined. Developers and operators should prioritize strategies that foster positive attitudes towards metaverse game platforms. This can be achieved by ensuring compatibility with players' needs, facilitating trialability, and emphasizing the observability of platform benefits. Platforms should avoid unnecessary complexity, as it may deter potential users. Simplifying user interfaces and streamlining user experiences can mitigate this barrier and improve user adoption rates.

Although this study presents a set of significant findings, several limitations and suggestions for future research are examined. First, acknowledging limitations in sample representation, future research should aim for larger and more diverse samples to enhance the generalizability of findings. Second, longitudinal studies are recommended to track the evolution of players' intentions and attitudes over time, especially with advancements in metaverse technology. Thus, future research could explore additional variables not included in the current model to gain a more comprehensive understanding of player behavior in metaverse environments. Third, in investigating and validating our collected and validated items used in prior research, we only employed 22 students in the pilot survey. Because recruiting more participants can enhance the validity of our questionnaire design procedures, future research should play attention to the number of participants in the survey.

By addressing these theoretical, practical, and managerial implications, developers and operators can better understand and cater to the needs and preferences of users in the rapidly evolving landscape of metaverse gaming platforms.

Table 7
Total standardized effects on players' intention to use.

Constructs	Compatibility	Observability	Trialability	Complexity	Relative advantage	Attractiveness	Originality	Subcultural appeal	Enjoyment	Attitude
Effects	0.272	0.040	0.063	−0.112	0.047	0.178	0.005	0.102	0.287	0.527

CRediT authorship contribution statement

Eunil Park: Writing – original draft, Visualization, Validation, Supervision, Software, Resources, Project administration, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization.

Data availability

Data will be made available on request.

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