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CONSUMER ACCEPTANCE OF MIXED REALITY TECHNOLOGY: AN APPLICATION TO THE METAVERSE WITH WEARABLE TECHNOLOGY

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Abstract

This study examines consumer acceptance of mixed reality (MR) technologies within the framework of the Technology Acceptance Model (TAM) and the Diffusion of Innovation Theory (DIT). The Apple Vision Pro, a product not yet available in Türkiye but attracting significant global attention, was selected as the research context. Partial Least Squares Structural Equation Modeling (PLS-SEM) was used to analyze data from 477 valid surveys. The data were collected using a convenience sampling method and analyzed with SmartPLS 4. The analysis findings revealed that trust and perceived enjoyment had strong and positive effects on perceived usefulness (PU) and perceived ease of use (PEOU). It was confirmed that PU and PEOU significantly shaped attitudes, and attitude strongly predicted use/purchase intention. Among the DIT dimensions, relative advantage and compatibility exhibited increasing effects on intention. However, the direct effects of complexity, trialability, and visibility were not found to be significant. This research presents important findings regarding the acceptance dynamics of MR technologies by holistically considering cognitive (PU, PEOU), emotional (trust, entertainment), and innovation characteristics in the context of Apple Vision Pro.

Keywords: Mixed reality (MR), Technology acceptance model (TAM), Diffusion of innovations theory (DIT), Digital marketing, Apple Vision Pro.

KARMA GERÇEKLİK TEKNOLOJİSİNİN TÜKETİCİ KABULÜ: GİYİLEBİLİR TEKNOLOJİ İLE METAVERSE ÜZERİNE BİR UYGULAMA

Öz

Bu çalışma, Teknoloji Kabul Modeli (TAM) ve Yeniliklerin Yayılması Teorisi (DIT) çerçevesinde karma gerçeklik (MR) teknolojilerinin tüketici kabulünü incelemektedir. Araştırma bağlamı olarak, henüz Türkiye'de satışa sunulmayan ancak küresel düzeyde yoğun ilgi gören Apple Vision Pro ürünü seçilmiş; katılımcılardan ürünü gelecekte kullanma perspektifiyle değerlendirmeleri istenmiştir. Kolayda örnekleme yöntemiyle seçilen 477 geçerli anket verisi, Kısmi En Küçük Kareler Yapısal Eşitlik Modellemesi (EKK-YEM) ile SmartPLS 4 programı kullanılarak analiz edilmiştir. Analiz bulguları, güven ve algılanan eğlencenin algılanan fayda (PU) ve algılanan kullanım kolaylığı (PEOU) üzerinde güçlü ve pozitif etkiler yarattığını ortaya koymuştur. PU ve PEOU'nun tutumları anlamlı biçimde şekillendirdiği, tutumun da kullanım/satın alma niyetini güçlü biçimde belirlediği doğrulanmıştır. DIT boyutlarından göreceli avantaj ve uyumluluk niyeti artırıcı etkiler göstermiştir. Buna karşın karmaşıklık, denenebilirlik ve görünürlük değişkenlerinin doğrudan etkileri anlamlı bulunmamıştır. Bu araştırma, Apple Vision

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Pro bağlamında bilişsel (PU, PEOU), duygusal (güven, eğlence) ve yenilik özelliklerini bütüncül biçimde ele alarak, MR teknolojilerinin kabul dinamiklerine ilişkin önemli bulgular sunmaktadır.
Anahtar kelimeler: Karma gerçeklik (KG), Teknoloji kabul modeli (TKM), Yeniliklerin yayılması teorisi (YYT), Dijital pazarlama, Apple Vision Pro.

1. INTRODUCTION

As digitalization accelerates today, one of the most significant technologies transforming consumer experiences is mixed reality (MR). According to the taxonomy developed by Milgram and Kishino (1994), MR sits at the intersection of augmented and virtual reality technologies, blending real and virtual elements in varying proportions. This technology has the potential to create value not only in the gaming and entertainment sectors but also in broader fields such as marketing, education, healthcare, and retail (Horst & Dörner, 2018).

In marketing literature, MR is considered an innovative tool that enhances customer experience and enhances interaction. Flavián et al. (2019) argue that virtual, augmented, and mixed reality technologies increase consumers' perceived value and deepen the bond between the customer and the brand. According to Alcañiz et al. (2019), the use of virtual reality (VR) technologies has introduced a fresh stream of customer-focused research into marketing practice. Their analysis illustrates that mixed reality (MR) can transform consumer–brand encounters by making them not only more immersive but also more dynamic and affectively appealing.

The significance of MR in marketing is not confined to creating enriched customer experiences. Evidence also points to its direct contribution to purchase-related decisions. Li et al. (2022), for instance, showed that MR-based learning platforms applied within digital content marketing positively shaped online buying intentions. In parallel, Sung et al. (2021) observed that when MR solutions are combined with artificial intelligence features, consumers tend to exhibit stronger engagement and, in turn, develop more enduring brand bonds.

In order to better understand what drives consumers to adopt MR technologies, prior research frequently turns to established theoretical perspectives such as the Technology Acceptance Model (TAM) and the Diffusion of Innovation Theory (DIT). Rasimah et al. (2015) underline that factors including perceived usefulness, ease of use, and the rapidity of innovation adoption play a decisive role. Beyond utilitarian concerns, technology acceptance is also tied to hedonic evaluations; in particular, perceptions of enjoyment have been identified as an important determinant of users' attitudes and subsequent behavioral patterns.

Building on this foundation, the present study seeks to analyze how individuals in the context of wearable devices and the metaverse respond to MR technology. More precisely, it explores the influence of TAM variables (usefulness and ease of use) and DIT elements (relative advantage, compatibility, complexity, trialability, and observability) on consumer attitudes and behavioral intentions, while simultaneously considering the effects of trust and perceived enjoyment.

With the rapid development of metaverse environments, consumers' expectations for virtual shopping experiences are increasing, and brands are seeking new ways to interact in these digital universes. Mixed reality technology allows users to experience products in a virtual environment integrated with physical reality, creating greater engagement, trust, and purchase intentions during the shopping process. Therefore, addressing the study within the context of metaverse shopping creates a strategic imperative to understand not only the technical aspects of the technology but also its impact on consumer attitudes and purchase intentions from a marketing perspective.

Most existing studies on MR technology have focused on technical aspects, educational applications, or overall customer experiences (Alcañiz et al., 2019; Flavián et al., 2019). However, studies that directly measure consumer acceptance by combining wearable technologies with metaverse experiences are quite limited. Furthermore, the integrated assessment of the technology acceptance model and diffusion of innovation theory, along with the inclusion of perceived enjoyment

and trust variables, makes a significant contribution that distinguishes this study from similar studies in the literature.

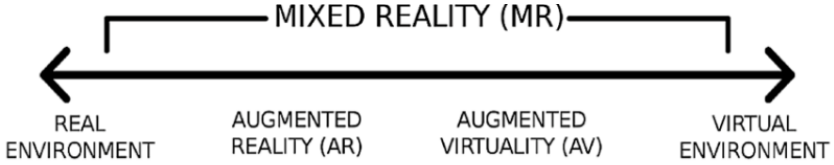
In this respect, the research possesses twofold originality, both theoretically and practically. From a theoretical perspective, the combined consideration of the TAM and DIT frameworks allows for the development of a more comprehensive model for explaining consumer acceptance of MR technology. From a practical perspective, it offers strategic insights for businesses by revealing the impact of wearable devices and metaverse experiences on consumer attitudes and purchase intentions in the marketing context. Thus, the study aims to fill the gap in the literature and provide a more in-depth understanding of the impact of mixed reality technology on consumer behavior.

2. LITERATURE REVIEW

2.1. Mixed Reality (MR)

Mixed reality (MR) can be described as a technological environment in which digital and physical components coexist and influence one another in real time. Milgram and Kishino (1994) conceptualized this phenomenon within a "reality–virtuality continuum," positioning it between the extremes of the completely real world and fully virtual settings. Within this spectrum, MR is situated between augmented reality (AR) and augmented virtuality (AV) (see Figure 1). Through this integration, MR provides users with an interactive experience that emerges from the dynamic combination of tangible and virtual elements in different degrees. Flavián et al. (2019) define MR as an environment that allows users to interact with both digital and physical elements in real time.

Figure 1. *Simplified representation of a "virtuality continuum" (Milgram & Kishino, 1994).*



MR technology is a remarkable innovation with its realistic, authentic, engaging, and fun features, applicable to devices such as computers, tablets, and smartphones (Kirkley & Kirkley, 2005). It provides a three-dimensional experience by superimposing elements such as images, text, video, and audio onto real spaces, supporting seamless interaction between real and virtual environments (Rasimah et al., 2011). This allows users not only to view virtual objects but also to interactively experience them in a real environment (Meral & Danacılar, 2024).

MR technology enables innovative applications across various sectors. In healthcare, it offers preoperative visualization through three-dimensional models in surgical training and planning (Sánchez-Margallo et al., 2021). In education, it enriches students' learning experiences by adding an interactive dimension to their learning processes (Radianti et al., 2020). In the retail sector, it stands out as a technology that enhances customer experience, increasing satisfaction and purchase intention. For example, Poushneh and Vasquez-Parraga (2017) demonstrated that AR applications shape the user experience and increase satisfaction and purchase intention.

Research on the adoption of emerging technologies highlights that perceived usefulness, ease of use, enjoyment, and personal innovativeness are key determinants. Yussof et al. (2011, p. 197) argue that the effectiveness of MR and Augmented Reality (AR) systems is contingent upon users perceiving them as beneficial, simple to operate, and efficient. More recent studies, however, extend the traditional TAM framework by showing that additional factors—such as task–technology fit, interface design, personal innovativeness, and mobility—also play a decisive role in shaping adoption (Albeedan et al., 2023).

Field-based empirical studies also support these findings. Hammady et al. (2020) found that perceived enjoyment, usefulness, and ease of use in the museum context influenced adoption

intention, while social norms and individual innovativeness shaped attitudes. Similarly, Rasimah et al. (2011) emphasized that perceived usefulness, in particular, most strongly influenced future intention to use in students. Liu et al. (2021) showed that using MR-based games and concept maps at the middle school level strengthened learning intention by increasing ease of use and usefulness.

Öniz and Karaca (2026) conducted a bibliometric analysis of extended reality (XR) studies in the field of marketing, encompassing virtual, augmented, and mixed reality technologies. The analysis results revealed that reality technologies represent an emerging research trend in the field of marketing. İpek (2023) notes that despite the significant potential of mixed reality technologies, they have not yet achieved widespread adoption due to high costs, a limited market, and a mismatch between technological expectations and actual developments.

Doğan et al. (2021) state that mixed reality technology has significant applications, particularly in the fields of health and medical education, and that its use is expected to become more widespread in diagnostic, treatment, and simulation processes in the future. Yengin and Bayrak (2020) have demonstrated that eye-tracking technology is an effective method for analyzing users' visual focus and interaction behaviors in mixed and virtual reality environments and that it provides important data for understanding the effects of new media technologies on users.

Additionally, there are studies in Türkiye examining the adoption of virtual and augmented reality technologies within the framework of the technology acceptance model. Kasaroğlu and Güler (2023) found that perceived benefit, perceived ease of use, and fun in virtual reality applications influence attitude, while perceived benefit and attitude, in turn, significantly affect usage intention.

2.2. Technology Acceptance Model (TAM)

Numerous studies have been conducted in the literature to explain the factors that shape individuals' decisions to adopt or reject new technologies. The most widely accepted of these studies is the Technology Acceptance Model (Ward, 2013, p. 223), which explains the process of technology acceptance and use through two fundamental variables. Davis (1989, p. 320) based the model on Fishbein and Ajzen's (1975) Theory of Reasoned Action but adapted it to include technology-specific variables. While TRA offers a powerful framework for explaining individuals' behavioral intentions, it is limited by its lack of technology-specific factors. TAM fills this gap and explains technology acceptance through perceptual dimensions. TAM's operation is defined in three stages. In the first stage, external factors (e.g., system design, user support) shape individuals' perceptual evaluations. In the second stage, these evaluations are transformed into perceived usefulness and perceived ease of use. In the final stage, these two perceptions influence attitudes and intentions towards technology, leading to usage behavior (Marikyan & Papagiannidis, 2025).

The model explains individuals' intentions to use technology through two fundamental beliefs: perceived usefulness and perceived ease of use. Perceived usefulness refers to the belief that a technology will enhance individual performance, while perceived ease of use refers to the perception that the technology can be used effortlessly. TAM also shares similarities with theories based on social psychology. Expectancy-Value Theory and Self-Efficacy Theory, in particular, offer similar causal patterns in explaining individuals' evaluations of technology use. In this respect, the model focuses not only on the objective functionality of technologies but also on users' subjective perceptions (Davis, 1989).

The model has been developed over time, and various versions have been obtained. TAM2 incorporates factors such as social influence and job fit (Venkatesh & Davis, 2000), while TAM3 increases its explanatory power by detailing the antecedents of perceived ease of use (Venkatesh & Bala, 2008). Thanks to these developments, the TAM maintains its applicability in many areas, including information systems, mobile applications, educational technologies, and e-commerce (Marikyan & Papagiannidis, 2025; Luo et al., 2024). Later, a unified model called UTAUT (Unified Theory of Technology Acceptance and Use) was formulated; this model includes four primary determinants on

intention and use and four moderators that examine the effects of these relationships (Venkatesh et al., 2003).

Furthermore, TAM has a flexible structure that can be adapted to different contexts. The literature emphasizes that the dimensions of perceived usefulness, ease of use, and intention, in particular, enable systematic analysis of individual tendencies towards technology. It is stated that the model can be adapted to different contexts by integrating individual differences and technological perceptions (Cibaroğlu et al., 2021).

Empirical evidence demonstrates that both the Technology Acceptance Model (TAM) and the Diffusion of Innovation Theory (DIT) provide valuable frameworks for explaining technology adoption across diverse contexts. Soon et al. (2016), by integrating these models, identified perceived usefulness, ease of use, and risk as critical factors in the adoption of big data technologies. In the cryptocurrency sector, Bharadwaj and Deka (2021) reported that complexity, compatibility, and observability shape users' perceptions of usefulness and ease of use, which in turn influence their behavioral intentions. Within the field of educational technologies, Al-Adwan et al. (2023) found that perceived usefulness, personal innovativeness, and enjoyment act as drivers of metaverse adoption, whereas cyber risk serves as a barrier.

The model developed in this study includes perceived trust and perceived enjoyment in addition to the classic TAM variables. The literature has shown that trust is a determinant of usefulness and ease of use (Gefen, 2000; McKnight et al., 2002; Pavlou, 2003), while enjoyment strengthens perceptions of usefulness and ease of use by increasing user motivation (Moon & Kim, 2001; Van der Heijden, 2004). Accordingly, the current research also includes the dimensions of trust and enjoyment in explaining the acceptance of mixed reality technologies.

2.3. Perceived Trust

Perceived trust refers to individuals' perceptions of the reliability and security level of another party when using a technology, service, or system (McKnight et al., 2002). Perceived trust is considered a critical determinant of users' purchasing behavior and continued usage intentions in e-commerce, online banking, and digital platforms (Gefen, 2000; Gefen et al., 2003; Kim et al., 2008). The literature indicates that trust is inversely related to perceived risk, thus decreasing risk perception as trust levels increase (Pavlou, 2003).

Gefen (2000) combined TAM and social cognitive theories to examine the effects of trust on intention to use in an e-commerce environment, demonstrating that trust, along with perceived usefulness and ease of use, is a critical precursor to technology adoption. McKnight et al. (2002) divided trust into three key components: competence trust, integrity trust, and intention trust, demonstrating the mediating role of trust in technology acceptance.

Pavlou (2003) integrated trust with the Technology Acceptance Model (TAM) and emphasized that trust can have a direct or indirect effect on behavioral intention (BI) through perceived usefulness (PU) and perceived ease of use (PEU). Kaur and Rampersad (2018) suggested that trust is an important factor directly affecting consumers' behavioral intention (BI) and can also mediate the effects on perceived usefulness (PU) through perceived ease of use (PEOU). Zhang (2024) revealed that trust has a positive effect on perceived usefulness and perceived ease of use. Based on these findings, hypotheses H1 and H2 were formulated:

H1: Trust in mixed reality technology has an impact on perceived usefulness.

H2: Trust in mixed reality technology has an impact on perceived ease of use.

2.4. Perceived Enjoyment

Perceived enjoyment is a personal evaluation of a technology's perceived enjoyment, satisfaction, and performance (Van der Heijden, 2004). Perceived enjoyment, as a device for cognitive and emotional satisfaction, was first identified in the information systems literature by Davis et al. (1992), but subsequent examination of the diffusion system was conducted by Moon and Kim (2001). Moon and Kim's (2001) work integrated the perceived enjoyment variable into the traditional Technology Acceptance Model (TAM), allowing users to explore the possibility of using the technology not only for functional benefit but also for pleasure and entertainment.

If the user can experience entertainment while adopting a new technology, this has been found to positively affect the attitude towards technology adoption (Suki & Suki, 2011). Research conducted by Van der Heijden (2004) has shown that perceived entertainment in internet-based information systems directly positively affects users' attitudes towards technology and increases their intention to use it.

Cyr et al. (2006) demonstrated that perceived ease of use has an impact on perceived usefulness and perceived enjoyment. Hussain et al. (2016) demonstrated that perceived usefulness, perceived ease of use, and perceived enjoyment have a significant and positive impact on user adoption of interactive mobile maps. Nguyen (2015) states that the fun and enjoyment some users experience when using a new application or technology is a significant factor motivating their rapid adoption of these technologies. Sun and Zhang (2006) demonstrated that perceived enjoyment is a significant determinant of perceived ease of use. Based on past and current studies, hypotheses H3 and H4 were formulated:

H3: Enjoyment of mixed reality technology has an impact on perceived usefulness.

H4: Enjoyment of mixed reality technology has an impact on perceived ease of use.

The Technology Acceptance Model (TAM) posits that perceived usefulness is a central driver of information technology adoption (Cheung et al., 2011; Ngai et al., 2015). According to Davis (1989), when users perceive a technology as useful, their intention to adopt it increases. Empirical research has consistently confirmed the positive influence of perceived usefulness on the adoption of various technologies, including wearable devices (Al-Emran et al., 2022; Guest et al., 2018), mobile applications (Shemesh & Barnoy, 2020; Rivera et al., 2015), and virtual reality headsets (Huang et al., 2016; Tokel & İşler, 2015; Abd Majid & Mohd Shamsudin, 2019).

Perceived usefulness is defined as the belief that using a particular technology enhances an individual’s functional performance (Davis, 1989). It is widely recognized as one of the most influential predictors of users’ attitudes toward technology and their behavioral intentions to adopt it (Venkatesh & Davis, 2000; King & He, 2006). Evidence from studies on mobile applications and e-commerce further underscores that perceived usefulness plays a pivotal role in shaping positive user attitudes (Ali & Warraich, 2025). Drawing on these insights, the following hypothesis is proposed:

H5: Perceived usefulness positively influences attitude.

Perceived ease of use, on the other hand, refers to the extent to which individuals believe a technology can be used with minimal effort (Davis, 1989). Beyond directly affecting attitudes, ease of use has also been shown to reinforce perceived usefulness, thereby strengthening overall technology acceptance (Venkatesh & Bala, 2008; Luo et al., 2024).

Furthermore, studies in the context of health information systems and educational technologies have revealed that ease of use increases users' positive attitudes toward technology (Yang et al., 2025; Misirlis & Munawar, 2023). Numerous studies have examined users' intention to use VR using the TAM, particularly in terms of ease of use (Tokel & İşler, 2015; Fetscherin & Lattemann, 2008; Bertrand & Bouchard, 2008; Chow et al., 2012). Based on past and current studies in the literature, hypotheses H6 and H7 were formulated:

H6: Perceived ease of use positively influences attitude.

H7: Perceived ease of use positively influences perceived usefulness.

Attitude refers to an individual's general evaluation and tendency toward a technology. Within the scope of the Technology Acceptance Model (Davis, 1989) and the Theory of Planned Behavior (Fishbein & Ajzen, 1975; Ajzen, 1991), attitude has been shown to be one of the strongest determinants of behavioral intention. Kim and Nan (2012) showed that attitude has a strong and direct effect on behavioral intention. Recent research has revealed that positive attitudes towards the metaverse and new media technologies increase usage intention (Venkatesh et al., 2012; Misirlis & Munawar, 2023; Toraman, 2022, p. 71; Toraman & Geçit, 2023, p. 96). The existing literature is limited in directly examining the relationship between attitude and intention in the context of MR technologies (Dino et al., 2024; Liu & Liu, 2025; Rasimah et al., 2011; Shin & Lee, 2025; Wan et al., 2024). In this context, hypothesis H8 was developed:

H8: Attitude positively influences behavioral intention.

2.5. Diffusion of Innovations Theory (DIT)

Diffusion of Innovations Theory (DIT), pioneered by Rogers (2003), is one of the most fundamental frameworks explaining how new products, services, or technologies are adopted by individuals and society. This theory identifies several perceptual characteristics that influence individuals' adoption of innovations. The first of these is relative advantage, which refers to the extent to which the innovation is perceived as better, more useful, or superior to existing alternatives (Tornatzky & Klein, 1982; Lin, 2011). The second characteristic, perceived compatibility, describes the extent to which the innovation aligns with individuals' existing values, experiences, and lifestyles (Moore & Benbasat, 1991; Al-Jabri & Sohail, 2012). The third dimension, complexity, relates to the difficulty of understanding or implementing the use of the innovation; high complexity may delay adoption (Tornatzky & Klein, 1982; Hofmann et al., 2024). The fourth dimension, trialability, refers to whether individuals have limited opportunities to experiment with the innovation (Rogers, 2003; Jilani et al., 2022). Observability refers to the extent to which the benefits and outcomes of an innovation can be seen by others (Rogers, 2003; Elbayoumy et al., 2023). Collectively, the five dimensions of the Diffusion of Innovation Theory (DIT) provide a systematic explanation for the pace at which innovations are adopted and how they influence behavioral intentions.

Over the years, DIT has been extended across multiple disciplines and applied to contemporary contexts such as mobile payments (Lin et al., 2020), mobile banking (Al-Jabri & Sohail, 2012; Elbayoumy et al., 2023), augmented and mixed reality (Alam et al., 2024), and artificial intelligence–driven applications (Gutiérrez-Leefmans et al., 2026). Findings from recent studies suggest that relative advantage and compatibility frequently emerge as the strongest determinants of behavioral intention, while complexity tends to exert negative effects (Lin, 2011; Al-Jabri & Sohail, 2012). In contrast, trialability and observability become particularly influential in the adoption of novel technologies characterized by high levels of uncertainty (Jilani et al., 2022; Lin et al., 2020). Thus, DIT provides a robust theoretical lens for understanding not only the diffusion of traditional products and services but also the acceptance of cutting-edge digital innovations such as the metaverse, virtual influencers, AI-powered chatbots, and mixed reality.

Among these factors, the perception that an innovation is “better than available alternatives”—captured through relative advantage—consistently stands out as one of the most reliable predictors of behavioral intention.

Classic meta-analyses and early DIT studies have shown that relative advantage is systematically positively related to adoption/intention (Tornatzky & Klein, 1982). Numerous studies in banking and payment contexts also confirm this effect; a study in the mobile banking sector observed that relative advantage significantly influences attitude, which in turn leads to behavioral intention to adopt mobile banking (Lin, 2011). Research in Saudi Arabia and Egypt found that relative advantage has a positive

effect on behavioral intention (Al-Jabri & Sohail, 2012; Elbayoumy et al., 2023). The findings are consistent across current consumer technologies: relative advantage has a strong impact on intention in augmented reality (AR) shopping applications and mobile payment (Alam et al., 2024; Lin et al., 2020); and relative advantage also positively affects intention in metaverse marketplace adoption (Hofmann et al., 2024). H9 was formulated based on past and current studies in the literature.

H9: Relative advantage positively influences behavioral intention.

Compatibility is the extent to which an innovation aligns with an individual's values, experiences, and needs and is a strong determinant of intention (Moore & Benbasat, 1991; Tornatzky & Klein, 1982). Empirically, compatibility significantly increases attitude and intention in mobile banking (Lin, 2011; Al-Jabri & Sohail, 2012). In AR shopping applications, mobile payment systems, and mobile learning, compatibility is one of the strongest predictors of intention (Alam et al., 2024; Lin et al., 2020; Wang et al., 2022). Based on these past and current studies, H10 was formed.

H10: Perceived compatibility positively influences behavioral intention.

Complexity is the perception that an innovation is "difficult to understand/use," and it is often negatively positioned in the DIT literature: meta-analyses and numerous field studies show that complexity reduces adoption/intention (Tornatzky & Klein, 1982; Hofmann et al., 2024). In mobile banking and Egyptian samples, the effect of complexity has generally been found to be negative or insignificant (Al-Jabri & Sohail, 2012; Elbayoumy et al., 2023). However, in some recent models (especially in UTAUT2+DIT integrated studies where modeling preferences differ), the complexity variable is reverse-coded or reported with a positive sign due to its conceptual overlap with "effort expectancy/ease" (Lin et al., 2020). Furthermore, there are examples of positively reported complexity-intention relationships in the AR business context. Based on past and current studies in the literature, H11 was formulated.

H11: Complexity negatively influences behavioral intention.

Trialability is the ability for users to experience innovation through "trial and error," and it has frequently been shown to strengthen intention, particularly in new/uncertain technologies. In mobile health applications during the COVID-19 period, trialability and campaigns that reinforce it have been found to increase usage intention (Jilani et al., 2022). Trialability has a significant and positive effect on university students' intention to use AI chatbots for educational purposes (Gutiérrez-Leefmans et al., 2026). There is also increasing evidence in payment/finance and digital currency studies that "preview/trial" opportunities strengthen intention (Amin et al., 2025). However, the effect of trialability has been reported to be statistically insignificant in some mobile banking samples (Al-Jabri & Sohail, 2012). Based on these past and current studies, H12 was formulated.

H12: Trialability positively influences behavioral intention.

Observability refers to the noticeability of an innovation's outcomes/benefits to others, and within the DIT framework, it is a characteristic that increases intention. Multiple studies have shown that observability increases intention in mobile banking and payment contexts (Al-Jabri & Sohail, 2012; Lin et al., 2020). Similarly, systematic and empirical studies in education and healthcare technologies indicate that observability supports adoption through the attitude/intention channel (Al Breiki et al., 2023; Yang et al., 2023). Based on these past and current studies, H13 was formulated.

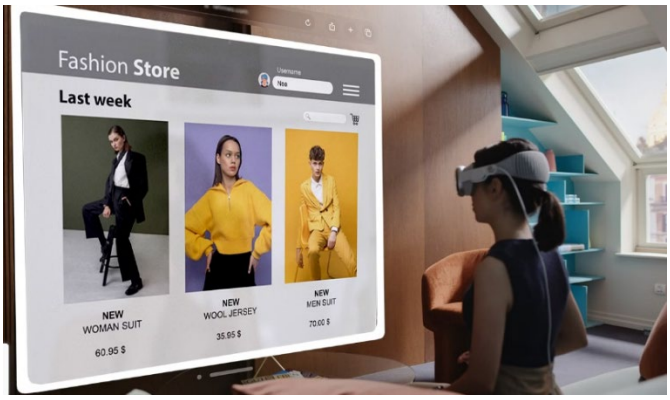
H13: Observability positively influences behavioral intention.

3. METHODOLOGY

This research is designed to examine the factors influencing the use of the Apple Vision Pro, a mixed reality technology product. The research population consists of consumers living in Türkiye who are interested in technology and who enjoy and prefer online shopping. Because the Apple Vision Pro is not yet available in Türkiye, participants were asked to answer the questions specifically about the Apple Vision Pro, which is likely to be available in the future. To ensure that participants were familiar

with the research context, two screening questions were included at the beginning of the questionnaire. Participants were asked whether they had previously used the Apple Vision Pro and whether they had seen or heard about the Apple Vision Pro before. These questions helped determine participants' level of awareness of the product prior to answering the main survey questions. Since the Apple Vision Pro is not yet available in Türkiye, visual materials such as photographs and videos were also presented to provide participants with a clearer understanding of the product and its potential usage. Before starting the survey, participants were informed of the statement, "Apple Vision Pro, which combines augmented reality and virtual reality technologies, is a wearable technology introduced by Apple. These glasses allow for an immersive shopping experience through the Metaverse." Photographs (Figure 2) and videos were shared to provide insights into Apple Vision Pro usage.

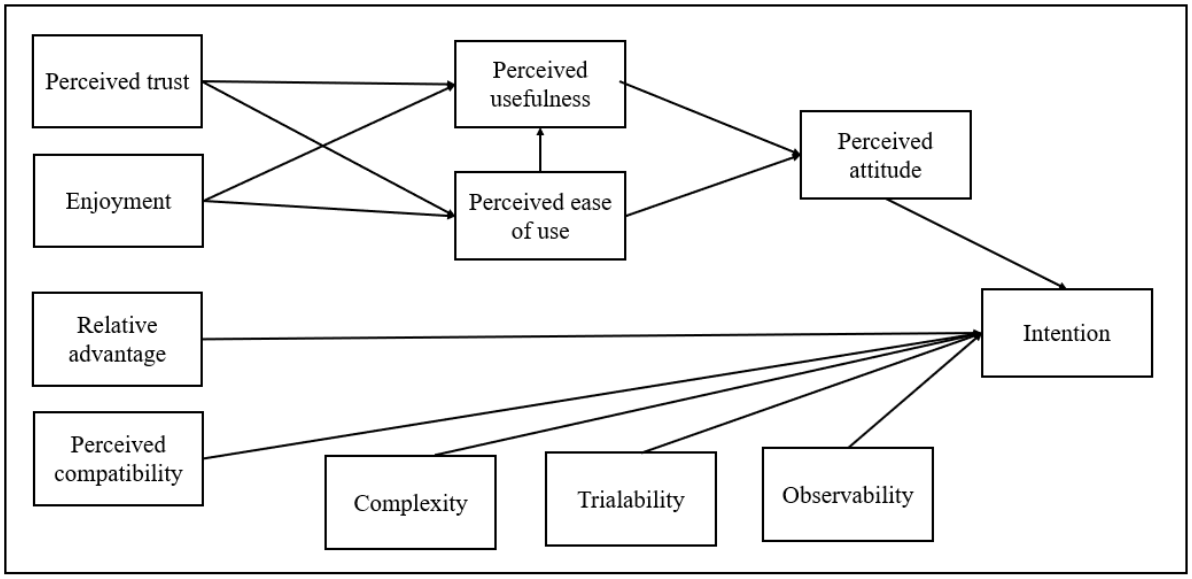
Figure 2. *Virtual store shopping experience with Apple Vision Pro (Codilar, 2023).*



The number of participants is considered sufficient for the sample to be considered suitable for analysis if it is five times the number of statements in the survey form (Brown, 2015; Tabachnick & Fidell, 2013). According to the formula where sample size is calculated based on the population size, confidence interval, and margin of error (Kılıç, 2012), the minimum sample size that can represent the population of this study with a 95% confidence interval and a 5% margin of error was determined as 384. Ethics committee approval was received for this research from the Istanbul Nişantaşı University Ethics Committee dated August 22, 2024, and numbered 2024/08.

In this study, the sample was determined using a convenience sampling method. The surveys were conducted through face-to-face interviews with consumers interested in technology between 01.12.2024 and 01.05.2025. Within the available resources, 500 questionnaires were distributed, and after eliminating incomplete or invalid responses, 477 questionnaires were included in the analysis. The descriptive information of the participants within the scope of the research is as follows: 30.6% are between the ages of 18-20, 41.3% are between the ages of 21-29, 3.1% are between the ages of 30-39, and 25% are between the ages of 40-59. 59.5% of the sample is male and 40.5% is female; 95% are single, 5% are married; 4.4% have a postgraduate degree, 82.8% have a bachelor's degree, 7.5% have an associate degree, 4.8% have a high school degree, and 0.4% have a secondary school degree.

Figure 3. *Conceptual research model.*



The research model was created to reveal the relationships among the variables of perceived trust, perceived enjoyment, perceived usefulness, perceived ease of use, perceived attitude, and behavioral intention, as well as the relationships between relative advantage, perceived compatibility, complexity, trialability, observability, and behavioral intention. The research model shown in Figure 3 was tested.

The first part of the survey form included questions to determine whether the participants had seen the Apple Vision Pro before and their experience with it. There were three statements on the perceived trust variable, three on the perceived enjoyment variable, four on the perceived usefulness scale, four on the perceived ease of use scale, three on the perceived attitude scale, four on the relative advantage scale, four on the perceived compatibility scale, four on the complexity scale, three on the trialability scale, three on the observability scale, and three on the behavioral intention scale. The last part included questions about the demographic information of the participants. All statements were measured with a 5-point Likert-type scale (1=Strongly disagree; 5=Strongly agree). Perceived trust scale statements were adapted from Jin et al. (2008); perceived enjoyment, perceived usefulness, perceived ease of use, and behavioral intention scale statements were adapted from Venkatesh and Bala (2008); perceived attitude scale statements were adapted from Na et al. (2024); perceived compatibility, trialability, and observability scale statements were adapted from Yuen et al. (2021); relative advantage scale statements were adapted from Ceyhan Günay and Toraman (2024), and complexity scale statements were adapted from Tran and Cheng (2017) and Hardgrave et al. (2003).

4. ANALYSIS AND FINDINGS

Partial Least Squares Structural Equation Modeling (PLS-SEM), a frequently preferred structural modeling technique, was used to analyze relationships between multivariate constructs during the research analysis (Hair et al., 2022, pp. 56–67). Furthermore, analyses were conducted using Smart PLS 4, one of the analysis programs that supports this model. During the data analysis phase, inconsistent and missing values in the data set were first checked and corrected. Reliability and validity analyses were then conducted.

Table 1. *Construct validity and reliability.*

Construct	Items	Factor Loadings	Cronbach's Alpha	Composite Reliability (CR)	Average Variance Extracted (AVE)
Perceived Usefulness	PU1: Apple Vision Pro will be useful for my shopping activities in the Metaverse system.	0.93	0.93	0.96	0.88
	PU2: Apple Vision Pro will facilitate transactions in shopping activities in the Metaverse system.	0.95			
	PU3: Apple Vision Pro will enable faster completion of shopping activities in the Metaverse system.	0.94			
	PU4: Apple Vision Pro will increase users' options in shopping activities in the Metaverse system.	0.92			
Perceived Ease of Use	PEOU1: It will be easy to gain the ability to use Apple Vision Pro in shopping activities in the Metaverse system.	0.94	0.93	0.96	0.88
	PEOU2: Using Apple Vision Pro in shopping activities in the Metaverse system will be clear and understandable.	0.94			
	PEOU3: It will be easy to follow the steps required to use Apple Vision Pro in shopping activities in the Metaverse system.	0.94			
	PEOU4: It will be easy to use Apple Vision Pro for shopping activities in the Metaverse system.	0.94			
Perceived Trust	PT1: Apple Vision Pro is safe to use in the Metaverse shopping experience.	0.95	0.94	0.96	0.90
	PT2: Using Apple Vision Pro is reliable for the shopping experience in the Metaverse system.	0.96			
	PT3: I trust using Apple Vision Pro for the shopping experience in the Metaverse system.	0.94			
Attitude Towards Use	AT1: It is valuable for me to use Apple Vision Pro for shopping activities in the Metaverse system.	0.94	0.92	0.95	0.86
	AT2: It is important for me to complete shopping activities in the Metaverse system with Apple Vision Pro.	0.92			
	AT3: I am interested in using Apple Vision Pro for shopping activities in the Metaverse system.	0.92			
Enjoyment	E1: I don't think I'll get bored while using Apple Vision Pro in the shopping experience in the Metaverse system.	0.92	0.84	0.93	0.86
	E2: It will be enjoyable to use Apple Vision Pro in the shopping experience in the Metaverse system.	0.94			
	E3: I will enjoy using Apple Vision Pro in the shopping experience in the Metaverse system.	0.95			

Construct	Items	Factor Loadings	Cronbach's Alpha	Composite Reliability (CR)	Average Variance Extracted (AVE)
Intention	I1: I plan to use Apple Vision Pro for my shopping activities in the Metaverse system.	0.93	0.94	0.96	0.89
	I2: I anticipate using Apple Vision Pro for my shopping activities in the Metaverse system.	0.95			
	I3: I will use Apple Vision Pro for my shopping activities in the Metaverse system.	0.94			
Observability	O1: I can use Apple Vision Pro, although it is not common.	0.90	0.89	0.93	0.82
	O2: Before using Apple Vision Pro, I observe people around me who use Apple Vision Pro.	0.92			
	O3: If I see most people using Apple Vision Pro, I'll use it too.	0.90			
Relative Advantage	RA1: Using Apple Vision Pro in shopping activities in the Metaverse system will make a positive difference.	0.95	0.88	0.94	0.89
	RA2: Using Apple Vision Pro in shopping activities in the Metaverse system makes it easier for me to access products (that I can purchase).	0.95			
	RA3: Using Apple Vision Pro in shopping activities in the Metaverse system will be advantageous compared to other methods.	0.96			
	RA4: Using Apple Vision Pro in shopping activities in the Metaverse system will allow me to access products (that I can purchase) faster.	0.94			
Complexity	COMP1: Using Apple Vision Pro to access products (that I can purchase) through the Metaverse system requires technical skill.	0.89	0.93	0.95	0.82
	COMP2: Using Apple Vision Pro to access products (that I can purchase) through the Metaverse system requires a lot of mental effort.	0.92			
	COMP3: Using Apple Vision Pro to access products (that I can purchase) through the Metaverse system can be challenging.	0.92			
	COMP4: Using Apple Vision Pro to access products (that I can purchase) through the Metaverse system can be frustrating.	0.89			
Trialability	T1: Before I decide to use Apple Vision Pro, I'd like to see a demonstration of it in use.	0.97	0.94	0.97	0.94
	T2: Before I decide to use Apple Vision Pro, I would like to get an introduction to using the product.	0.97			
	T3: I would like to try Apple Vision Pro before deciding to use it.	0.96			
	PC1: Apple Vision Pro meets my needs.	0.96	0.89	0.95	0.90

Construct	Items	Factor Loadings	Cronbach's Alpha	Composite Reliability (CR)	Average Variance Extracted (AVE)
Perceived Compatibility	PC2: Apple Vision Pro fits my needs.	0.95			
	PC3: Apple Vision Pro fits my lifestyle.	0.95			
	PC4: Apple Vision Pro fits my preferences.	0.95			

Within the PLS-SEM framework, the reliability and validity of the measurement model were evaluated. Indicator loadings, Cronbach's alpha, Composite Reliability (CR), and Average Variance Extracted (AVE) values are presented in Table 1.

The factor loadings of all items were above 0.70, and Cronbach's alpha and CR values were above 0.80. These results indicate that the variables in the scales have high reliability. AVE values were also above 0.50, supporting the sufficient validity of each construct in the measurement. These findings demonstrate that the scales were used reliably and validly in the study.

Figure 4. *Research path analyses.*

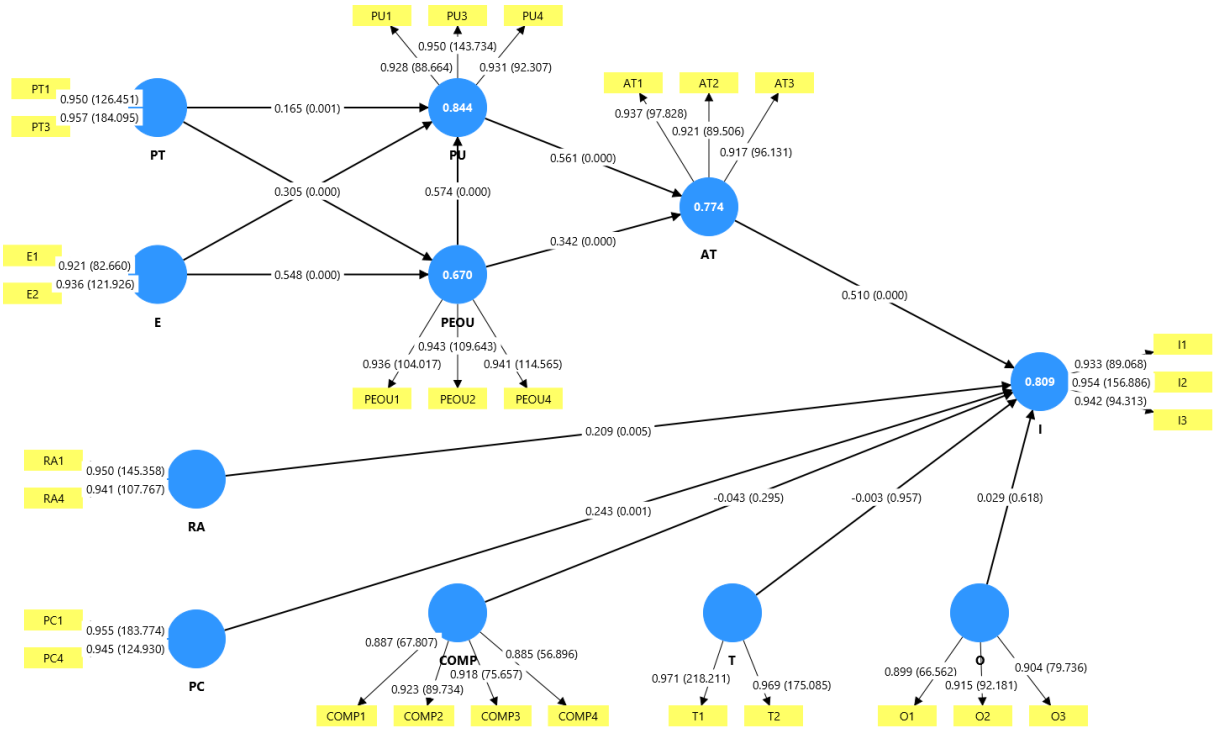


Table 2. *Fornell-Larcker criterion: Correlations between variables.*

Variable	AT	COMP	E	I	O	PC	PEOU	PT	PU	RA	T
AT	0.93										
COMP	0.69	0.90									
E	0.80	0.63	0.93								
I	0.87	0.66	0.83	0.94							
O	0.78	0.75	0.75	0.77	0.91						
PC	0.82	0.74	0.77	0.83	0.83	0.95					
PEOU	0.84	0.72	0.80	0.82	0.81	0.85	0.94				
PT	0.79	0.62	0.83	0.81	0.74	0.76	0.77	0.95			
PU	0.87	0.71	0.84	0.86	0.82	0.83	0.89	0.81	0.94		
RA	0.81	0.72	0.79	0.82	0.82	0.85	0.90	0.78	0.89	0.95	
T	0.73	0.75	0.76	0.72	0.84	0.76	0.80	0.71	0.82	0.83	0.97

*AT: Perceived attitude, COMP: Complexity, E: Enjoyment, I: Intention, O: Observability, PC: Perceived Compatibility, PEOU: Perceived Ease of Use, PT: Perceived trust, PU: Perceived Usefulness, RA: Relative Advantage, T: Trialability

In the Fornell–Larcker criterion, diagonal elements represent the square roots of the Average Variance Extracted (AVE). The off-diagonal elements below the diagonal represent inter-construct correlations.

Table 2 reports the correlations among the constructs and the square root of the AVE values, following the Fornell–Larcker criterion. The square root AVE values, which appear on the diagonal of the table, exceed 0.90 for all constructs. This indicates that each construct adequately represents the concept it is intended to measure and demonstrates a strong level of convergent validity (Fornell & Larcker, 1981).

The correlation coefficients listed below the diagonal are lower than the corresponding AVE square roots, showing that each construct is more strongly associated with its own measures than with those of other constructs. This provides evidence of discriminant validity. For instance, the correlation between perceived usefulness (PU) and perceived ease of use (PEOU) is 0.89, while the square root AVE for PU is 0.94, suggesting that PU is more strongly linked to its own construct than to PEOU. Similarly, the correlation between perceived trust (PT) and enjoyment (E) is 0.83, whereas the square root AVE of PT is 0.95, further confirming the discriminant validity of the PT construct.

Overall, the Fornell–Larcker analysis demonstrates that both convergent and discriminant validity have been established for all constructs. These results confirm that the structural model is based on reliable and valid measures, providing a solid foundation for hypothesis testing. Specifically, the constructs of perceived usefulness (PU), perceived ease of use (PEOU), trust (PT), enjoyment (E), attitude (AT), intention (I), and the DIT variables (RA, COMP, O, T, PC) are shown to be conceptually distinct and sufficiently independent from one another.

In addition, multicollinearity was assessed, which is particularly relevant in marketing research since excessive correlations among independent variables (e.g., PU, PEOU, PT, E, AT) can obscure the determination of their relative influence on consumer behavior. The VIF values observed in this study remained within acceptable thresholds, with all below 5, indicating the absence of problematic multicollinearity and supporting the robustness of the model for testing variable effects (Hair et al., 2022).

Table 3. *Structural equation model analysis results*

Hypothesis	Relationship	Path Coefficient	t-values	p-values	p < .05?
H1	PT -> PU	0.17	3.32	< .001*	Accepted
H2	PT -> PEOU	0.31	6.05	< .001*	Accepted
H3	E -> PU	0.24	4.36	< .001*	Accepted
H4	E -> PEOU	0.55	10.37	< .001*	Accepted
H5	PU -> AT	0.56	8.39	< .001*	Accepted
H6	PEOU -> AT	0.34	4.94	< .001*	Accepted
H7	PEOU -> PU	0.57	10.82	< .001*	Accepted
H8	AT -> I	0.51	7.44	< .001*	Accepted
H9	RA -> I	0.21	2.84	.005*	Accepted
H10	PC -> I	0.24	3.34	< .001*	Accepted
H11	COMP -> I	-0.04	1.05	.295	Rejected
H12	T -> I	-0.00	0.05	.957	Rejected
H13	O -> I	0.03	0.50	.618	Rejected

p < .05 indicates statistical significance.

SEM analysis results show that perceived trust (PT) and perceived enjoyment (E) variables have significant and positive effects on both perceived usefulness (PU) and perceived ease of use (PEOU) (H1: $\beta = 0.17$, $t = 3.32$, $p < 0.001$; H2: $\beta = 0.31$, $t = 6.05$, $p < 0.001$; H3: $\beta = 0.24$, $t = 4.36$, $p < 0.001$; H4: $\beta = 0.55$, $t = 10.37$, $p < 0.001$). These results highlight that trust and the sense of enjoyment are pivotal drivers in the adoption of MR technology.

Perceived usefulness and ease of use significantly affect users' attitudes towards technology (AT) (H5: $\beta = 0.56$, $t = 8.39$, $p < 0.001$; H6: $\beta = 0.34$, $t = 4.94$, $p < 0.001$). Moreover, the impact of PEOU on

PU was shown to be substantial (H7: β = 0.57, t = 10.82, p < 0.001), reinforcing the traditional associations proposed within the TAM framework.

Users' attitudes (AT) significantly determine their purchase and usage intentions (I) (H8: β = 0.51, t = 7.44, p < 0.001). Within the scope of DIT theory, relative advantage (RA) and compatibility (PC) also showed positive and significant effects on intention (H9: β = 0.21, t = 2.84, p = 0.005; H10: β = 0.24, t = 3.34, p < 0.001), indicating that the advantage and compatibility of technology to user life are critical for adoption.

On the other hand, the effects of the mixed technology complexity (COMP), experienceability (T), and observability (O) variables on intention were not found to be significant (H11–H13, p > 0.05). This suggests that these three factors are not direct determinants of users' adoption of MR technology; their effects may be indirect or contextual.

When the mediation relationships in the research model were examined, no significant results were detected, and therefore they were not presented.

Overall, the SEM analysis demonstrates the validity of the TAM and DIT-based model and demonstrates that factors such as trust, enjoyment, usefulness, and attitude significantly shape user intention. These findings suggest that enhancing user trust and enjoyable experiences in marketing strategies will strengthen the adoption of MR technology.

Table 4. *Results of R^2 and adjusted R^2*

Variables	R^2	$Radj^2$
AT	0.77	0.77
I	0.81	0.81
PEOU	0.67	0.67
PU	0.84	0.84

Table 4 reports the R^2 and adjusted R^2 values, which illustrate the explanatory power of the model for the endogenous constructs. For perceived ease of use (PEOU), the results (R^2 = 0.67; adjusted R^2 = 0.67) indicate that 67% of the variance is explained by the model. Likewise, for perceived usefulness (PU), the values (R^2 = 0.84; adjusted R^2 = 0.84) suggest that 84% of the variance is accounted for. The R^2 values for user attitude (AT) and behavioral intention (I) are 0.77 and 0.81, respectively, further demonstrating that the model provides strong explanatory power for these constructs.

Overall, these results show that the integrated TAM and DIT model effectively captures both cognitive factors (PU, PEOU) and behavioral outcomes (AT, I) in the adoption of MR technology. The high R^2 values reinforce that the model offers a robust foundation for predicting consumer behavior (Hair et al., 2022).

5. DISCUSSION

This study investigated the adoption of mixed reality (MR) technology through the integration of the Technology Acceptance Model (TAM) and the Diffusion of Innovations Theory (DIT). The measurement model demonstrated strong convergent and discriminant validity under the Fornell–Larcker criterion, confirming that the hypothesized relationships rest on a solid methodological basis (Fornell & Larcker, 1981). Structural equation modeling (SEM) results revealed that trust (PT) and enjoyment (E) significantly shaped users' perceptions of both usefulness (PU) and ease of use (PEOU). Unlike many prior studies that primarily emphasize functional aspects such as usefulness and ease of use, these findings highlight the importance of emotional and psychological factors—namely trust and hedonic experience—in driving MR adoption.

The analysis also confirmed the classical TAM predictions: perceived usefulness and perceived ease of use strongly influenced user attitudes, demonstrating their continued relevance in the MR context. This indicates that cognitive evaluations (PU and PEOU) play a central role in fostering positive user attitudes and shaping behavioral intentions. In addition, the strong effect of PEOU on PU reinforces

the reciprocal relationship between these two constructs, emphasizing that perceptions of ease can substantially enhance perceptions of usefulness.

The findings showed that the “relative advantage (RA)” and “compatibility (COMPAT)” dimensions of the DIT also significantly affected intention. This result supports the literature suggesting that the tangible advantages an innovation brings to users' lives and its compatibility with existing values play a critical role in adoption (Tornatzky & Klein, 1982; Lin, 2011). In contrast, it is noteworthy that the complexity (COMP), trialability (T), and observability (O) variables did not show significant effects on intention. While these variables are generally found to have positive effects in the literature (Al-Jabri & Sohail, 2012; Jiang et al., 2021), their lack of significant results in the context of MR technology may be due to the inherent high uncertainty and experience differences inherent in this technology. In particular, limited opportunities to experiment with MR technology (e.g., the cost or difficulty of accessing the devices) and the inadequate observation of its benefits by users may have weakened the direct effect of these variables on intention.

The findings of the study both confirm and differ from existing studies in the literature in some respects. The critical importance of trust and enjoyment, particularly hedonic motivation in UTAUT2 and trust, often overlooked in DIT, has brought these variables to the forefront in the context of MR. Thus, the study offers a more holistic approach that goes beyond cognitive factors in the adoption of technological innovations.

6. CONCLUSION AND RECOMMENDATIONS

This research, conducted with participants living in Türkiye and interested in technology, examined acceptance factors for the potential future use of the Apple Vision Pro, which is not yet available in the Turkish market. The integration of TAM (Davis, 1989) and DIT (Rogers, 2003) theories, as well as the inclusion of psychosocial variables often overlooked in explaining consumer behavior, such as trust (PT) and enjoyment (E), constitutes a unique contribution that distinguishes it from similar studies in the literature.

The findings of the study reveal positive and significant effects of the relative advantage and compatibility dimensions of DIT on intention, while the complexity, trialability, and visibility variables have no significant effect in the context of the Apple Vision Pro. This result partially aligns with previous studies demonstrating that the effects of DIT may vary across contexts (Tornatzky & Klein, 1982; Lin, 2011). However, the lack of effect of these variables, particularly in the context of MR, provides a distinct contribution to the literature. This result may be explained by the Apple Vision Pro's lack of experience in Türkiye, the low physical observability of the product, and the lack of opportunity for users to try it in person. In this context, the study highlights the importance of conditional factors such as product accessibility and market maturity in technology acceptance models.

In terms of theoretical contribution, the study combines TAM and DIT, highlighting the role of trust and enjoyment, thus adding psychosocial dimensions to technology acceptance research, which has largely focused on functional dimensions in the literature. It also suggests that some DIT variables may operate differently depending on context, suggesting that theories should be reinterpreted with contextual flexibility.

The findings of this study offer important implications, particularly for digital marketers. First, the decisive role that trust and perceived enjoyment play in the adoption of mixed reality technologies like the Apple Vision Pro demonstrates that digital marketing strategies should not be based solely on the functional benefits of the product. Marketers should consider consumers' emotional and psychosocial dimensions in addition to their cognitive evaluations (perceived usefulness and ease of use); in particular, emphasis on trust and the hedonic experience should be central to campaign messages.

Secondly, the findings demonstrate that the relative advantages and compatibility of a product strongly influence consumer intentions. This suggests that when promoting MR-based products, marketers should emphasize how they fit into consumers' existing lifestyles and the tangible

advantages they offer. Especially in new shopping environments like the metaverse, clearly articulating the aspects of a product that add value to consumers will accelerate adoption.

Conversely, the lack of significance in the trialability and observability variables serves as a strategic warning for marketers. As with the Apple Vision Pro, limited opportunities to experience a product can undermine consumer acceptance. Therefore, digital marketers should offer consumers the opportunity to experience the product through innovative methods such as virtual try-on apps, augmented reality-based demo experiences, or pop-up experience areas. This can make the product's intangible benefits more visible.

Furthermore, this research reveals the impact of MR technologies on consumer attitudes and intentions, providing digital marketers with strategic insights in the metaverse. Brands should view devices like the Apple Vision Pro not only as technological products but also as channels for digital interaction and customer experience design. In this context, integrating applications such as metaverse stores, virtual showrooms, or interactive product experiences into their marketing mix will increase consumer engagement and purchase intention.

Finally, the research results suggest that digital marketers should support technology acceptance not only with short-term sales strategies but also with long-term trust-building and user experience optimization. Secure payment infrastructures, personal data protection, transparent communication, and entertaining experiences that deliver value to the user will provide a critical competitive advantage in mixed reality-based marketing strategies.

Limitations include the fact that participants were not able to directly experience the Apple Vision Pro product because it was not yet available in Türkiye. This may have led to the non-significance of DIT variables, particularly trialability and visibility. Furthermore, because the sample was limited to technology enthusiasts in Türkiye, generalization across different cultural and demographic contexts may be limited.

For future research, longitudinal studies with real-world user experiences after the product's launch are recommended. Furthermore, conducting comparative studies across different age groups and cultures would increase the generalizability of the findings. Furthermore, including additional variables such as social influence, perceived risk, and price value in the model could help explain the acceptance of MR technologies more comprehensively.

In conclusion, this research, as one of the first academic efforts on consumer acceptance of the Apple Vision Pro, offers an original contribution to the literature and allows for the reinterpretation of technology acceptance theories in the context of MR. The findings provide valuable contributions to the literature on marketing, product development, and consumer behavior at both theoretical and practical levels.

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Declaration of Conflicting Interests and Ethics

The authors declare no potential conflict of interest with respect to the research, authorship, and/or publication of this article. This study was conducted in accordance with the principles of research and publication ethics. Ethics committee approval for this research was obtained from the Istanbul Nişantaşı University Ethics Committee (date: August 22, 2024; number: 2024/08).

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Data Availability Statement

The data that support the findings of this study are available from the corresponding author upon reasonable request.

Artificial Intelligence (AI) Disclosure

An artificial intelligence–based language assistant, including Grammarly and DeepL, was used to provide limited language support and improve the language quality of the translated manuscript. The authors take full responsibility for the accuracy and final content of the translation.

Contribution of Authors

Ayben Ceyhan Günay: Conceptualization, methodology, writing original draft, data collection, interpretation of findings, writing review and editing. Begüm Maral: Literature review, writing original draft, interpretation of findings. Yavuz Toraman: Methodology and data analysis. All authors have read and approved the final version of the manuscript.

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