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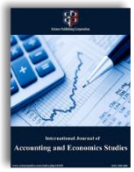

Bridging Technology and Education: How Immersion and Usefulness Drive Mobile AR Use in Medical and Health Science Education

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Abstract

Using the Mobile Augmented Reality Acceptance Model, this study examines the motivations of current health science and medical educators to incorporate MAR in their teaching methods. The MARAM augments the Technology Acceptance Model (TAM) by offering proportional benefits, enjoyment, and ease of use, mobile self-efficacy, information seeking, flow, and novelty. Additionally, this study examines MARAM validity. This study aimed to evaluate how well students learnt when the same material was presented in an augmented reality environment. Professors from medical institutes received 370 questionnaires; 325 of them were determined to include information that was appropriate for the study. Structural equation modeling with partial least squares is used to test the relationships among variables. Consumers are much more likely to use mobile augmented reality if they think it will save them time, be convenient, be fun, and give them confidence. Additionally, empirical findings indicate that flow and information-seeking tendencies have a significant impact on usage intention, whereas the role of novelty is comparatively minimal. These findings further emphasize the roles of immersion and perceived usefulness as mediators of the favorable outcomes from AR purchasing.

Keywords: *Augmented Reality; MARAM; Technology Acceptance; Perceived Usefulness; Immersion; Intention to Use.*

1. Introduction

Since the beginning of this decade, there has been a significant rise in the number of people who are interested in utilizing augmented reality (AR) in both conventional and non-conventional educational settings (Arici et al., 2019). Research in the field of augmented reality (AR) has recently shown promising results, including improved learning outcomes, increased student motivation and engagement, and benefits for a broad range of academic fields (Xusheva et al., 2025). Simultaneously, as mobile technology has advanced, numerous researchers and organizations have been inspired to create a range of mobile augmented reality applications and books for educational reasons. The authors of this work are (M. Akçayır & G. Akçayır (2017).

Furthermore, a multitude of augmented reality (AR) publishing platforms and tools have been established, enabling educators and learners to effortlessly generate their own AR learning tasks, whether they are image-centric or location-centric, without the need for programming proficiency. (C. Lytridis, 2018). Modifications are being made to medical education to accommodate contemporary learners. Currently established tools are employed to improve medical education learning. Virtual reality and augmented reality, according to Panteleidis et al. (2018), have significantly enhanced the training and education of future surgical experts. The article Virtual and Augmented Reality in Medical Education was previously published by Panteleimon and Panteleimon (2018). A Look Back, Present, and Future of Medical and Surgical Trainees.

One major distinction between VR and AR is that VR apps aim to completely dispense with the real world in favor of a computer-generated simulation. The users will be immersed in an artificial world without interaction with the real physical world. Taking into account the aforementioned findings, our research aims to contribute to the body of knowledge addressing the scarcity of research on mobile augmented reality acceptance models in the realm of medical education and professional educators. The present research aims to discover the factors that influence users' intentions of using mobile augmented technologies, with an emphasis on perceived relative advantage, perceived ease of use, perceived enjoyment, mobile self-efficacy, and perceived usefulness. Furthermore, it investigates the effects of information seeking, flow, novelty, and immersion on this intention.

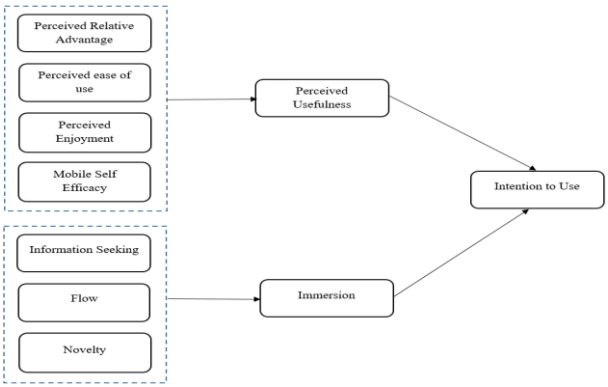

Fig. 1: Author's Model.

Source:(Koutromanos, G et al., 2024)

2. Review of Literature and Development of Hypotheses

AR technology perception, acceptance, and interaction are explained by the Model of Augmented Reality Acceptance in Fig. AR can visualize complicated medical concepts in immersive, interactive, and realistic ways, making it popular in medical education. For AR, the MARA model extends technological acceptance models like the TAM to better identify aspects that affect AR acceptability and use in medical training. The MARA approach helps educators and developers design AR apps that students like and improve learning by focusing on perceived utility, ease of use, enjoyment, and additional characteristics.

2.1. Perceived relative advantage

(Meister et al., 2008)The authors contend that the frequent conflation of these concepts can make it difficult to understand how people adopt new technologies. Their conceptual framework divides PU from RA, which is the perceived superiority of a new technology above existing alternatives, and RA, which is the technology's unique advantages. According to their research, PU explains why people adopt new technologies, yet RA is needed to consider competitive alternatives when making judgments.
(Uhde &Mombeuil, 2021)This study investigates the relative benefits of mobile payment systems, particularly WeChat Pay, and how these benefits impact the intent to use the structure continuously. The study uses a mixed-method technique to examine relative advantage in addition to perceived convenience and security. The outcomes support the view that consumers evaluate novel technologies centered on relative advantages above present outcomes as perceived relative advantage influences user intentions.
In their 2006 study, Karahanna et al. found that TAM's perceived usefulness is in accordance with Rogers' relative advantage theory. And both dimensions should be incorporated into investigating technology adoption because understanding how people evaluate new technologies in relation to their predecessors is essential (Kapoor & Menon, 2025).
H1: Perceived relative advantage (PRA) positively affects perceived usefulness (PU)

2.2. Perceived ease of use

The term "perceived ease of use" refers to the degree to which users believe that interacting with a technology is relatively simple (Davis, 1989). "Perceived ease of use", with its foundation in the prior frameworks, works in conjunction with 'perceived utility' to affect the attitudes and purposes of users and to inspire implementation. It is also the degree to which people understand technology that is reachable and easy to operate (Nasta, Amin, &Hasriani, 2022).
Considered an essential component of the Technology Acceptance Model (TAM), it has been the subject of extensive research in the fields of accessibility and human-machine interaction. A person's self-efficacy—their belief in their ability to carry out the tasks at hand—is highly related to how easily they perceive a product or service to be usable. The degree to which end users embrace new forms of technology is influenced by this (Effendy, Hurriyati, &Hendrayati, 2021).
Studies have established that individuals' opinions on access to use in current technologies like social media and e-wallets, along with electronic libraries and payment gateways, influence their prospects of truly using them (Pokhrel, 2021). Several outcomes are associated with perceived usability, including its influence on the sustainable development of micro, small, and medium-sized enterprises (MSMEs) through social media marketing and its influence on the online advertising effectiveness of businesses (Yeh & Teng, 2012).
When people perceive that a technology is easy to use and understand, they are more likely to be open to learning and implementing it. PEOU has a significant impact on user acceptance, especially in hedonic contexts such as streaming (P. Zhu, Liu, Li, Jiang, & Zhu, 2022). Making technologies more user-friendly through improving PEOU makes them more appealing to specific audiences.
H2: PU is positively affected by PEU
H3: PU is positively related to PE

2.3. Mobile self-efficacy

As mobile technology has evolved and become more accessible, individuals now have the chance to use smartphones and tablets to digitally improve their daily lives (Oakley &Palvia, 2012). The mobile phone phenomenon has grown into a fundamental component of our modern existence, and it is part of our humanity, because it has penetrated all sections of society, from the old to the young, work, and unrelated job activities (Ahn & Park, 2022).
Self-efficacy is regarded as one of the primary elements supporting the widespread adoption of mobile phones, gadgets, and new technology (Attaran, 2022). Self-efficacy is described as the individual user's belief/confidence that they have the ability and capacity to do a specific activity or performance (Yoo, 2010).

Mobile self-efficacy is an individual's conviction or confidence in their capacity to make use of mobile phone devices. In the context of mobile health services, it refers to an individual's belief in their capacity to navigate and use mobile health applications to receive specialized healthcare services. Previous studies have shown that self-efficacy has a substantial impact on people's behavioral intentions to accept and use electronic and mobile health services (Garge et al., 2022).
In the current study, yet, researchers are interested in looking at the moderating influence of mobile self-efficacy on both the effect of performance expectation and effort expectancy on mobile health service uptake, as well as its immediate effect on citizens' intentions to suggest mobile health services.
H4: The relationship between usability and of impact on perceived usefulness is strong for (MSE)

2.4. Perceived usefulness

The subjective advantages that users perceive about a technology's capacity to improve their performance are represented by perceived usefulness (Halizah et al., 2022). When it comes to the technology acceptance model (TAM), PU is one of the most important factors in predicting users' attitude and intention towards adoption, standing with perceived ease of use. The impact of PU on real intentions and actions regarding technology use has been studied intensively in the fields of information systems, learning, and consumer research (Lee & Oh, 2022).
About hedonic systems in particular, PU satisfies users' expectations for enjoyment, cultivates perceived value, and encourages desire for utilization. “Perceived utility" is adopted in the areas of e-media and augmented reality, to mention the extent to which consumers trust that these developments give them welfare and improve their user understanding. While applications advance operators' visions of the real world, impacting utility and ease of interaction (Alam et al., 2021), quite a lot of readings have examined their awareness regarding digital broadcasting and interface accessibility.
An array of research has examined that usefulness has a substantial outcome on the purposes of using augmentation in store settings (McLean & Wilson, 2019. Digital media and augmented validity, in total, are a significant element in viewpoints and choices. These are found to have probable understandings, making it more expedient, and deliver functionalities that are novel and valuable.
H5: Perceived usefulness (PU) has a positive effect on Intention to use

2.5. Information seeking

Looking for extra information is a thoughtful deed that individuals do when they require information or when they are ambiguous about it (Wilson, 1999). Various academic arenas, which comprise advertising, IT, and interactions, have considered these actions expansively in digital surroundings. Convenience, seeming usefulness, and consumer enthusiasm are a few things that affect information seeking (Case, 2002).
Shoppers, as observed in prior studies by Pirolli & Card, 1999), consider the welfares and shortcomings of numerous bases of information and provide fondness to additional content with lesser efforts (Bhuvanesh et al., 2023). Elements like individual commitment, observed integrity, and belief in the source are sturdily related to looking for out information practices in situations like therapeutic communication, online instruction, and buying decisions (Kim, Mattila, &Baloglu, 2011).
Investigation further suggests that individuals are more likely to pursue and process information while it is unique or within the zone (Nakamura & Lindholm, 2025). The study by Sundar et al. (2014) presents that, capability to emphasize one's opinions and decline resilience to information overwork are upgraded by a state of flow, while contact with innovative stimuli may inspire probing activities. Therefore, digital platforms and content approach proposals might be an advantage to these constructs.
H6: Information seeking positively affects Immersion

2.6. Flow

Areas such as psychology and relations between individuals and processors, flow—anemotional form is regarded as the whole participation and inclination in a mission that has been systematically examined (Csikszentmihalyi, 1990). “Flow” is presented in their research (Novak, Hoffman, & Yung, 2000) as the ability to be compatible with the needs of a job, when it has distinct intentions and benefits from prompt support.
Individuals in a state of flow are making use of the internet or additional digital platforms and are involved, content, and passionately receptive. Authors (Chen et al., 1999) observed that it increases the level of essential efforts, encourages assurance, and inspires episodic habits or visits (Doaim et al., 2023). In online learning and spending, the flow experience affects customer actions by making it feel comfortable to engage in evidence and lessening the effort that is required to do so (Huang, 2003).
H7: Flow is positively associated with Immersion

2.7. Novelty

The concept that a stimulus, event, or piece of information is novel or distinctive is known as novelty. In the domains of behavioral research and consumer psychology, novelty is essential for drawing interest and encouraging participation (Hirschman, 1980). Novel encounters have been found to increase internal drive, foster investigation, and stimulate curiosity (Berlyne, 1960). It is a crucial factor in digital platforms upholding and fascinating consumers, mainly on platforms that count on frequent communication, such as smartphones, e-learning tools, and public broadcasting applications (Rafaeli&Ravid, 2003).
Results from empirical research suggest that retention of recall and fulfillment amongst users are enhanced by posting innovative information (Lee &Labroo, 2004). To add to it, it is intensely interrelated with personal responses, including pleasure, which then influence behavioral intentions (Menon&Soman, 2002). User engagement and attention retention may be prominently upgraded in instructional and persuasive backgrounds by including inventive features into content or interface scheme (Shin, 2006).
H8: Novelty is positively related to Immersion.

2.8. Immersion

To explain how consumers are drawn into a digital setting, making them experience a tangibly present and more engaged environment. Various components, which include observing know-how, pictorial resolution, sensual and artistic characteristics, might label immersion (Zeng et al., 2020).
Research has demonstrated that it enhances education by opening opportunities for contextual learning, viewpoint diversity, and knowledge exchange (Holopainen et al., 2020). Studies have shown that children learn best when they are fully immersed in an online educational activity (Georgiou et al., 2019).
This concept is "to be captivated in an experience," which is particularly accurate in digital realms (Aiken & Berry, 2015). Inside the dominion of digital media, the phrase "immersion" relates to the participation and responsiveness to one specific assignment (Diemer et al., 2015).
The impression of a physical occurrence in a digital situation may be influenced by their levels, which affect the content of the media that is exposed (Imam & Ilori, 2022). To highlight the diversity of arrangements it may undertake, simulated fictional immersion can be categorized as either narrative or ludic (Ernstsen, Mallam, & Nazir, 2019).
The production of digital media art has also become increasingly dependent on immersive media, which includes augmented realities and intelligent technology (Cypress, 2022). To summarise, the concept of immersion deserves deeper investigation because it significantly influences user psychology in various disciplines (Atti, L. M. 2024).
H9: Immersion positively influences customer Intention to use.

3. Methods

Data were gathered from the respondents using a self-administered "Questionnaire" survey, which is essential for collecting data. This survey has five questionnaire components. The majority of surveys were given in universities; however, some were emailed. Significant dissatisfaction or satisfaction can be marked on the Likert scale from one to five. The responses were evaluated in this manner at this juncture.

3.1. Data collection

This study included 325 professors from prominent Indian medical universities. The sample was gathered between January and April 2025 utilizing a non-probability purposive sampling approach and a quantitative descriptive strategy, which is known for its successful statistical data processing and might save time and money (Chbaly H, 2022). The study collected primary data from Chennai private university professors using a standardized online questionnaire. India's largest metropolis, Chennai, is known for its excellent medical education and healthcare (Kristian et al., 2014).
Students seeking medical degrees in Chennai have many benefits. Aspiring doctors choose Chennai medical universities for their complete education, hands-on experience, research, and worldwide outreach. The research sample includes 325 valid replies from 370 questionnaires issued to the workers of several medical universities in Chennai, India. The participants had no trouble filling out the online questionnaires that were distributed through informal groups and online platforms. Answers were kept confidential, and no private information was sought. Thus, responders remained anonymous. Sample selection eliminated unfinished submissions, biased responses, and big outliers to optimize sample size.

3.2. Measures

Table **1** shows that previous studies generated and validated the survey's measurement items to confirm validity and reliability. Centered on Cronbach's alpha coefficient criteria, a test or scale with an alpha coefficient above 0.8 is highly reliable (Tavakol M, 2011). The variable's values were all within range. One was "strongly disagree" and five was "strongly agree" on a Likert scale was deployed.

Table 1: Indicators and References

Construct	Items	Sources
Perceived Relative Advantage	5	Yoon et al. (2020)
Perceived ease of use	3	Davis (1989)
Perceived Enjoyment	4	Venkatesh and Bala (2008)
Perceived Usefulness	3	Davis (1989)
Information Seeking	4	Park and Stangl (2020)
Flow	4	Rauschnabel et al. (2017)
Novelty	4	Yim et al. (2017)
Immersion	4	Yim et al. (2017)
Intention to Use	3	Ajzen and Fishbein (1980)

Source: Prepared by Authors (2025).

3.3. Demographic profile of the participants

A study of 325 medical university faculty was conducted. Of these, 148 (44.8%) were female and 177 (55.2%) male professors. Of the 190 respondents, 60% aged 36–40. Most professors were medical postgraduates with over six years of experience.

3.4. Reliability and validity

According to Urbach &Ahlemann (2010), we calculated Cronbach's alpha, composite reliability (CR), average variance extracted (AVE), and loading measures to assess reliability and convergent validity. We assessed item internal consistency using Cronbach's alpha. The degree to which a collection of items is consistent with one another and reliable is measured by Cronbach's alpha, independent of whether

or not these items reflect an identical construct. On a scale of 0 to 1, estimates above 0.7 indicate reasonable dependability and greater than 0.8 indicate an extremely good fit (Cronbach, 1951).
This is referred to as "indices of the average variance between the variables that are observed used as a measure of a latent construct" by Fornell and Larcker (1981). The items under assessment assess the same construct when their values exceed the 0.7 threshold. The validity of the construct is subsequently verified by these two indicators. We tested convergent validity with AVE and factor loading. Analyses excluded weak factor loadings. Loadings below 0.4. Measurement error and construct variance are measured by AVE. Measures of 0.5 or higher are advised for convergence.

3.5. Regression analysis

Regression analysis was implemented to determine the model's predictive power and the dependent variable's relation to any number of independent variables. Following the completion of the analysis, the R value was found to be 0.791, and the R2 value was found to be 0.626. This indicates that the predictors are responsible for approximately 62.6% of the variance in the dependent variable. There was an absence of autocorrelation as described in

Table **2**.

Table 2: Model Estimate

Model Summary					
Model	R	R Square	'Adjusted R Square'	Std. Error of the Estimate	Durbin-Watson
1	.791[a]	.626	.615	2.21223	1.967
a. Predictors: (Constant), IMM, FLW, INF_SEE, NOV, PER_ADV, MO_S_EF, PER_USE, PE_E_USE, PER_ENJ					
b. Dependent Variable: INT_USE					

Source: Prepared by Authors (2025).

3.6. Model validation

The technique of structural equation modeling, also known as SEM, was utilized for the analysis of the data. Descriptive statistics, such as correlation, standard deviation, and mean, are presented in Table 3. There is a positive correlation between every relationship, and the data shows an acceptable measure of variation.

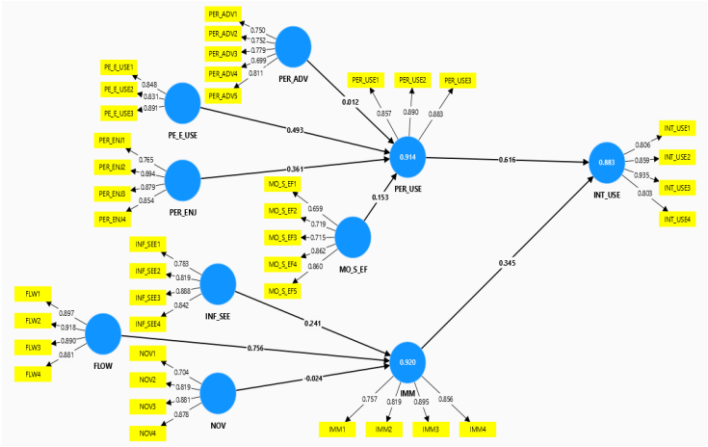

Fig. 1: PLS SEM Algorithms.

Source: Prepared by Authors (2025).

The measurement model was evaluated using four distinct metrics, including discriminant and convergent validity, as well as construct and indicator reliability, as illustrated in Figure 2. For indicator reliability, confirmatory factor analysis was employed to examine item loading. Retaining items with loadings greater than 0.70 promoted reliability.
Better dependability was achieved by removing items with values below 0.70. Construct reliability was measured using composite reliability and Cronbach's α. To guarantee construct dependability, Hair et al. (2019) recommend both measures >0.70. The results of the CR were between 0.863 and 0.938, while α was between 0.787 and 0.912. These assessments indicate construct reliability. AVE was utilized to establish the validity. (Fornell & Larcker, 1981) found that AVE values >0.50 indicate increased convergent validity to quantify the idea of variance.
AVE measures are presented inTable 3**:** Descriptive Statistics, indicating good AVE. To further verify the discriminant validity, the square root of the AVE was utilized as an indicator. The root of the AVE shows with larger correlation loadings, which indicates that constructs are distinct from one another.

Table **1**'s diagonal indicates that there are no issues about construct similarities. If all four indicators were good, structural model analysis was carried out.

Table 3: Descriptive Statistics

	FLOW	IMM	INF_SEE	INT_USE	MO_S_EF	NOV	PER_ADV	PER_ENJ	PER_USE	PE_E_USE
FLOW	0.897									
IMM	0.950	0.833								
INF_SEE	0.855	0.878	0.834							
INT_USE	0.949	0.902	0.873	0.852						

MO_S_EF	0.883	0.794	0.701	0.906	0.768					
NOV	0.481	0.427	0.364	0.521	0.724	0.824				
PER_ADV	0.768	0.728	0.669	0.727	0.811	0.776	0.759			
PER_ENJ	0.947	0.920	0.844	0.959	0.857	0.511	0.754	0.849		
PER_USE	0.950	0.904	0.903	0.928	0.825	0.439	0.745	0.912	0.877	
PE_E_USE	0.836	0.814	0.967	0.871	0.716	0.409	0.683	0.833	0.912	0.857

Source: Prepared by Authors (2025).

3.7. Testing of hypotheses

3.7.1. Structural equation modeling

The data presented
Table **4**in indicates that there is evidence in favor of hypothesis H1, which states that perceived utility (PU) and perceived relative advantage (PRA) are positively correlated. The beta value is 0.012, and the 0.00 was the p-value. Hypothesis 2 (H2) has been confirmed: Perceived ease of use (PEU) has a favorable effect on perceived usefulness (PU). The beta value was 0.012, and the p-value is 0.000. The third hypothesis, which states that perceived enjoyment (PE) and perceived usefulness (PU) have a positive association (beta = 0.361, p-value = 0.000), was found to be accepted.

Table 4: Test of Hypothesis

Relationships	Original Sample(O)	p-value	Hypothesis support	Adjusted R2
Hyp1	0.012	<0.001	Validated	0.910
Hyp 2	0.493	<0.001	Validated	
Hyp 3	0.361	<0.001	Validated	
Hyp 4	0.153	<0.001	Validated	
Hyp 5	0.616	<0.001	Validated	0.881
Hyp 6	0.241	<0.001	Validated	
Hyp 7	0.756	<0.001	Validated	
Hyp8	-0.024	0.529	Not Validated	
Hyp9	0.345	<0.001	Validated	0.917

Source: Prepared by Authors (2025).

The relationship H4: Mobile self-efficacy (MSE) has a significant relationship on perceived usefulness (PU) with the values (beta = 0.153, p-value = 0.000). H5 indicates that consumer intention to use correlates favourably with perceived usefulness (PU) (beta = 0.616, 'p' p-value = 0.000). The results (beta = 0.241, p-value = 0.000) for H6 also showed that it was significant. Hypotheses 7 and 9 were significant (beta = 0.756, 0.345, p-value = 0.000). H8 was determined to be statistically insignificant in the analysis that contained the values (beta = -0.024, p-value = 0.529).

4. Discussion

The current study backs up previous research that has shown Augmented Reality (AR) to be an effective tool for medical education. Results are in line with those of Barsom, Graafland, & Schijven (2016), who discovered that augmented reality provides real-time visualization and improved interaction, both of which can greatly improve the understanding of anatomy and procedures. Consistent with the findings of (Ma, Jain, & Anderson, 2014), the usage of augmented reality in various areas of medical instruction, such as anatomy, patient communication, and surgery, showcases its adaptability and extensive educational potential. In addition, the study supports the conclusions drawn by (Küçük, Yilmaz, & Göktaş, 2014), which demonstrate that augmented reality aids in better understanding by delivering complicated and abstract medical ideas through immersive simulations. It also benefits educators by facilitating the intuitive and engaging demonstration of high-level material, which supports Bacca Acosta et al.'s (2014) observation on AR tools that assist instructors in managing cognitive load and enhancing instructional quality.
Despite the benefits seen, this study also agrees with previous research that has pointed out problems with implementation. Accessibility of devices, high development costs, and the steep learning curve for educators are some of the limitations highlighted by (Radianti, Majchrzak, Fromm, & Wohlgenannt, 2020). Particularly in contexts without adequate infrastructure, these obstacles remain and were reflected in the present study. Additionally, the importance of well-planned instructional design and institutional backing for equitable and effective integration of AR into the curriculum is emphasized by Akçayır & Akçayır (2017).
Considering its advantages and disadvantages, incorporating augmented reality (AR) into medical education necessitates the development of well-constructed educational frameworks and instructional strategies that are supported by research. Zhu et al. (2014) advocate that the assimilation of augmented reality must align its position with instructive objectives and perspective, rather than concentrating exclusively on technological features. The outcomes indicate that it can enrich pupil wisdom and performance when it is considerately employed and reinforced by professionally equipped, skilled tutors.

4.1. Managerial implications

In medical institutions, these discoveries are significant for regulating the incorporation of 'smartphone-enabled augmented reality'. Organizations must aid faculties in establishing positive insights to endorse their implementation in instructional operations. Successful MAR implementation requires educators to recognize its benefits for both themselves and their students, in addition to its enjoyment. This technology must be proven to provide educational value and affordances compared to other technologies. Institutions ought to enable teachers to use MAR effectively by providing the necessary infrastructure, resources (such as mobile devices and internet connectivity), and possibilities (such as time to prepare courses). The study also impacts researchers.
It's intriguing that perceived utility and attitudes towards MAR still predict intentions. This research is the principal to integrate perceived relative advantage into a model for the adoption of MAR technology. From the perspective of education, perceived relative advantage is an evaluation of how teachers perceive the benefits that MAR offers in comparison to other digital technologies. Interestingly, mobile self-efficacy increases perceived usefulness. Interestingly, mobile self-efficacy influences perceived usefulness. This suggested feature can be

incorporated into MAR technology acceptance models soon. The views of educators towards their intention to use are positively impacted by their perceptions of how easy it is to use and how enjoyable it is.
It also shows how immersion and perceived utility make AR experiences satisfying. Educational institutions must build AR campaigns that help people lose track and feel as if they exist in the AR world. This study also explains why people adopt AR as a pedagogy. Big factors influencing AR familiarity were seeking information, novelty, and flow. (Cummings & Bailenson, 2016), (Peukert et al., 2019) conducted outstanding work on immersion. Flow and information seeking directly affect immersion perception, but novelty has a less significant impact.

4.2. Limitations and directions for future research

This study featured medical university professors who learned about MAR affordances, used MAR apps, and created their own augmented content for multiple specialties. Thus, the findings cannot be applied to academics unfamiliar with MAR from other universities nationwide. Future research might examine AR's long-term implications on medical education, best practices for AR integration, and AR adoption spanning medical specialties and cultures. Longitudinal studies could determine if the new teaching tool improves the retention of information. Application improvement can be achieved through functional and heuristic testing. Future research should focus on respondent history to improve internal reliability and accuracy. Technically, the application should have greater virtual-real-world interaction. Additional engagement is needed in the application, especially between instructors and students.

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