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Factors Influencing 360-Degree Video Adoption in e-Learning: a UTAUT2 Case Study with Pre-service Primary Education Teachers in Spain

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Abstract

This study analyses the acceptance of immersive virtual reality (iVR) videos among e-learning students (N=198) enrolled in a Primary Education Degree English course at the University of Las Palmas de Gran Canaria. iVR, with its ability to create realistic and interactive virtual environments, has emerged as a transformative tool in enhancing learning experiences. Its application extends to higher education, proving invaluable for pre-service teacher training through an authentic simulation of classroom dynamics. Acknowledging the pivotal role of student acceptance and comfort with this technology, this research aims to understand the factors influencing its efficacy.

To measure acceptance, students actively engaged in a competency activity, immersing themselves in the analysis of a 360-degree-recorded classroom practice within a Primary Education setting. Subsequently, a structured questionnaire, based on the Unified Theory of Acceptance and Use of Technology 2 (UTAUT2), was administered. This questionnaire assessed the factors influencing the acceptance of this educational technology across eight dimensions and their behavioral intentions to use it.

Results from this investigation underscore that the factors Hedonic Motivation, Performance Expectancy and Effort Expectancy received the highest ratings among participants. Conversely, lower ratings were observed for Habit and Price Value. Confirmatory factor analysis demonstrated that the UTAUT2 model effectively captured preservice teachers' perceptions of iVR across all dimensions (Performance Expectancy, Effort Expectancy, Social Influence, Facilitating Conditions, Hedonic Motivation, Price Value, Habit and Behavioural Intention).

KEYWORDS: UTAUT2 Model, Immersive Virtual Reality, e-Learning, Pre-Service Teacher Training.

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1. Introduction

Virtual reality (VR) is gaining momentum in education, as evidenced by initiatives such as the European Horizon program on eXtended Reality Learning (European Commission, 2021). This technology is being regarded as a highly effective educational tool (Li et al., 2022), particularly within the landscape of higher education where extended reality (XR) technologies, including VR and 360-degree videos (immersive virtual reality (iVR) videos), are undergoing active exploration (Brown et al., 2020). Despite diverse applications of 360-degree videos in education, with a noticeable focus on Medicine and Healthcare (c.f., Bernard et al., 2019; Chang et al., 2019; Zulkiewicz et al., 2020, to name a few), studies on their use in teacher education are scarce (Theelen et al., 2019; Theelen et al. 2020; Walshe & Driver, 2019; Ye et al., 2021), indicating a need for more exploration, a gap this study seeks to address.

The versatility of 360-degree videos, recorded in immersive reality with spherical cameras, offers users a

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unique ability to navigate and control their viewing experience. Their immersive nature, sense of presence, and interactivity are key attributes that contribute to their effectiveness (Walsh & Pawlowski, 2002). In the field of education, the realism of 360-degree videos, their affordability and mobility provide an immersive experience that enhances content understanding (Shadiev et al., 2022), and can encourage the development of educational inclusion through the use of technologies (Guerra-Santana et al., 2022). Yet, for iVR benefits to materialize, it is crucial for students to accept and feel comfortable with the technology.

To investigate the factors influencing on the acceptance and intention to use iVR within the context of teacher training, our study adopts the Unified Theory of Acceptance and Use of Technology 2 (UTAUT2) (Venkatesh et al., 2012) as its research framework. UTAUT2 is a widely used model in educational settings, and it provides a robust foundation for understanding technology perceptions (Abdekhoda & Dehnad, 2023; Bower et al., 2020; Tamilmani et al., 2021). Its versatility is evident in applications across diverse educational contexts, including studies on mobile phone usage, PowerPoint, Google Classroom, the metaverse, and virtual reality games (Chávez Herting et al., 2020; Jakkaew & Hemrungrote, 2017; Nikolopoulou et al., 2020; Udeozor et al., 2021; Yang et al., 2022). The absence of similar investigations in Spain underscores the distinctive value of our research, especially considering that studies on iVR acceptance using UTAUT2 have been conducted in various other countries such as China (Li et al., 2022), Australia (Bower et al., 2020), Belgium (Boel et al., 2023), and South Africa (Mbonye, 2022).

UTATU2 builds upon the foundation of the original UTAUT model (Venkatesh et al. 2003), which identifies four key factors shaping an individual's intention to use and actual usage behavior of a technology: Performance Expectancy, Effort Expectancy, Social Influence, and Facilitating Conditions. UTAUT2 introduces three additional constructs: Hedonic Motivation, Price Value, and Habit (Venkatesh et al., 2012). Compared to the original UTAUT model, this extended framework is better equipped to explain and analyze individuals' technology acceptance behaviors (Tamilmani et al., 2021). Given the explanatory power of UTAUT2 in anticipating behavioral intention, particularly in contexts where educators have more freedom to choose teaching tools (Wong et al., 2013), it is deemed more appropriate for our study. Below is a brief overview of the constructs of UTAUT2 that influence and predict the intention and usage of iVR, adapted to the purpose of this study.

Performance Expectancy: the extent to which pre-service teachers believe that using 360-degree videos will enhance their teaching performance and contribute to improved learning outcomes in their future classrooms.

Effort Expectancy: prospective teachers' perceptions of the ease of use (mental and physical effort) associated with integrating iVR videos into their teaching practices.

Social Influence: the influence of various stakeholders, such as colleagues and educational authorities, on trainee teachers' decisions to adopt 360-degree videos in their teaching.

Facilitating Conditions: pre-service teachers' perceptions of the availability of organisational and technical support systems necessary to facilitate the integration of 360-degree videos into their future teaching practice.

Hedonic Motivation: the intrinsic pleasure, enjoyment, and satisfaction that student teachers derive from using iVR videos in their teaching.

Price Value: the future teachers' perceptions of the cost-effectiveness and value proposition of using 360-degree videos in their teaching practice.

Habit: the degree to which pre-service teachers' use of 360-degree videos becomes habitual and automatic over time, based on their prior experiences and reinforcement.

Behavioural Intention: the individuals' intentions and willingness to incorporate 360-degree videos into their future teaching practices.

Figure 1 presents the UTAUT2 model, providing a visual guide to the eight constructs under investigation.

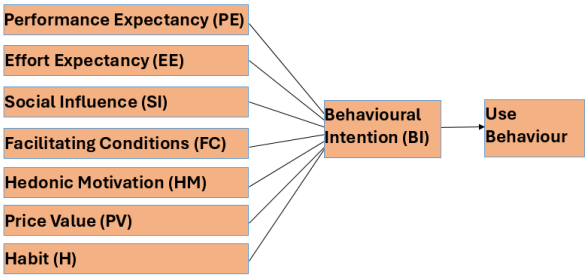

Figure 1 - UTAUT2 model (based on Venkatesh et al., 2012).

The object of study in this research is to quantitatively measure pre-service teachers' perceptions of iVR videos in each dimension of the UTAUT2 model. Specifically, the study explored the following research questions:

RQ1. What factors influence e-learning pre-service teachers in adopting immersive virtual reality in their future teaching practice?

RQ2. To what extent are e-learning pre-service teachers inclined to use immersive virtual reality in their future teaching practice?

The subsequent sections delve into the methodology, results, and discussion, offering a comprehensive analysis of the factors influencing pre-service teachers' perceptions of immersive virtual reality use in education.

2. Methods

2.1 Participants

The research encompassed a total of 198 (N=198) undergraduate pre-service teachers enrolled in the bachelor's degree program in Primary Education, which was delivered in an e-learning format at the University of Las Palmas de Gran Canaria. Table 1 summarizes information about participant profiles.

Table 1 - Demographic overview of participants.

Variable	Value	n	%
Gender	Male	43	22.0
	Female	155	78.0
Age	18-24	90	45.5
	25-34	77	38.9
	Over 35	31	15.7
Experience with iVR	No experience	52	26.3
	Very little experience	69	24.8
	Some experience	54	27.3
	A lot of experience	20	10.1
	Extensive experience	3	1.5

2.2. Measure and procedure

As part of the e-learning course, students engaged in a competency-based activity, viewing a 6:21-minute recording of a 4th-grade English class in Primary Education captured using a 360-degree camera (Insta360 ONE X2), recorded by the researcher. They analyzed the video based on dimensions aligned with the course content (teaching aims, teaching steps, grouping, classroom management). Afterward, students completed an online questionnaire via Google Forms, expressing their intentions regarding future iVR use in teaching.

The survey, based on the UTAUT2 instrument (Venkatesh et al., 2012), adapted for iVR by Bower et al. (2020), consisted of 28 items on a 7-point Likert scale (1=strongly disagree to 7=strongly agree), measuring eight UTAUT2 dimensions: Performance Expectancy (PE, 4 items), Effort Expectancy (EE, 4 items), Social Influence (SI, 3 items), Facilitating Conditions (FC, 4 items), Hedonic Motivation (HM, 3 items), Price Value (PV, 3 items), Habit (H, 4 items), and Behavioural Intention (BI, 3 items).

2.3. Data analysis

Statistical analysis was conducted using IBM SPSS (Statistical Package for the Social Sciences) version 25.0. The analysis focused on examining participants' Likert scale ratings based on the UTAUT2 factors to assess the factors influencing the acceptance and intention to use iVR in the context of teacher training. Descriptive analysis was performed to explore the distribution of participant responses across different UTAUT2 constructs, thereby providing insights into the perceptions of iVR use in education. Additionally, correlation analysis investigated the relationships among key UTAUT2 constructs. Linear regression analysis was utilized to assess the predictive capability of the UTAUT2 model for pre-service teachers' perceptions of iVR use in education.

3. Results

3.1 Model Fit, reliability, and descriptive analysis

The examination of participants' Likert scale ratings based on UTAUT2 factors revealed an adequate model fit: χ^2=495.320, df=271, χ^2/df=1.83, p<0.0001. The Tucker-Lewis Index (TLI) and Comparative Fit Index (CFI) surpassed the threshold of 0.9, with values of 0.928 and 0.940, respectively (Hair et al., 2014). Consistent with assessment criteria (Hair et al., 2014), the standardised root mean square residual (SRMR) and root mean square error of approximation (RMSEA) fell within acceptable ranges at 0.07 and in the 90% confidence interval of 0.06 to 0.07. Standardised estimates for all items exceeded 0.50, ranging from 0.6 to 0.9, affirming the structural equation model's alignment with observed data.

Reliability assessment using Cronbach's Alpha (Table 2) revealed values exceeding 0.80 in seven constructs and 0.732 in one, indicating good internal consistency. This attests to the high reliability of the measurement instrument (Taber, 2017). The results of the Confirmatory Factor Analysis (CFA) confirmed the UTAUT2 model's suitability in explaining participant perceptions of iVR use in education.

Table 2 displays a detailed breakdown of the descriptive statistics for participant responses to Likert scale questions across different constructs within the UTAUT2 model. Mean scores, ranging from 1.69 to 5.45 indicate diverse ratings, reflect a spectrum of perceptions across UTAUT2 dimensions. Hedonic Motivation emerges with the highest mean score of 5.36, indicating a strong inclination towards intrinsic enjoyment and satisfaction derived from using iVR. Following closely are Performance Expectancy and Effort Expectancy, with mean scores of 4.99 and 4.81 respectively. This suggests a significant belief in the

technology's capability to enhance performance and ease of use. Conversely, Habit exhibits the lowest mean score of 2.77, underscoring a relatively weaker habitual tendency towards iVR adoption. Price Value and Social Influence also demonstrate lower mean scores of 3.19 and 3.92 respectively, which showing less emphasis on the perceived affordability and external influence in shaping participants' intentions towards iVR use.

The standard deviations, ranging from 0.23 to 0.93, highlight the variability in participant responses across various constructs. Habit shows a remarkably low standard deviation ranging from 0.23 to 0.70, which points to a more consistent and less varied response pattern among participants regarding the habitual nature of using iVR. In contrast, Social Influence stands out with a higher standard deviation, ranging from 0.80 to 0.93. This indicates a greater diversity of opinions among participants regarding the influence of important individuals on their decision to use iVR. Overall, the variability in participant responses captures nuanced attitudes towards the adoption of iVR in education.

3.2 Statistical analysis: Correlation and Regression

Table 3 illustrates the Pearson correlation coefficients, revealing significant relationships among key constructs within the UTAUT2 model with Behavioural Intention. A notably strong positive correlation ($r=0.737$, $p<0.001$) is observed between Habit and Behavioural Intention, indicating the substantial impact of habitual use on the intention to use iVR among pre-service teachers. Additionally, Hedonic Motivation exhibits a robust positive correlation with Behavioural Intention ($r=0.565$, $p<0.001$), which emphasizes the influence of enjoyment and pleasure associated with iVR on the intention to use it. Similarly, Performance Expectancy and Social Influence demonstrate a moderately strong positive correlation with Behavioural Intention ($r=0.545$, $p<0.001$; $r=0.518$, $p<0.001$, respectively), highlighting the importance of perceived performance benefits and the impact of peer and social factors in shaping the intention to use iVR. In contrast, Facilitating Conditions, Price Value, and Effort Expectancy exhibit comparatively lower correlations with Behavioural Intention, with coefficients of $r=0.376$ ($p<0.001$), $r=0.342$ ($p<0.001$), and $r=0.337$ ($p<0.001$) respectively. This implies a weaker influence on participants' intention to use iVR compared to other UTAUT2 constructs.

In Table 4, the linear regression analysis offers insights into the UTAUT2 model's predictive capability for preservice teachers' perceptions of immersive virtual reality use in education. With a significant correlation coefficient ($R=0.828$), the model accounts for approximately 66.7% (adjusted $R^2=0.667$) of the variance in preservice teachers' intention to use virtual reality. The standard error of the estimate (0.719) indicates precise estimation.

Statistical change metrics reveal the model's impact, with a change in R squared of 0.686, denoting improved predictive accuracy, supported by a change in F statistic (36.897, $df1=11$, $df2=186$, $p<0.000$). The Durbin-Watson statistic (2.214) suggests no significant autocorrelation in residuals, affirming the model's reliability. Expanding on these findings, multiple regression analysis offers further insights into the predictive factors. Among the scrutinized predictors, Habit emerges as the most influential (Sig.=.000; $t=9.142$), followed by Hedonic Motivation (Sig.=.000; $t=5.313$), and Age (Sig.=.003; $t=2.961$), albeit with a somewhat lesser influence. Additionally, two other variables, Social Influence (Sig.=.049; $t=1.981$) and Performance Expectancy (Sig.=.023; $t=2.299$), also surface as significant moderators of Behavioural Intention regarding the use of iVR.

4. Discussion and Conclusions

This study delves into the behavioral intentions of e-learning pre-service Primary Education teachers in Spain concerning the adoption and use of iVR technology in online learning, employing the UTAUT2 model. This represents a novel exploration within the Spanish context and contributes to the broader international discourse on the integration of immersive technologies in education. Understanding the behavioral intentions of future teachers towards incorporation of such innovative technologies hinges on the acceptance and intention of users (Bower et al., 2020). The findings gleaned from this investigation offer valuable insights for educators, researchers, and policymakers involved in shaping the landscape of technology-enhanced education. Furthermore, the outcomes of this study serve as a benchmark for future research endeavors using the UTAUT2 model in the domain of iVR in education.

From a methodological standpoint, this study underlines the effectiveness of the UTAUT2 model in delineating the factors that influence the behavioral intentions of e-learning trainee teachers in Spain towards the adoption of iVR. The Confirmatory Factor Analysis (CFA) indicates favorable model fit indices, affirming the applicability of the UTAUT2 model in the unique context of iVR integration in education.

This validation aligns with previous research that has successfully employed the UTAUT2 model in diverse educational technology contexts (e.g., Chávez Herting et al., 2020; Jakkaew & Hemrungrote, 2017; Nikolopoulou et al., 2020).

Table 2 - Descriptive statistics for each item of the UTAUT2 model.

Constructs	*Means*	*Standard deviation*	*Cronbach's alpha*
Performance Expectancy (PE)	**4.99**	**0.78**	0.825
I think Virtual Reality is useful for teaching in schools. (PE1)	5.20	0.86	
Using Virtual Reality increases my chances of achieving my teaching goals. (PE2)	4.88	0.79	
Using Virtual Reality is helpful for accomplishing things more quickly in teaching. (PE3)	5.01	0.80	
Using Virtual Reality helps increase my teaching productivity. (PE4)	4.88	0.74	
Effort Expectancy (EE)	**4.81**	**0.77**	0.861
Learning how to use Virtual Reality is easy for me. (EE1)	4.82	0.76	
My interaction with Virtual Reality technology is clear and understandable. (EE2)	4.66	0.73	
I find Virtual Reality easy to use. (EE3)	4.73	0.75	
It is easy for me to become skillful at using Virtual Reality. (EE4)	5.01	0.85	
Social Influence (SI)	**3.92**	**0.88**	**0.**945
People who are important to me think that I should use Virtual Reality. (SI1)	3.90	0.93	
People who influence my behavior think that I should use Virtual Reality. (SI2)	3.84	0.91	
People whose opinions that I value suggest that I use Virtual Reality. (SI3)	4.01	0.80	
Facilitating Conditions (FC)	**4.45**	**0.55**	0.732
I have the resources necessary to use Virtual Reality. (FC1)	4.09	0.43	
I have the knowledge necessary to use Virtual Reality. (FC2)	4.07	0.43	
Virtual Reality is compatible with other technologies I use. (FC3)	5.02	0.78	
I can get help from others when I have difficulties using Virtual Reality. (FC4)	4.62	0.61	
Hedonic Motivation (HM)	**5.36**	**0.77**	0.950
Using Virtual Reality is fun. (HM1)	5.37	0.77	
Using Virtual Reality is enjoyable. (HM2)	5.25	0.75	
Using Virtual Reality is very entertaining. (HM3)	5.45	0.81	
Price Value (PV)	**3.19**	**0.52**	0.925
Virtual Reality is reasonably priced. (PV1)	3.01	0.48	
Virtual Reality is a good value for the money. (PV2)	3.27	0.50	
At the current price, Virtual Reality provides good value. (PV3)	3.29	0.58	
Habit (H)	**2.77**	**0.27**	0.812
The use of Virtual Reality has become a habit for me (H1)	2.57	0.27	
I am addicted to using Virtual Reality. (H2)	1.69	0.23	
I must use Virtual Reality. (H3)	4.20	0.70	
Using Virtual Reality has become natural to me. (H4)	2.62	0.24	
Behavioural Intention (BI)	**4.15**	**0.65**	0.863
I intend to continue using Virtual Reality in the future. (BI1)	4.14	0.67	
I will always try to use Virtual Reality in my teaching. (BI2)	4.30	0.66	
I plan to continue to use Virtual Reality frequently. (BI3)	4.02	0.68	

Table 3 - Pearson Correlation coefficients among UTAUT2 constructs.

		Performance Expectancy (PE)	Effort Expectancy (EE)	Social Influence (SI)	Facilitating Conditions (FC)	Hedonic Motivation (HM)	Price Value (PV)	Habit (H)
Performance Expectancy (PE)	Pearson correlation							
	Sig. (bilateral)							
Effort Expectancy (EE)	Pearson correlation	0,306**						
	Sig. (bilateral)	<0,001						
Social Influence (SI)	Pearson correlation	0,393**	0,181*					
	Sig. (bilateral)	<0,001	0,011					
Facilitating Conditions (FC)	Pearson correlation	0,309**	0,531**	0,370**				
	Sig. (bilateral)	<0,001	<0,001	<0,001				
Hedonic Motivation (HM)	Pearson correlation	0,489**	0,446**	0,303**	0,241**			
	Sig. (bilateral)	<0,001	<0,001	<0,001	<0,001			
Price Value (PV)	Pearson correlation	0,279**	0,193**	0,296**	0,252**	0,322**		
	Sig. (bilateral)	<0,001	0,006	<0,001	<0,001	<0,001		
Habit (H)	Pearson correlation	0,459**	0,387**	0,541**	0,504**	0,391**	0,376**	
	Sig. (bilateral)	<0,001	<0,001	<0,001	<0,001	<0,001	<0,001	
Behavioural Intention (BI)	Pearson correlation	0,545**	0,337**	0,518**	0,376**	0,565**	0,342**	0,737**
	Sig. (bilateral)	<0,001	<0,001	<0,001	<0,001	<0,001	<0,001	<0,001

* Correlation is significant at the 0.01 level (2-tailed).
* Correlation is significant at the 0.05 level (2-tailed).

Table 4 - Linear Regression model[b] summary of preservice teachers' perceptions of iVR use in education.

Model	R	R squared	Adjusted R squared	Standard error of the estimate	Change Statistics					Durbin-Watson
					R square changed	F Change	df1	df2	Sig. Change in F	
1	0.828[a]	0.686	0.667	0.719	0.686	36.897	11	186	< 0.0000	2.214

a Predictors: (Constant), Gender, Age, Experience with iVR, Hedonic Motivation, Price Value, Social Influence, Effort Expectancy, Performance Expectancy, Facilitating Conditions, Habit

b Dependent Variable: Behavioral Intention

RQ1. What factors influence e-learning pre-service teachers in adopting immersive virtual reality in their future teaching practice?

The analysis of descriptive statistics reveals that participants prioritize, in this order, Hedonic Motivation, Performance Expectancy and Effort Expectancy as the most influential factors shaping their willingness to accept iVR use. This pattern is consistent with similar findings from previous UTAUT2 studies on iVR acceptance for prospective educators (Boel et al., 2023; Bower et al., 2020; Li et al., 2022), though in the latter study, Performance Expectancy is ranked fifth, which might be attributed to the focus on both teachers and students as designers of iVR. However, it diverges from studies on the acceptance of different educational technologies. For instance, in studies related to Google Classrooms (Jakkaew & Hemrungrote, 2017), PowerPoint (Chávez Herting et al., 2020), mobile phones (Nikolopoulou et al., 2020), the metaverse (Yang et al., 2022), and e-learning systems (El-Masri & Tarhini, 2017). Hedonic Motivation and Performance Expectancy complement each other. Whereas the former is closely linked to intrinsic motivation, reflecting users' internal drive and perceptions of enjoyment and pleasure associated with a specific technology, the latter relates to extrinsic motivation, instilling a sense of purpose as users believe that a technology can enhance their task performance or productivity (Venkatesh et al., 2012). As for Effort Expectancy, participating prospective teachers seem to have generally found learning to use iVR technology straightforward and comprehensible, indicating a favorable view of its usability and accessibility. This implies that participants likely perceive iVR technology as user-friendly, potentially enhancing their willingness to adopt it in educational settings. Thus, the findings results of this study highlight the significance of harnessing both the enjoyment derived from iVR use in educational settings and its perceived utility. By emphasizing the intrinsic enjoyment and practical benefits of iVR technology, teacher education programs and educational systems can effectively maximize its potential benefits in schools. Effort Expectancy complements these factors by emphasizing the practical aspect of technology adoption, highlighting the ease and convenience of integrating iVR into teaching practices.

The dimensions that moderately influence the prediction of participants' adherence to iVR in this study are Facilitating Conditions and Social Influence. In similar studies, the ranking fluctuates between 4 to 6 positions for these factors (Boel et al., 2023; Li et al., 2022), but is not the case with Bower et al. (2020), where Social Influence was rated seventh, possibly due to aspects related to context. While participants showed moderate agreement with statements related to Social Influence, the mean scores suggest that the influence of important individuals and opinions on iVR adoption may vary among participants. This highlights the importance of considering individual differences in social influence when promoting iVR use in education. Participants reported favorable perceptions regarding the availability of resources and knowledge necessary for using iVR, as well as the compatibility of iVR with other technologies. However, the mean score for the item related to seeking help from others indicates a slightly lower perception of support available when encountering difficulties with iVR. One implication of these moderate influencing factors is the need for targeted interventions to address perceived barriers and enhance supportive conditions for iVR adoption in educational settings. Educators and policymakers could focus on providing comprehensive training and resources to support teachers in effectively integrating iVR into their teaching practices. Additionally, efforts to cultivate a supportive social environment, where colleagues and administrators encourage and assist each other in using iVR, can bolster its acceptance and use. Moreover, initiatives aimed at improving the compatibility of iVR with existing educational technologies can further facilitate its seamless integration into teaching and learning activities.

In our study, participants consistently rated Habit as the least important factor influencing their willingness to accept iVR use, in consonance with the outcomes of prior research conducted on the use of iVR by Bower et al. (2020) and Li et al. (2022), as well as with results from studies on the acceptance of the use of other technologies such as Google Classroom (Jakkaew & Hemrungrote, 2017) and PowerPoint (Chávez Herting et al., 2020). Yet, it deviates from findings in studies on mobile phone usage (Nikolopoulou et al., 2020), the metaverse (Yang et al., 2022), and e-learning systems (El-Masri & Tarhini, 2017). Our study also found that the second factor with less weight is Price Value, contrasting with previous findings results (Bower et al., 2020; Li et al., 2022). This discrepancy may arise from previous studies often using mounted-head or similar devices for iVR, incurring additional expenses if implemented in a classroom setting, whereas our study allowed students to engage with iVR content using their own devices (PC, laptop, mobile, tablet), eliminating any perceived extra cost. Notably, similar results were found in studies on e-learning systems and mobile phone usage (El-Masri & Tarhini, 2017; Nikolopoulou et al., 2020), and in research on the metaverse (Yang et al., 2022), which even discarded Price Value as one of the influencing factors for its use. In the context of this study, the findings suggest that leveraging readily available devices could be pivotal for the scalability of iVR adoption in educational settings.

According to the multiple regression analysis, Habit, Hedonic Motivation, Age, Social Influence, and

Performance Expectancy have significant positive effects on pre-service teachers' Behavioral Intention. However, our results diverge from those of Boel et al. (2023), whose analysis found that the interaction effects of gender, age, and experience with iVR were not significant predictors, and Li et al. (2022), who observed that while age initially had a significant positive effect on behavioral intention towards iVR use, this effect disappeared when additional factors were included in the regression model. Similarly, gender, year of study, and previous experience with iVR did not significantly influence behavioral intention in their study. These discrepancies highlight the variability in findings across studies in the field of technology adoption and education and underscore the importance of considering contextual factors and methodological differences when interpreting results in the field of technology adoption and education. All in all, by fostering a conducive environment for the effective integration of iVR technology into teaching practices, educational institutions can promote the widespread acceptance and usage of iVR in educational contexts.

RQ2. To what extent are e-learning pre-service teachers inclined to use immersive virtual reality in their future teaching practice?

In line with UTAUT2's propositions, the results point out that all seven dependent variables significantly influence students' intention to use iVR in their future teaching practice, exhibiting a robust positive correlation among them. Hence, the UTAUT2 model proves to be effective in elucidating the factors shaping the acceptance of iVR by future teachers, aligning with previous studies on iVR by Bower et al. (2020) and Li et al. (2022). This study, distinct from the aforementioned articles, tests the applicability of UTAUT2 in a new context (e-learning) and a different cultural environment (Spain), representing a valuable step in theory advancement as advocated by Alvesson and Kärreman (2007, in El-Masri and Tarhini, 2017).

Regarding methodological implications, two crucial points emerge. Firstly, the substantial correlation between Habit and Behavioural Intention holds significant implications for teaching and learning. Given that participants in this study are prospective teachers, an increase in the use and training on iVR during their university studies could heighten the likelihood of their intention to persistently use it in their future classroom practices, benefiting their potential students. Additionally, among all factors, the variables of Hedonic Motivation and Performance Expectancy secured the second and third highest ratings, respectively. This suggests that trainee teachers are cognizant of the utility of virtual reality as an educational tool and recognize its potential as a source of motivation.

In light of these findings, the beliefs and intentions of pre-service teachers regarding emerging technologies, such as iVR, seem to wield a substantial influence on the adoption and effective use of these tools within educational settings. Therefore, a profound understanding of the factors shaping their behavioral intentions becomes imperative. This study employed the UTAUT2 model to scrutinize the factors influencing the behavioral intention of undergraduate students pursuing a bachelor's degree in Primary Education at ULPGC, specifically in the context of e-learning.

The obtained results highlight the significance of the correlations between dependent variables, all of which are not only significant but also positive. This implies that, to enhance individuals' behavioral intention, a strategic focus on improving these variables is crucial. Such a conclusion underlines the crucial need for targeted interventions aimed at cultivating positive attitudes toward iVR technology among pre-service teachers, thereby paving the way for its extensive adoption and integration in educational contexts.

Overall, The UTAUT2 model was chosen for this study with the aim of investigating the variables that affect the acceptance of iVR among pre-service teachers pursuing a bachelor's degree in Primary Education in the online modality. Binomial correlation reveals that factors such as Hedonic Motivation and Performance Expectancy emerge as pivotal considerations in the acceptance of educational technologies like iVR, whereas Habit and Price Value do not seem to have a great impact on their adherence to iVR in their future teaching practice in the context of this research. Furthermore, the data yielded from the multiple regression analysis underscore the importance of factors such as Age and Social Influence in shaping preservice teachers' attitudes and intentions towards the integration of iVR technology. These results highlight the multifaceted nature of the variables influencing acceptance and usage of iVR technology among preservice teachers, bearing significant implications for the development of effective training programs in higher education and strategies in online education.

While this study provides valuable insights, it is not without limitations. Constraints related to time and scope necessitate further research encompassing diverse cohorts and employing longitudinal approaches. Qualitative interviews offer a promising avenue for deeper exploration of participants' motivations, offering richer insights into their perspectives. These collective efforts will undoubtedly contribute to a more comprehensive understanding of the intricate interplay between emerging technologies and education, facilitating the development of informed strategies for their effective integration.

In conclusion, this study emphasizes the pivotal role of Hedonic Motivation in shaping the acceptance of iVR among e-learning pre-service teachers. The robust positive correlations observed between Habit and Behavioural Intention underline the importance of habitual tendencies in predicting the intention to use iVR, despite its lower mean score compared to other constructs. These findings emphasize the complex nature of iVR adoption and the need to consider various factors, including both intrinsic motivations and habitual behaviors, when planning the integration of iVR in educational settings.

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References

Abdekhoda, M., & Dehnad, A. (2023). Effective organizational factors in adopting e-learning in education: extracting determinants and frameworks. *Journal of e-Learning and Knowledge Society*, *19*(4), 1-8. https://doi.org/10.20368/1971-8829/1135669

Alvesson, M., & Kärreman, D. (2007). Constructing mystery: Empirical matters in theory development. *The Academy of Management Review*, *32*(4), 1265-1281. http://www.jstor.org/stable/20159366

Bernard, F., Gallet, C., Fournier, H.D., Laccoureye, L., Roche, P.H., & Troude, L. (2019). Toward the development of 3-dimensional virtual reality video tutorials in the French neurosurgical residency program. Example of the combined petrosal approach in the French College of Neurosurgery. *Neurochirurgie*, *65*(4), 152-157. https://doi.org/10.1016/j.neuchi.2019.04.004

Boel, C., Rotsaert, T., Valcke, M., Rosseel, Y., Struyf, D., & Schellens, T. (2023). Are teachers ready to immerse? Acceptance of mobile immersive virtual reality in secondary education teachers. *Research in Learning Technology*, *31*, 2855. http://dx.doi.org/10.25304/rlt.v31.2855

Bower, M., DeWitt, D., & Lai, J.W. (2020). Reasons associated with preservice teachers' intention to use immersive virtual reality in education. British *Journal of Educational Technology*, *51*(6), 2215-2233. https://doi.org/10.1111/bjet.13009

Brown, M., McCormack, M., Reeves, J., Brook, D.C., Grajek, S., Alexander, B., Bali, B., Bulger, S., Dark, S., Engelbert, N., Gannon, K., Gauthier, A., Gibson, D., Gibson, G., Lundin, B., Veletsianos, G., & Weber, N. (2020). *2020 EDUCAUSE horizon report teaching and learning edition* (pp. 2-58). Educause. https://www.educause.edu/horizon-report-2020

Chang, C.Y., Sung, H.Y., Guo, J.L., Chang, B.Y., & Kuo, F.R. (2019). Effects of spherical video-based virtual reality on nursing students' learning performance in childbirth education training. *Interactive Learning Environments*, 1-17. https://doi.org/10.1080/10494820.2019.1661854

Chávez Herting, D., Cladellas Pros, R., & Castelló Tarrida, A. (2020). Patterns of PowerPoint use in higher education: a comparison between the natural, medical, and social sciences. *Innovative Higher Education*, *45*, 65-80. https://doi.org/10.1007/s10755-019-09488-4

El-Masri, M., & Tarhini, A. (2017). Factors affecting the adoption of e-learning systems in Qatar and USA: Extending the Unified Theory of Acceptance and Use of Technology 2 (UTAUT2). *Educational Technology Research and Development*, *65*, 743-763. https://doi.org/10.1007/s11423-016-9508-8

European Commission. (2021). *eXtended Reality Learning – Engage and Interact (IA)*. https://ec.europa.eu/info/funding-tenders/opportunities/portal/screen/opportunities/topic-details/horizon-cl4-2022-human-01-19

Guerra-Santana, M. F., Artiles-Rodríguez, J., & Rodríguez-Pulido, J. (2022). Prácticas inclusivas docentes en herramientas digitales: dimensiones preferentes. *Aloma: revista de psicologia, ciències de l'educació i de l'esport*, *40*(2), 49-57. https://doi.org/10.51698/aloma.2022.40.2.49-57

Hair, J.F., Black, W.C., Babin, B.J., & Anderson, R.E. (2014). *Multivariate data analysis* (7th ed.). Pearson Education.

Jakkaew, P., & Hemrungrote, S. (2017). The use of UTAUT2 model for understanding student perceptions using Google classroom: A case study of introduction to information technology course. In *Proceedings of 2017 International Conference on Digital Arts, Media and Technology (ICDAMT)*, 205-209. https://doi.org/10.1109/ICDAMT.2017.7904962

Li, Q., Liu, Q., & Chen, Y. (2023). Prospective teachers' acceptance of virtual reality technology: a mixed study in Rural China. *Education and Information Technologies*, *28*(3), 3217-3248. https://doi.org/10.1007/s10639-022-11219-w

Mbonye, V. (2022, August). A Framework to integrate virtual reality in teacher education institutions: A case of the Mancosa iTEACHlab. In *2022 International Conference on Artificial Intelligence, Big Data, Computing and Data Communication Systems (icABCD)* (pp. 1-7). IEEE. https://doi.org/10.1109/icABCD54961.2022.9856019

Nikolopoulou, K., Gialamas, V., & Lavidas, K. (2020). Acceptance of mobile phone by university students for their studies: An investigation applying UTAUT2 model. *Education and Information Technologies*, *25*, 4139-4155. https://doi.org/10.1007/s10639-020-10157-9

Shadiev, R., Yang, L., & Huang, Y.M. (2022). A review of research on 360-degree video and its applications to education. *Journal of Research on Technology in Education*, *54*(5), 784-799. https://doi.org/10.1080/15391523.2021.1928572

Tamilmani, K., Rana, N. P., & Dwivedi, Y. K. (2021). Consumer acceptance and use of information technology: A meta-analytic evaluation of UTAUT2. *Information Systems Frontiers*, *23*, 987-1005. https://doi.org/10.1007/s10796-020-10007-6

Tamilmani, K., Rana, N.P. & Dwivedi, Y.K. (2021). Consumer Acceptance and Use of Information Technology: A Meta-Analytic Evaluation of UTAUT2. *Inf Syst Front*, *23*, 987-1005. https://doi.org/10.1007/s10796-020-10007-6

Theelen, H., van den Beemt, A., & den Brok, P. (2019). Using 360-degree videos in teacher education to improve preservice teachers' professional interpersonal vision. *Journal of Computer Assisted Learning*, *35*(5), 582-594. https://doi.org/10.1111/jcal.12361

Theelen, H., van den Beemt, A., & den Brok, P. (2020). Developing preservice teachers' interpersonal knowledge with 360-degree videos in teacher education. *Teaching and Teacher Education*, *89*, 102992.

Udeozor, C., Toyoda, R., Russo Abegão, F., & Glassey, J. (2021). Perceptions of the use of virtual reality games for chemical engineering education and professional training. *Higher Education Pedagogies*, *6*(1), 175-194. https://doi.org/10.1080/23752696.2021.1951615

Venkatesh, V., Morris, M.G., Davis, G.B., & Davis, F.D. (2003). User acceptance of information technology: Toward a unified view. *MIS Quarterly*, *27*(3), 425-478. https://doi.org/10.2307/30036540

Venkatesh, V., Thong, J.Y., & Xu, X. (2012). Consumer acceptance and use of information technology: extending the unified theory of acceptance and use of technology. *MIS quarterly*, 157-178. https://doi.org/10.2307/41410412

Walsh, K.R., & Pawlowski, S.D. (2002). Virtual reality: A technology in need of IS research. *Communications of the Association for Information Systems*, *8*(1), 20.

Walshe, N., & Driver, P. (2019). Developing reflective trainee teacher practice with 360-degree video. *Teaching and Teacher Education*, *78*, 97-105. https://doi.org/10.1016/j.tate.2018.11.009

Wong, K. T., Teo, T., & Russo, S. (2013). Interactive whiteboard acceptance: Applicability of the UTAUT model to student teachers. *Asia-Pacific Education Researcher*, *22*(1), 1-10. https://doi.org/10.1007/s40299-012-0001-9

Yang, F., Ren, L., & Gu, C. (2022). A study of college students' intention to use metaverse technology for basketball learning based on UTAUT2. *Heliyon*, *8*(9), e10562. https://doi.org/10.1016/j.heliyon.2022.e10562

Ye, X., Liu, P.F., Lee, X.Z., Zhang, Y.Q., & Chiu, C.K. (2021). Classroom misbehaviour management: an SVVR-based training system for preservice teachers. *Interactive Learning Environments*, *29*(1), 112-118. https://doi.org/10.1080/10494820.2019.1579235

Zulkiewicz, B.A., Boudewyns, V., Gupta, C., Kirschenbaum, A., & Lewis, M.A. (2020). Using 360-degree video as a research stimulus in digital health studies: Lessons learned. *JMIR Serious Games*, *8*(1), e15422. https://doi.org/10.2196/1542