

## ORIGINAL RESEARCH ARTICLE

### Predicting teachers' intentions to use virtual reality in education: a study based on the UTAUT-2 framework

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Received: 19 January 2025; Revised: 18 March 2025; Accepted: 19 March 2025; Published: 15 May 2025

This study aims to investigate the factors influencing teachers' intentions to integrate Virtual Reality (VR) technology into their educational practices, utilising the Unified Theory of Acceptance and Use of Technology (UTAUT-2) framework. The research involved adapting and validating the 'Acceptance of Mobile Immersive Virtual Reality in Secondary Education Teachers' scale to the Turkish context, ensuring cultural relevance and psychometric reliability. Data were collected from 213 in-service teachers with prior experience in using VR in education. The results of the Confirmatory Factor Analysis (CFA) confirmed the validity of the adapted scale. The findings indicate that effort expectancy, social influence, personal innovativeness and hedonic motivation significantly predict teachers' behavioural intentions to adopt VR technology. However, contrary to expectations, performance expectancy and facilitating conditions did not show a significant impact. These results underscore the importance of focusing on the ease of use and social support mechanisms, as well as fostering a culture of innovation amongst educators, to successfully integrate VR into educational settings.

**Keywords:** virtual reality; technology acceptance; behavioural intention; UTAUT; teacher education

## Introduction

Virtual Reality (VR) technologies have rapidly revolutionised education, offering immersive and interactive experiences that bridge the gap between theoretical knowledge and practical application (Geriş & Özdener, 2024). Educators can significantly enhance student engagement, motivation and learning outcomes by integrating VR into academic settings through realistic simulations and simulated hands-on activities. Numerous studies affirm these benefits, demonstrating VR's ability to create captivating learning environments and boost information retention (Luo et al., 2021; Pellas

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et al., 2020b; Radianti et al., 2020). As more institutions adopt VR, its transformative impact on teaching and learning becomes increasingly apparent.

Expanding on its transformative potential, VR provides consistent and reproducible training environments, particularly beneficial in disciplines requiring practical experience such as medicine, engineering and the sciences (Ha et al., 2022). The technology's ability to simulate real-world scenarios allows students to practice skills and apply theoretical knowledge in a controlled, risk-free setting, thereby enhancing retention and comprehension. Systematic reviews underscore VR's effectiveness in various educational settings by supporting experiential learning, which is difficult to achieve in traditional classrooms, whilst also fostering the development of cognitive, technical and socio-emotional skills (Araiza-Alba et al., 2021; Hew & Cheung, 2010; Tan et al., 2022).

The ongoing integration of VR in education signals a modernisation of teaching practices and significant improvements in student outcomes (Geriş & Cukurbasi, 2025). However, the successful implementation of VR hinges on the acceptance and readiness of educators and students to embrace this technology. According to the Unified Theory of Acceptance and Use of Technology (UTAUT), factors such as perceived usefulness, ease of use and overall attitudes towards technology play crucial roles in this process. Research indicates that the acceptance of VR enhances educational experiences by increasing engagement, motivation and learning outcomes (Huang et al., 2010; Makransky & Lilleholt, 2018). Moreover, the COVID-19 pandemic underscored VR's role in ensuring educational continuity, establishing it as an essential tool for future educational practices (Angel-Urdinola et al., 2021; Gossett, 2023).

The UTAUT was initially developed to explain technology adoption in organisational settings. However, as technology adoption expanded beyond workplaces to personal and consumer contexts, Venkatesh et al. (2012) extended this model into UTAUT-2 by incorporating additional constructs such as hedonic motivation, price value and habit. Unlike UTAUT, which focuses on institutional and workplace adoption, UTAUT-2 emphasises individual adoption patterns, making it particularly relevant for understanding teachers' acceptance, in our study immersive virtual reality (iVR) in educational contexts (Boel et al., 2023). Given these theoretical advancements, understanding teachers' acceptance of iVR requires a framework that captures individual adoption patterns in educational settings.

Recognising the importance of VR acceptance in education, the study 'Acceptance of Mobile Immersive Virtual Reality in Secondary Education Teachers' aimed to identify factors influencing VR adoption amongst teachers, using the UTAUT-2 framework (Boel et al., 2023). The research highlighted that perceived usefulness, ease of use and social influence significantly predict teachers' intentions to use VR technology, emphasising the need for tailored professional development programs (Boel et al., 2023). As part of this research, Boel et al. (2023) developed an acceptance scale to measure secondary education teachers' adoption of mobile iVR, by adapting from Venkatesh et al. (2003) and Venkatesh et al. (2012). To extend its applicability across different cultural settings, adapting this scale is essential to ensure validity and reliability. This process involves translating the scale and validating it within new cultural contexts, addressing linguistic nuances and cultural differences that might affect the perception and acceptance of VR technology. Studies have shown that cultural factors significantly influence technology acceptance, underscoring the necessity of customising educational tools to fit specific cultural needs (Huang et al., 2010; Jensen & Konradsen, 2018; Karaoglan-Yilmaz et al., 2024).

## Aim

The primary objective of this study is to investigate and elucidate the factors influencing Turkish teachers' intentions to integrate VR tools into their educational practices, employing the UTAUT-2 framework as theoretical background. This study specifically aims to address two critical research questions:

1. Is the iVR Scale valid and reliable in the context of Turkish teachers?
2. To what extent do performance expectancy, effort expectancy, social influence, facilitating conditions, hedonic motivation and personal innovativeness predict teachers' behavioural intention to use VR in education?

Through these inquiries, this study aims to provide a comprehensive understanding of the factors that encourage or inhibit the adoption of VR in educational settings, offering insights that could inform the development of targeted professional development programs and strategic initiatives to enhance the integration of VR technologies in schools.

## Background of the study

### *VR in education: an advanced exploration*

Virtual Reality technology has rapidly evolved into a cornerstone of modern educational practices, offering immersive and interactive experiences that significantly enhance learning outcomes. The integration of VR into education has transformed traditional pedagogical methods by enabling students to engage deeply with content through realistic simulations and experiential learning. The promise of VR in education lies in its ability to transcend geographical and physical limitations, providing students with access to environments and experiences that would otherwise be inaccessible.

One of the primary benefits of VR in education is its capacity to facilitate immersive learning experiences that lead to higher engagement and retention. Studies demonstrate that VR creates environments where learners can interact with complex concepts in an intuitive and accessible manner. Pellas et al. (2020a) highlight the effectiveness of VR in Science, Technology, Engineering, Mathematics (STEM) education, showing how students could explore abstract concepts through virtual simulations, resulting in improved understanding and knowledge retention. Similarly, Marougkas et al. (2023) underscore the application of constructivist learning theories in VR environments, enabling students to learn by doing a particularly beneficial approach in fields requiring hands-on practice.

Field studies further show the practical benefits of VR in specific educational settings. Al-Gindy et al. (2020) developed a VR simulation platform for teaching the water cycle to young students, which significantly enhanced their understanding and engagement. This study, along with others like it, illustrates the potential of VR to bring abstract concepts to life, making learning more dynamic and interactive. In higher education, Rafiq et al. (2022) conducted research showing how VR could boost student engagement in vocational training, particularly in engineering disciplines, by simulating real-life scenarios that are otherwise difficult to replicate in a classroom. Additionally, a study by Geriş and Özdenir (2024) demonstrates the effectiveness of skill-based Internet of Things (IoT) education delivered in a VR environment.

This study found that students who engaged with the VR-based training significantly improved their academic performance. Furthermore, their ability to transfer the knowledge acquired in the VR setting to real-world applications was confirmed through high scores in a post-training practical exam.

However, alongside its benefits, the integration of VR into educational settings presents several challenges that must be addressed for successful implementation. One significant issue is the cost and accessibility of VR technology. Lai et al. (2021) identified cost, content availability and the need for technical infrastructure as major barriers to widespread VR adoption in higher education. These challenges are further compounded by the need for educators to develop new pedagogical strategies that effectively integrate VR into existing curricula. Moreover, Hidayanto and Prabowo (2022) pointed out that whilst VR holds great promise, its implementation is hindered by the potential for motion sickness and other physical discomforts, which can detract from the learning experience.

The success of VR integration in classrooms largely depends not only on the readiness of both educators and students to embrace this technology but also on critical factors such as financial resources, software compatibility with curricula, necessary hardware infrastructure and institutional support. Studies such as Alalwan et al. (2020) have revealed significant obstacles, including a lack of teacher competency and instructional design, which can impede the effective use of VR tools in primary education. Teachers often require extensive training, and without proper support, the full potential of VR in education may not be realised. Additionally, issues like cybersickness, highlighted by Mareta et al. (2022), particularly in higher education, where prolonged use of VR can lead to discomfort and decreased student engagement, further complicate its integration.

### ***UTAUT-2 model in technology acceptance: application and insights in VR***

The UTAUT, initially developed by Venkatesh et al. (2003), has become a foundational framework for understanding user intentions to adopt technology and subsequent usage behaviour. This model synthesises elements from eight prominent technology acceptance theories, focusing on key constructs such as performance expectancy, effort expectancy, social influence and facilitating conditions. These constructs have been instrumental in explaining the factors that drive technology acceptance across various contexts. Building upon this, Venkatesh et al. (2012) extended the original model to create UTAUT-2, incorporating additional constructs like hedonic motivation, price value and habit, thereby enhancing its applicability, particularly in consumer technology contexts, including education.

In the context of VR, the UTAUT-2 model has proven effective in predicting technology acceptance amongst students and educators. Al Farsi (2023) applied the UTAUT-2 model to investigate students' acceptance of VR systems in Omani universities. This study integrated the UTAUT-2 framework with learning value architecture, revealing that performance expectancy, effort expectancy and social influence significantly impacted students' behavioural intentions to use VR, underscoring the model's predictive power in educational settings. Further studies have explored the application of UTAUT-2 in diverse educational contexts to assess the acceptance of VR and other digital learning environments. Boel et al. (2023) examine the acceptance of mobile immersive VR amongst secondary education teachers in Flanders. Their findings indicate that performance expectancy, social influence and hedonic

motivation were significant predictors of teachers' intentions to integrate VR into their teaching practices. Notably, this study also highlighted the role of personal innovativeness, suggesting that teachers who more open to innovation are more likely to adopt VR technologies. In a similar vein, the Mobile Augmented Reality (AR) Acceptance Model developed by Koutromanos et al. (2024) extends this framework to AR in education, highlighting the influence of perceived usefulness and ease of use on teachers' adoption intentions.

The UTAUT-2 model has also been critically applied in higher education, where virtual learning environments (VLEs) are becoming increasingly prevalent. Barbosa et al. (2020) utilised UTAUT-2 to validate the acceptance of VLEs amongst university students, demonstrating that the model effectively predicts students' behavioural intentions and usage patterns. Moreover, UTAUT-2 has been extended and adapted to assess technology acceptance in various innovative educational technologies. Teng et al. (2022) expanded the UTAUT model to include perceived risk in studying the adoption of an educational metaverse platform. This study found that whilst traditional UTAUT-2 factors like performance expectancy and effort expectancy remained significant, perceived risk negatively impacted users' satisfaction and continued usage intentions.

Challenges associated with VR adoption in education, as analysed through the UTAUT-2 lens, offer critical insights into the barriers and enablers of technology acceptance. Huang (2020) adapted the UTAUT-2 model to assess the acceptance of a VR e-scooter service, finding that whilst fully immersive VR had higher acceptance rates, issues like usability and facilitating conditions still posed significant challenges. These findings are echoed in studies focusing on classroom integration of VR, where sufficient technical support and perceived ease of use are often highlighted as crucial factors (Boel et al., 2021). In conclusion, the UTAUT-2 model continues to serve as a robust framework for examining technology acceptance in educational contexts, particularly concerning the integration of advanced technologies like VR.

## **Method**

### ***Sample of the study***

The study participants were in-service teachers with prior experience with VR in education. A purposive sampling approach was adopted to ensure that only educators with relevant VR exposure were included in the study. Initially, 244 participants were recruited; however, 19 individuals were excluded due to a lack of VR-related experience in educational settings. Additionally, 12 cases were identified as outliers and removed from the dataset. The final sample in Table 1 consisted of 213 in-service teachers, representing various educational departments in primary and secondary education.

The demographic analysis reveals a fairly balanced gender distribution amongst participants, indicating that both male and female teachers are equally engaged in VR adoption. The largest age group falls within the 30–34 range, suggesting that mid-career educators may be more open to integrating VR into their teaching practices. Additionally, the data indicate that the majority of participants have 6–10 years of teaching experience, implying that educators with moderate experience levels are more likely to explore immersive technologies. 94.4% of participants have attended VR training, highlighting a high level of familiarity with VR tools. However, despite

Table 1. Demographics of the participants.

Variable	Group	N	%
Gender	Female	109	51.2
	Male	104	48.8
Age	25–29	50	23.5
	30–34	76	35.7
	35–39	54	25.4
	40+	33	15.5
	Teaching experience in years	1–5	62
	6–10	84	39.4
	11–15	40	18.8
	16+	27	12.7
Attending VR training	No	12	5.6
	Yes	201	94.4
Using VR in class	Rarely	61	28.6
	Sometimes	121	56.8
	Often	31	14.6
<b>Total</b>		213	100.0

VR, Virtual Reality

this training, only 14.6% use VR frequently in their lessons, whilst a significant portion (56.8%) reports using it occasionally.

### **Data collection tools**

In this study, two instruments were administered for data collection.

### **Demographic information form**

This form was developed by the researchers to gather personal data from participants, including their gender, age, teaching experience, attendance in VR training and experience with VR usage.

### **iVR acceptance scale**

The original scale, developed by Boel et al. (2023) based on the UTAUT-2 acceptance model, comprises 25-item and utilises a 7-point Likert scale, where responses range from ‘(1) Completely disagree’ to ‘(7) Completely agree’. There was one negative item. The scale is structured into seven dimensions: performance expectancy (3 items), effort expectancy (4 items), social influence (5 items), facilitating conditions (3 items), hedonic motivation (3 items), personal innovativeness (4 items, including one reverse-coded item) and behavioural intention to use (3 items). Exploratory factor analysis was conducted to reveal the factor structure of the scale. Cronbach’s alpha coefficients of the sub-scales vary between 0.63 and 0.96. As a result, the validity and reliability studies of the iVR Acceptance Scale demonstrated the scale is valid and reliable in the context of Flemish secondary education teachers.

**Immersive virtual reality acceptance scale adaptation into Turkish context**

To ensure the development of a valid and reliable Turkish version of the iVR Acceptance Scale, the cross-cultural measurement tool adaptation process recommended by Beaton et al. (2000) was followed, as illustrated in Figure 1.

During the initial translation phase, the original English scale was translated into Turkish by three experts who were either native or near-native speakers of both English and Turkish. This process aimed to ensure that the translation was both linguistically accurate and culturally appropriate. The researchers consolidated the feedback from these experts to produce a draft of the Turkish version of the scale. In the subsequent back-translation phase, three different experts, also native or near-native speakers of both languages, cross-verified the draft by translating it back from Turkish into English. These experts utilised a form provided by the researchers to review each item in both languages. No significant discrepancies were identified during this process. Importantly, these six experts were also specialists in fields such as computer and instructional technology education, machine learning, computer programming and distance learning. They assessed the content validity and cultural relevance of the draft scale, with the expert review phase occurring concurrently with the translation process.

Following this, cognitive interviews were then conducted with three potential participants from the target population teachers with VR experience to identify any issues related to the comprehension or interpretation of the scale items (Drennan, 2003). Then, a Turkish language expert reviewed the draft for language accuracy and clarity. Upon completion of these phases, the draft scale in Turkish was administered to a larger sample ( $N = 244$ ). Subsequent validity and reliability studies were conducted to evaluate the psychometric properties of the draft scale. Necessary adjustments were made to preserve the integrity of the constructs within the new cultural context.

**Data collection and analysis**

The data were gathered via social media platforms such as LinkedIn, Twitter, Facebook and WhatsApp. All participants were informed about the study and attended on a voluntary basis. The dataset initially included 244 participants; however, those who lacked experience with VR were excluded. As a result, the preliminary analysis was conducted with 225 participants. The analysis procedure followed the recommendations



Figure 1. Scale adaptation process.

of DeVellis (2017) and Field (2009). First, Mahalanobis distances were calculated to identify the outliers for multiple normality, and 12 participants were removed. With the remaining dataset ( $N = 213$ ), normal distribution was assessed using skewness and kurtosis values, along with a normality histogram. VIF and tolerance values were calculated to check for multicollinearity. The histogram of standardised residuals, the normal probability plot of standardised residuals and the scatterplot of standardised residuals were examined to assess the multivariate normality assumption. The independence of error assumption was confirmed using the Durbin-Watson test. As a result of these preliminary tests, the assumptions necessary for conducting parametric statistics were met. Following this, we conducted a Confirmatory Factor Analysis (CFA) to evaluate the validity of the draft scale in Turkish. Factor loadings less than 0.50 (Hair et al., 2009) were removed to adjust the scale validity based on factor loading values and modification indices. Finally, multiple linear regressions used to predict the influence of several variables on a single outcome and to test a hypothetical model based on their relationships (Field, 2009) were conducted to evaluate the UTAUT-2 framework in the context of VR in education in Türkiye.

## Findings

### CFA findings

After preliminary analyses, CFA was performed to test the construct validity of the scale in the Turkish setting. The analysis started with 25 items and 7 dimensions. Initial CFA results did not meet the acceptable fit measures due to low factor loadings. Four items loaded less than 0.50 were removed. These items were ‘The school management is helpful in the use of virtual reality’. (item no. 10), ‘In general, the school management supports the use of virtual reality’. (item no. 11), ‘A specific person or service is available for assistance with virtual reality difficulties’. (item no. 15) and ‘In general, I am hesitant to try out new information technologies’. (item no. 21).

After removing four items, the CFA results in Table 2 indicated that the model fit improved and met commonly accepted thresholds. The chi-square ratio ( $\chi^2/df = 2.216$ ) falls within the acceptable range ( $\leq 3$ ), suggesting a reasonable model fit. Additionally, the Root Mean Square Error of Approximation (RMSEA) value (0.076) is within the acceptable limits, indicating a moderate fit. The Comparative Fit Index (CFI) (0.937) and Tucker Lewis Index (TLI) (0.921) values are both above 0.90, reflecting an overall satisfactory model fit. These results confirm that the adapted version of the iVR Acceptance Scale maintains a factor structure consistent with the original scale whilst demonstrating strong construct validity. The final version consists of performance expectancy, social influence, hedonic motivation, personal innovativeness and

Table 2. CFA results.

Fix measures	Good fit	Acceptable fit	Suggested fit measures
$\chi^2/df^a$	$0 \leq \chi^2/df \leq 2$	$2 < \chi^2/df \leq 3$	2.216
RMSEA <sup>a</sup>	$0 \leq RMSEA \leq 0.05$	$0.05 \leq RMSEA \leq 0.08$	0.076
SRMR <sup>a</sup>	$0 \leq SRMR \leq 0.05$	$0.05 < SRMR \leq 0.10$	0.0612
CFI <sup>b</sup>	$0.95 \leq CFI \leq 0.1$	$0.90 \leq CFI \leq 0.95$	0.937
TLI <sup>b</sup>	$0.95 \leq TLI \leq 0.1$	$0.90 \leq TLI \leq 0.95$	0.921

<sup>a</sup>Schermelleh-Engel et al. (2003); <sup>b</sup>Hu and Bentler (1999)

behavioural intention, each with three items, whilst effort expectancy and facilitating conditions have two items each. The fit indices support the structural integrity of the scale, validating its use in the Turkish educational context. Performance expectancy, social influence, hedonic motivation, personal innovativeness and behavioural intention have three items in each, effort expectancy has four items and facilitating conditions has two items.

Table 3 provides means and standard deviations and Cronbach’s alpha reliability coefficients for each dimension of the final scale. The descriptive statistics indicate that participants generally hold positive attitudes towards the various constructs measured in the study, with high mean scores across most variables. Amongst these, hedonic motivation has the highest mean score ( $M = 6.87$ ), indicating that participants find significant enjoyment in using VR for educational purposes. Conversely, facilitating conditions have the lowest mean score ( $M = 5.48$ ), suggesting that participants perceive limited institutional support and resources for VR integration in schools. The reliability analysis indicates that most constructs demonstrate strong internal consistency, with Cronbach’s alpha values exceeding 0.80. However, facilitating conditions show a lower reliability score ( $\alpha = 0.513$ ) (Field, 2009), which may be attributed to variability in resource availability across different educational institutions. Additionally, significant positive correlations were observed amongst all dimensions, ranging from  $r = 0.275$  to  $r = 0.645$  ( $p < 0.001$ ;  $N = 213$ ), further supporting the validity of the scale. Considering these statistical findings, the iVR Acceptance Scale is confirmed to be a valid and reliable instrument for assessing Turkish teachers’ acceptance of VR technologies in education.

Table 3. Descriptive statistics and Cronbach’s alpha coefficients.

Descriptives	M	SD	$\alpha$
Performance expectancy	6.2222	0.54912	0.832
Effort expectancy	6.0540	0.62948	0.886
Social influence	5.7944	0.60186	0.918
Facilitating conditions	5.4804	0.83945	0.513
Hedonic motivation	6.8670	0.30465	0.817
Personal innovativeness	5.9977	0.68723	0.867
Behavioural intention	6.5962	0.52079	0.906

Table 4. Multiple linear regression results.

Model	Unstandardised coefficients		Standardised coefficients	$t$	$p$
	B	Std. Error	Beta		
<b>(Constant)</b>	1.152	0.563		2.044	0.042
<b>Performance expectancy</b>	0.067	0.063	0.070	1.055	0.293
<b>Effort expectancy</b>	0.160	0.052	0.194	3.056	0.003
<b>Social influence</b>	0.165	0.060	0.191	2.762	0.006
<b>Facilitating conditions</b>	0.012	0.036	0.020	0.337	0.737
<b>Hedonic motivation</b>	0.195	0.094	0.114	2.066	0.040
<b>Personal innovativeness</b>	0.283	0.047	0.374	6.074	<0.001

### **UTAUT-2 framework findings**

The multiple linear regression analysis results presented in Table 4 indicate the relationships between several predictors and the dependent variable, which is the behavioural intentions to use VR in the education of teachers.

Amongst the predictors, personal innovativeness has the strongest and most significant positive relationship with the dependent variable ( $\beta = 0.374$ ,  $t = 6.074$ ,  $p < 0.001$ ), indicating that as personal innovativeness increases, the dependent variable significantly increases as well. Effort expectancy ( $\beta = 0.194$ ,  $t = 3.056$ ,  $p = 0.003$ ), Social Influence ( $\beta = 0.191$ ,  $t = 2.762$ ,  $p = 0.006$ ) and hedonic motivation ( $\beta = 0.114$ ,  $t = 2.066$ ,  $p = 0.040$ ) also have significant positive effects on the dependent variable. However, performance expectancy ( $\beta = 0.070$ ,  $t = 1.055$ ,  $p = 0.293$ ) and facilitating conditions ( $\beta = 0.020$ ,  $t = 0.337$ ,  $p = 0.737$ ) do not significantly predict behavioural intention ( $p > 0.05$ ). Overall,  $R^2$  value is 0.553, meaning that approximately 55.3% of the variance in behavioural intention can be explained by the predictors in the model.

### **Discussion and implications**

This study sought to elucidate the factors influencing Turkish teachers' intentions to incorporate VR technology into their pedagogical practices, employing the UTAUT-2 framework as its theoretical foundation. Specifically, the study adapted and validated the 'Acceptance of Mobile iVR in Secondary Education Teachers' scale, originally developed by Boel et al. (2023), to the Turkish educational context. Data were meticulously gathered from 213 teachers with VR experience, and the scale was rigorously analysed to ensure its cultural and contextual relevance. The analysis revealed that effort expectancy, social influence, hedonic motivation and personal innovativeness emerged as significant predictors of teachers' behavioural intentions to adopt VR technology. These findings highlight the importance of addressing these factors in the successful integration of VR in educational settings.

The adaptation and validation of the 'Acceptance of Mobile Immersive Virtual Reality in Secondary Education Teachers' scale for the Turkish context demonstrated robust psychometric properties, including high reliability and construct validity, which align with similar findings in the literature, such as those by Çetin and Demirkan (2023) and Bunz et al. (2021). The rigorous process, which included the removal of four items with low factor loadings, was essential for enhancing the scale's internal consistency and ensuring its applicability in a new cultural context, echoing the methodological adjustments seen in studies by Wang et al. (2023) and González Bravo et al. (2020). Comparative analysis reveals that whilst performance expectancy is a significant predictor in some contexts (González Bravo et al., 2020), Turkish educators are more influenced by social factors and personal innovativeness, highlighting the importance of cultural nuances in technology acceptance.

Amongst the predictors, personal innovativeness demonstrates the strongest effect on behavioural intention, suggesting that teachers who are more open to new technologies are more likely to integrate VR into their teaching practices. In contrast, whilst effort expectancy, social influence and hedonic motivation also contribute to the model, their effects are more moderate. This indicates that whilst these factors play a role in shaping VR adoption, they do not exert as strong an influence as personal innovativeness. These findings align with previous studies, emphasising the varying impact of psychological and contextual factors on technology acceptance (Erçağ & Yasakçı, 2022).

The findings from this study offer a nuanced understanding of the factors influencing Turkish teachers' intentions to adopt VR in educational settings, as examined through the UTAUT-2 model. Contrary to expectations, performance expectancy was not a significant predictor of VR adoption, suggesting that the perceived educational benefits alone are insufficient to drive adoption amongst Turkish teachers. This contrasts with findings from Marks and Thomas (2022), where performance expectancy was a strong predictor in higher education contexts, particularly in technical fields like engineering. On the other hand, the hypotheses regarding effort expectancy and social influence were confirmed, aligning with AL-Oudat and Altamimi (2022) research in Jordanian universities, where ease of use and peer influence played critical roles in technology adoption decisions. The significant role of social influence in this context underscores the importance of peer and institutional support, indicating that educators are more likely to embrace VR when they feel supported by their colleagues and leadership.

The study's findings also reveal that facilitating conditions were not a significant predictor of VR adoption, differing from Hamurcu et al.'s (2023) findings in industrial design education, where specific tools and infrastructure were crucial. This discrepancy may stem from the different educational contexts and discipline-specific requirements. Furthermore, hedonic motivation was found to have a smaller yet significant impact, suggesting that whilst enjoyment and engagement are valued, they are not the primary drivers of VR adoption. This finding is consistent with Mastrolemo Ventura et al. (2022), who noted that practicality and utility often outweigh enjoyment in educational settings. Finally, personal innovativeness emerged as the most significant predictor, consistent with Boel et al. (2023), emphasising the importance of fostering a culture of innovation and openness to new technologies within educational institutions.

The findings of this study have significant implications for both the practical application and theoretical understanding of VR technology in education. Practically, the results highlight the need for professional development programs that focus on enhancing teachers' effort expectancy and leveraging social influence to support the adoption of VR. Educational policymakers should prioritise creating robust social networks and support systems within schools to foster a culture that encourages the integration of VR technology. Additionally, curricular reforms should incorporate VR tools and resources to ensure that educators are equipped to effectively utilise these technologies in their teaching practices.

Theoretically, this study contributes to the refinement of the UTAUT-2 model, particularly in educational contexts where cultural factors may influence technology acceptance. The lack of significance for performance expectancy suggests that traditional models may need adaptation when applied to different educational settings. Moreover, the strong influence of personal innovativeness, effort expectancy and social influence highlight the importance of these factors in driving technology adoption. Future research should focus on exploring customised VR educational interventions and conducting longitudinal studies to assess the long-term impacts of VR on student outcomes, such as academic achievement and engagement. These insights will be critical in guiding the effective integration of VR into educational practices.

## **Conclusion**

The present study offers valuable insights into the factors influencing the adoption of VR technology amongst Turkish teachers, utilising the UTAUT-2 framework. The

findings reveal that whilst effort expectancy, social influence and personal innovativeness are significant predictors of VR adoption, performance expectancy and facilitating conditions play less critical roles in this context. These results highlight the importance of understanding the specific cultural and contextual factors that shape technology acceptance in educational settings. By acknowledging these nuances, educational institutions can better tailor their approaches to supporting teachers in integrating VR into their curricula.

Looking forward, this study underscores the need for targeted professional development programs that emphasise the ease of use and social endorsement of VR, as well as the cultivation of a culture of innovation amongst educators. Future research should build on these findings by exploring the long-term impacts of VR on student outcomes and by further refining technology acceptance models to account for cultural differences. Such efforts will be crucial in maximising the potential of VR as a transformative educational tool, ensuring that its integration is both effective and sustainable across diverse educational contexts.

### **Limitations**

One of the primary limitations of this study is the selection of participants, which was restricted to in-service teachers with prior experience in using VR in educational contexts. This criterion inherently limited the sample size, as the adoption of VR technology in education is still in its nascent stages, particularly in regions where technological integration in classrooms is not yet widespread. Whilst this limitation narrows the generalisability of the findings to a broader population of educators, it simultaneously adds value to the study by ensuring that the insights gathered are from individuals with direct, practical experience in utilising VR. This focus allows for a more nuanced understanding of the factors influencing VR adoption amongst those who are likely to be early adopters and pioneers in the educational use of emerging technologies.

### **Conflict of interest and funding**

This research did not receive any specific grant from funding agencies in the public, commercial or not-for-profit sectors. The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

### **Data availability**

The data that support the findings of this study are available from the corresponding author, [Ali Geriş], upon reasonable request.

### **References**

- Alalwan, N. et al. (2020). Challenges and prospects of virtual reality and augmented reality utilization among primary school teachers: A developing country perspective. *Studies in Educational Evaluation*, 66, 100876. <https://doi.org/10.1016/j.stueduc.2020.100876>

- Al Farsi, G. (2023). The efficiency of UTAUT2 Model in predicting student's acceptance of using virtual reality technology. *International Journal of Interactive Mobile Technologies*, 17(12), 17–27. <https://doi.org/10.3991/ijim.v17i12.36951>
- Al-Gindy, A. et al. (2020). Virtual reality: Development of an integrated learning environment for education. *International Journal of Information and Education Technology*, 10(3), 171–175. <https://doi.org/10.18178/ijiet.2020.10.3.1358>
- AL-Oudat, M., & Altamimi, A. (2022). Factors influencing behavior intentions to use virtual reality in education. *International Journal of Data and Network Science*, 6(3), 733–742. <https://doi.org/10.52677/j.ijdns.2022.3.008>
- Angel-Urdinola, D., Castillo, C., & Hoyos, A. (2021). *Virtual reality: Could it be the next big tool for education?* World Economic Forum, <https://www.weforum.org/agenda/2021/05/virtual-reality-simulators-develop-students-skills-education-training/>
- Araiza-Alba, P., Keane, T., Chen, W. S., & Kaufman, J. (2021). Immersive virtual reality as a tool to learn problem-solving skills. *Computers & Education*, 164, 104121. <https://doi.org/10.1016/j.compedu.2020.104121>
- Barbosa, R. P., Martins, A. S., Da Silva, I. P. A., Costa, L., Oliveira, R., & De Souza, H. (2020). Acceptance and use of a virtual learning environment (VLE): Structural equations modeling of The Unified Theory of Acceptance and Use of Technology. *International Journal for Innovation Education and Research*, 8(4), 237–244. <https://doi.org/10.31686/ijer.vol8.iss4.2285>
- Beaton, D. E. et al. (2000). Guidelines for the process of cross-cultural adaptation of self-report measures. *Spine*, 25(24), 3186–3191. <https://doi.org/10.1097/00007632-200012150-00014>
- Boel, C., Raeijmaekers, D., Rotsaert, T., Valcke, M., Schellens, T., & Struyf, D. (2021, 8-9 March). Acceptance of immersive virtual reality in secondary education teachers. An explorative study of perceptions from teachers, it-staff, principals and teachers' trainers. In *INTED2021 Proceedings* (pp. 589–596). IATED, Online Conference.
- Boel, C. et al. (2023). Are teachers ready to immerse? Acceptance of mobile immersive virtual reality in secondary education teachers. *Research in Learning Technology*, 31, 2855. <https://doi.org/10.25304/rlt.v31.2855>
- Bunz, U., Seibert, J., & Hendrickse, J. (2021). From TAM to AVRTS: Development and validation of the attitudes toward Virtual Reality Technology Scale. *Virtual Reality*, 25, 31–41. <https://doi.org/10.1007/s10055-020-00437-7>
- Çetin, F., & Demirkan, Ö. (2023). A validity and reliability analysis of the pre-service teachers' attitudes towards Virtual Classroom Environment Scale. *Educational Policy Analysis and Strategic Research*, 18(2), 133–147. <https://doi.org/10.29329/epasr.2023.548.7>
- DeVellis, R. F. (2017). *Scale development: Theory and applications* (4th ed.). Sage.
- Drennan, J. (2003). Cognitive interviewing: Verbal data in the design and pretesting of questionnaires. *Journal of Advanced Nursing*, 42(1), 57–63. <https://doi.org/10.1046/j.1365-2648.2003.02579.x>
- Erçağ, E., & Yasakci, A. (2022). The perception scale for the 7E model-based augmented reality enriched computer course (7EMAGBAÖ): Validity and reliability study. *Sustainability*, 14(19), 12037. <https://doi.org/10.3390/su141912037>
- Field, A. P. (2009). *Discovering statistics using SPSS: And sex, drugs and rock "n" roll* (3rd ed.). Sage.
- Geris, A., & Cukurbasi, B. (2025). AI-supported VR in education: Learning analytics, interactions, and ethical bias. In S. Gökoğlu & F. Erdoğan (Eds.), *Virtual technology innovations in education* (pp. 119–152). IGI Global Scientific Publishing. <https://doi.org/10.4018/979-8-3693-6030-9.ch005>
- Geriş, A., & Özdenir, N. (2024). Design, development, and evaluation of educational virtual reality environment: EVRECA. *Educational Technology Research and Development*, 72(2), 915–945. <https://doi.org/10.1007/s11423-023-10303-3>
- González Bravo, L. et al. (2020). Psychometric analysis of a measure of acceptance of new technologies (UTAUT), applied to the use of haptic virtual simulators in dental students. *European Journal of Dental Education*, 24(4), 706–714. <https://doi.org/10.1111/eje.12559>

- Gossett, S. (2023). *Virtual reality in education: Benefits, uses and examples*. Built In, <https://builtin.com/articles/virtual-reality-in-education>
- Ha, Y.-S., Park, Y.-K., Kim, E.-H., & Kim, K.-J. (2022). The effects of digital empowerment teacher training program applying virtual reality on digital media literacy, teacher efficacy, and problem-solving ability of school nurse. *Journal of Health Informatics and Statistics*, 47(2), 118–125. <https://doi.org/10.21032/jhis.2022.47.2.118>
- Hair, J. F., Black, W. C., Babin, B. J., & Anderson, R. E. (2009). *Multivariate data analysis* (7th ed.). Pearson.
- Hamurcu, A., Timur, Ş., & Rızvanoğlu, K. (2023). A study on the adoption of virtual reality in industrial design education. *IEEE Transactions on Learning Technologies*, 16(6), 900–913. <https://doi.org/10.1109/TLT.2023.3321292>
- Hew, K. F., & Cheung, W. S. (2010). Use of three-dimensional (3-D) immersive virtual worlds in K-12 and higher education settings: A review of the research. *British Journal of Educational Technology*, 41(1), 33–55. <https://doi.org/10.1111/j.1467-8535.2008.00900.x>
- Hidayanto, A. N., & Prabowo, H. (2022, August 11–12). Discipline, impact, and challenges of virtual reality in higher education: A systematic literature review. *2022 International Conference on Information Management and Technology (ICIMTech)*. Semarang.
- Hu, L., & Bentler, P. M. (1999). Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modeling: A Multidisciplinary Journal*, 6(1), 1–55. <https://doi.org/10.1080/10705519909540118>
- Huang, F.-H. (2020). Adapting UTAUT2 to assess user acceptance of an e-scooter virtual reality service. *Virtual Reality*, 24(4), 635–643. <https://doi.org/10.1007/s10055-019-00424-7>
- Huang, H.-M., Rauch, U., & Liaw, S.-S. (2010). Investigating learners' attitudes toward virtual reality learning environments: Based on a constructivist approach. *Computers & Education*, 55(3), 1171–1182. <https://doi.org/10.1016/j.compedu.2010.05.014>
- Jensen, L., & Konradsen, F. (2018). A review of the use of virtual reality head-mounted displays in education and training. *Education and Information Technologies*, 23, 1515–1529. <https://doi.org/10.1007/s10639-017-9676-0>
- Karaoglan-Yilmaz, F. G. et al. (2024). Transactional distance perceptions, student engagement, and course satisfaction in flipped learning: A correlational study. *Interactive Learning Environments*, 32(2), 447–462. <https://doi.org/10.1080/10494820.2022.2091603>
- Koutromanos, G. et al. (2024). The mobile augmented reality acceptance model for teachers and future teachers. *Education and Information Technologies*, 29(7), 7855–7893. <https://doi.org/10.1007/s10639-023-12116-6>
- Lai, N. Y. G., Wei, S., Halim, D., Fow, K. L., Kang, H. S., & Yu, L. J. (2021). Why Not More Virtual Reality in Higher Ed Teaching and Learning?. In *2021 IEEE International Conference on Engineering, Technology & Education (TALE)* (pp. 248–254). IEEE.
- Luo, H. et al. (2021). Virtual reality in K-12 and higher education: A systematic review of the literature from 2000 to 2019. *Journal of Computer Assisted Learning*, 37(3), 887–901. <https://doi.org/10.1111/jcal.12538>
- Makransky, G., & Lilleholt, L. (2018). A structural equation modeling investigation of the emotional value of immersive virtual reality in education. *Educational Technology Research and Development*, 66(5), 1141–1164. <https://doi.org/10.1007/s11423-018-9581-2>
- Mareta, S. et al. (2022). A study of the virtual reality cybersickness impacts and improvement strategy towards the overall undergraduate students' virtual learning experience. *Interactive Technology and Smart Education*, 19(4), 460–481. <https://doi.org/10.1108/ITSE-10-2021-0193>
- Marks, B., & Thomas, J. (2022). Adoption of virtual reality technology in higher education: An evaluation of five teaching semesters in a purpose-designed laboratory. *Education and Information Technologies*, 27(1), 1287–1305. <https://doi.org/10.1007/s10639-021-10653-6>
- Marougkas, A. et al. (2023). Virtual reality in education: A review of learning theories, approaches and methodologies for the last decade. *Electronics*, 12(13), 2832. <https://doi.org/10.3390/electronics12132832>

- Mastrolembo Ventura, S. et al. (2022). Implementation of virtual reality in construction education: A content-analysis based literature review. *Journal of Information Technology in Construction*, 27, 705–731. <https://doi.org/10.36680/j.itcon.2022.035>
- Pellas, N., Dengel, A., & Christopoulos, A. (2020a). A scoping review of immersive virtual reality in STEM education. *IEEE Transactions on Learning Technologies*, 13(4), 748–761. <https://doi.org/10.1109/TLT.2020.3019405>
- Pellas, N., Kazanidis, I., & Palaigeorgiou, G. (2020b). A systematic literature review of mixed reality environments in K-12 education. *Education and Information Technologies*, 25(4), 2481–2520. <https://doi.org/10.1007/s10639-019-10076-4>
- Radianti, J. et al. (2020). A systematic review of immersive virtual reality applications for higher education: Design elements, lessons learned, and research agenda. *Computers & Education*, 147, 103778. <https://doi.org/10.1016/j.compedu.2019.103778>
- Rafiq, A. A., Triyono, M. B., & Djatmiko, I. W. (2022). Enhancing student engagement in vocational education by using virtual reality. *Waikato Journal of Education*, 27(3), 175–188. <https://doi.org/10.15663/wje.v27i3.964>
- Schermelleh-Engel, K., Moosbrugger, H., & Müller, H. (2003). Evaluating the fit of structural equation models: Tests of significance and descriptive goodness-of-fit measures. *Methods of Psychological Research Online*, 8(2), 23–74.
- Tan, Y. et al. (2022). Augmented and virtual reality (AR/VR) for education and training in the AEC industry: A systematic review of research and applications. *Buildings*, 12(10), 1529. <https://doi.org/10.3390/buildings12101529>
- Teng, Z. et al. (2022). Factors affecting learners' adoption of an educational metaverse platform: An empirical study based on an extended UTAUT model. *Mobile Information Systems*, 2022(1), 5479215. <https://doi.org/10.1155/2022/5479215>
- Venkatesh, V. et al. (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*, 36(1), 157–178. <https://doi.org/10.2307/41410412>
- Wang, E. Y. et al. (2023). Predicting pediatric healthcare provider use of virtual reality using a technology acceptance model. *JAMIA Open*, 6(3), ooad076. <https://doi.org/10.1093/jamiaopen/ooad076>