

Analysis of Factors Influencing Digital Human Teacher Satisfaction Based on the Extended TAM Model

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Abstract. This study examines digital human teacher satisfaction via an enhanced Technology Acceptance Model (TAM), focusing on virtual anchors' role in online education. It investigates the impact of perceived usefulness, ease of use, playfulness, and trust on user satisfaction, comparing 2D and 3D virtual anchors among elementary students. Findings highlight playfulness's significant role in 3D contexts and ease of use in 2D settings, enriching TAM's applicability in virtual education. Despite its limited geographical scope and sample diversity, the study underscores the importance of engaging content and interactive experiences in improving learning outcomes. Future research should expand to diverse settings and consider broader virtual anchor samples to further explore virtual teaching technologies' educational potential.

Keywords: TAM, Digital Human Teacher, Satisfaction

1 Introduction

In the current digital era, virtual anchors, as an emerging form of content creation and interaction, have rapidly gained widespread attention and research interest globally. Since the first generation virtual Vtuber Kizuna AI opened her YouTube account and released her first video on December 1, 2016, utilizing advanced real-time animation capture and facial expression capture technologies, the market size of virtual anchors has exceeded \$50 billion worldwide, with the user count surpassing 5 million. Recent studies have begun to focus on the interaction between virtual anchors and users, finding that compared to real live streaming, virtual anchors show greater potential in enhancing users' sense of social presence and continuous engagement behavior (Jie,2022)[1].

Online education, as a supplement and extension of traditional education, has shown significant advantages in expanding educational coverage, improving learning efficiency, and reducing pressure on students and teachers (Bali,2018[2]). Nonetheless, the online learning environment still faces issues such as a lack of interactivity and insufficient teaching design, with teachers often focusing more on the content itself, neglecting the importance of the learning environment and teaching activities (Butnaru,2021)[3]. In response to these challenges, this study proposes using virtual anchors as an innovative online teaching activity design solution, aiming to improve the online education experience by enhancing teaching interaction and participation.

Existing research indicates that the type of anchor plays a crucial role in enhancing user experience and satisfaction (Mou,2023)[4]. Different types of anchors can have varying impacts at different stages of user experience, providing a new perspective on understanding the interaction between users and virtual anchors. Based on this background, this study aims to deeply explore the application potential of virtual anchors in the field of online education and their impact on teacher satisfaction, with the goal of providing more attractive and effective teaching solutions for online education through comparative analysis of two-dimensional and three-dimensional virtual anchors.

2 Theoretical Framework and Hypotheses

2.1 Impact of User Experience and Its Influencing Factors

In the realm of user experience research, prior studies have identified several factors that directly or indirectly affect user satisfaction, including but not limited to perceived usefulness (Davis,1989)[5], perceived ease of use (Davis,1989)[5], user satisfaction itself (Bhattacharjee, 2001)[6], and perceived playfulness (Moon,2001)[14].Despite this, discussions on the impact of perceived trust on user experience satisfaction are relatively scarce in the academic field. Recent research by Jie(2022)[1]has revealed the positive role of perceived trust in promoting continuous user engagement, highlighting its critical importance in maintaining and enhancing user experience. Perceived trust is often understood as the likelihood of users experiencing the joy of social interaction and happiness when actively participating in social media activities (Valkenburg,2006)[7]. For example, when students watch live broadcasts, expressing their emotions through emojis or likes not only helps build a positive emotional attitude but also plays a key role in enhancing the overall user experience. This indicates the importance of considering perceived trust factors when designing technologies and content aimed at improving user satisfaction and participation levels.

2.2 Model and Hypotheses

The discussion in the previous section suggests using the model depicted in Figure 1 to verify the determinants of user experience satisfaction and to study the comparative satisfaction with two-dimensional and three-dimensional virtual anchors. The model employed in this research is an adaptation of the TAM model (**Figure 1**). As illustrated, the modified model includes five variables: perceived usefulness, perceived ease of use, perceived playfulness, perceived trust, and user experience satisfaction.

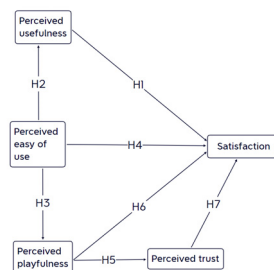


Fig. 1. Virtual anchor user experience model

2.3 Hypotheses

The Impact of Perceived Usefulness on Virtual Anchor Satisfaction

According to Davis (1989)[5], Perceived Usefulness is the degree to which a user believes that using a particular product or technology will enhance their job performance. Numerous studies have confirmed the significant role of perceived usefulness in enhancing user experience. In this study, we specifically define perceived usefulness as the improvement in information reception efficiency that students experience while watching virtual anchor content. Based on the theoretical framework of the Technology Acceptance Model (TAM), this study proposes the following hypothesis:

H1: Perceived usefulness will positively impact user experience satisfaction.

The Impact of Perceived Ease of Use on the Perceived Usefulness and Satisfaction of Virtual Anchors

Perceived Ease of Use, identified by Davis (1989)[9] as a key dimension in the TAM, refers to the degree to which a person believes that using a particular technology or product will be effort-free. This concept has been validated and emphasized in numerous studies (Wöber, 2000)[16], which confirm the importance of ease of use in promoting technology acceptance and user satisfaction. Perceived ease of use's subjectivity is reflected in users' personal feelings towards the convenience of operating and understanding information, especially when watching virtual anchor content. In this research, we refine it to the ease of use and understanding of information perceived by students while watching virtual anchor educational content. Thus, based on TAM theory, we propose the following hypotheses:

H2: Perceived ease of use will positively impact perceived usefulness.

H3: Perceived ease of use will positively impact perceived playfulness.

H4: Perceived ease of use will positively impact user experience satisfaction.

The Impact of Perceived Playfulness on the Perceived Trust and Satisfaction of Virtual Anchors

Defined by Davis (1989) [5] and Moon (2001)[14], Perceived Playfulness involves the degree of entertainment or enjoyment a person feels towards a particular activity, task, or content. This concept emphasizes how a user's level of interest in a product or technology affects their usage experience and depth of understanding. For students, a high level of interest can enhance their attention and motivate them to actively explore and learn. In this study, we define perceived playfulness as the level of interest students have while watching educational live broadcasts by virtual anchors. Based on this, we propose the following hypotheses to explore the role of perceived playfulness in the user experience of virtual anchors:

H5: Perceived playfulness will positively impact perceived trust.

H6: Perceived playfulness will positively impact user experience satisfaction.

The Impact of Perceived Trust on Virtual Anchor Satisfaction

Defined by Chung (2009)[8] as the willingness to rely on another party, perceived trust represents a sense of security. Gefen (2000)[9] further explains that this trust is built through

continuous interaction between people, with Gefen (2004)[10]noting that the more frequent and high-quality the interactions, the easier it is to establish perceived trust. In this research, perceived trust specifically refers to the reduction in unreal feelings students have when watching virtual anchors, facilitated by interactions with the virtual anchors, thereby enhancing trust and satisfaction with the virtual teaching content (Jiang, 2019) [11]. Based on the above theoretical framework, this study proposes the following hypothesis:

H7: Perceived trust will positively impact user experience satisfaction.

3 Empirical Analysis

3.1 Experimental Method

To investigate the impact of two-dimensional (2D) and three-dimensional (3D) virtual anchor types on user experience satisfaction, participants were divided into Group A (3D virtual anchor type) and Group B (2D virtual anchor type). They then utilized the model depicted in Figure 1 to elucidate the factors affecting user experience satisfaction with virtual anchors and explored the differences between the two types of virtual anchors through comparison. Two videos of both 2D and 3D virtual anchors, each selected from platforms with high overall viewership exceeding one million views and varied in educational content, were prepared and distributed to the participants. They were required to watch the videos before filling out the questionnaire. The subjects of the survey were elementary school students, who immediately completed the questionnaire after viewing the videos. This study collected a total of 540 questionnaires on 2D virtual anchor type and 3D virtual anchor type, of which 461 were valid. Specifically, there were 230 questionnaires for 3D virtual anchors and 231 for 2D virtual anchors.

3.2 Characteristics of Respondents

After consolidating the data from Group A and Group B respondents, descriptive statistical analysis revealed: there were 234 male participants (50.6%) and 227 female participants (49.1%).In terms of virtual anchor viewing rates, 340 individuals (73.5%) had watched virtual anchors, with 70 (15.2%) frequently watching them.In the context of viewing duration for virtual anchors, considering students' academic commitments and relaxation time on weekends, 80% of students watch for less than 30 minutes per session, indicating a lack of sufficient time for extended viewing. Among these, 20% of students have ample viewing time, with 23 (6.8%) watching for more than 60 minutes, suggesting that despite being a novel form of media communication, virtual anchors possess a strong appeal to users.

3.3 Empirical Analysis of Three-Dimensional Virtual Anchors

Reliability Analysis

Reliability analysis of the questionnaire for two-dimensional and three-dimensional virtual anchors indicates that the Cronbach's Alpha values for this study are all above 0.7,surpassing the 0.7 threshold recommended by Larcker (1981)[15].This indicates that the questionnaires for both two-dimensional and three-dimensional virtual anchors possess good reliability.

Overall, the results in Table 1 confirm that the model has sufficient reliability for both groups of users.

Table 1. Reliability analysis

Construct	Group A	Group B
	Cronbach's Alpha	Cronbach's Alpha
Perceived usefulness	0.829	0.817
Perceived easy of use	0.820	0.847
Perceived playfulness	0.810	0.845
Perceived trust	0.863	0.790
Satisfaction	0.847	0.828
Overall reliability	0.927	0.928

Correlation Analysis

According to the correlation analysis conducted for this study (Table 2), the p-values between each variable for both Group A and Group B were less than 0.01, and the Pearson correlation coefficients were all greater than 0.4. This indicates that the correlations between each variable are significant and demonstrate a notably positive relationship.

Table 2. Correlation testing between variables

Construct	Group A				Group B			
	PU	PEU	PP	PT	PU	PEU	PP	PT
PU PCC	1				1			
PEU PCC	.541	1			.540	1		
PP PCC	.471	.564	1		.556	.609	1	
PT PCC	.473	.578	.643	1	.510	.535	.539	1
SA PCC	.508	.501	.566	.591	.554	.628	.618	.541

Regression analysis results

The regression analysis results of the model (Table 3) show that the p-values for the path hypotheses for both Group A and Group B are less than 0.05. Hypothesis 1: Perceived usefulness has a significant positive impact on user experience satisfaction, with $p < 0.01$, the coefficient for Group A being 0.506 and for Group B being 0.553. This indicates that the higher the efficiency of information transmission by virtual anchors is perceived by students, the higher their personal satisfaction. Thus, this hypothesis is confirmed. Hypothesis 2: Perceived ease of use has a significant positive effect on perceived usefulness, with $p < 0.01$,

the coefficient for Group A being 0.497 and for Group B being 0.477. This shows that the easier students find it to understand knowledge through virtual anchors, the more they can perceive the information conveyed by the virtual anchors. Therefore, this hypothesis is confirmed. Hypothesis 3: Perceived ease of use significantly positively impacts perceived playfulness, with $p < 0.01$, the coefficient for Group A being 0.474 and for Group B being 0.571. This suggests that the easier students find it to understand the information conveyed by virtual anchors, the higher their overall interest in the information. Thus, this hypothesis is confirmed. Hypothesis 4: Perceived ease of use has a significant positive effect on user experience satisfaction, with $p < 0.01$, the coefficient for Group A being 0.458 and for Group B being 0.501. This indicates that the easier it is for students to understand the information conveyed by virtual anchors, the higher their personal satisfaction. This conclusion is confirmed. Hypothesis 5: Perceived playfulness significantly positively affects perceived trust, with $p < 0.01$, the coefficient for Group A being 0.765 and for Group B being 0.464. This means that when students' interest in the information increases, they are more likely to recognize themselves and be filled with confidence. Therefore, this hypothesis is confirmed. Hypothesis 6: Perceived playfulness has a significant positive impact on user experience satisfaction, with $p < 0.01$, the coefficient for Group A being 0.616 and for Group B being 0.581. This suggests that the more interested students are in virtual anchors and the information conveyed, the higher their personal satisfaction. This conclusion is confirmed. Hypothesis 7: Perceived trust significantly positively affects user experience satisfaction, with $p < 0.01$, the coefficient for Group A being 0.541 and for Group B being 0.549. This indicates that the higher the students' self-recognition, the higher their personal satisfaction. This conclusion is confirmed. In summary, the results of this study statistically support all the hypotheses.

Table 3. Path analysis between variables

Construct	Group A		Group B	
	B	Standard error	B	Standard error
H1 PU→SA	.506	.057	.553	.055
H2 PEU→PU	.497	.051	.477	.049
H3 PEU→PP	.474	.046	.571	.049
H4 PEU→SA	.458	.052	.553	.045
H5 PP→PT	.765	.060	.464	.048
H6 PP→SA	.616	.059	.581	.049
H7 PT→SA	.541	.049	.549	.056

The standardized paths for Group A and Group B are as shown in the table, with path analyses centered on user experience depicted separately in **Figure 2** and **Figure 3**.

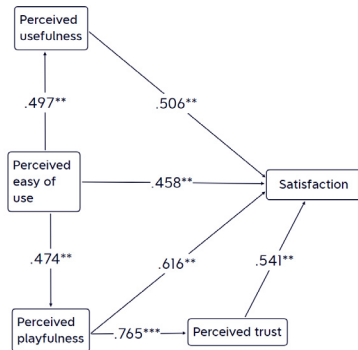


Fig. 2. Group A virtual anchor path diagram

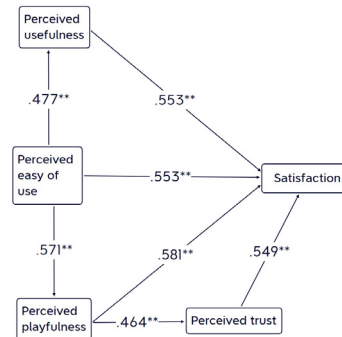


Fig. 3. Group B virtual anchor path diagram

Comparison Analysis of User Experience Satisfaction Between Two-Dimensional and Three-Dimensional Virtual Anchors

To further compare the user experience satisfaction between two-dimensional and three-dimensional virtual anchors, the method adopted by Keil (2000)[13] was used to test the differences in the estimates along the same path for the two user groups. As shown in Table 3, From the understanding of the regression path coefficients, for students watching three-dimensional virtual anchors, perceived playfulness has a more significant impact on perceived trust. Moreover, for these students, perceived playfulness exerts a greater influence on user experience satisfaction compared to those watching two-dimensional virtual anchors. For students watching two-dimensional virtual anchors, perceived ease of use significantly affects perceived playfulness. Regardless of whether students are watching two-dimensional or three-dimensional virtual anchors, perceived playfulness is more important than perceived ease of use, usefulness, and perceived trust in affecting user experience satisfaction. Additionally, the impact of perceived ease of use on user experience satisfaction for two-dimensional virtual anchor viewers is significantly greater than that for students watching three-dimensional virtual anchors.

4 Discussion and Implications

The results of this study indicate that regardless of the type of virtual anchor, the perceived usefulness, perceived ease of use, perceived playfulness, and perceived trust of both two-dimensional and three-dimensional virtual anchors significantly positively affect user experience satisfaction. These findings are consistent with those presented by Davis (1989)[5], Moon (2001)[14], among others, where perceived playfulness of both two-dimensional and three-dimensional virtual anchors has a strong impact on user experience satisfaction.

The results show that the perceived usefulness of two-dimensional virtual anchors is slightly higher than that of three-dimensional ones, suggesting that students may find information acquisition from two-dimensional virtual anchors easier, possibly due to their simpler and more intuitive design which can facilitate more focused attention on the information. In terms of perceived ease of use, two-dimensional virtual anchors have a slightly higher coefficient

than three-dimensional ones, indicating that the educational information conveyed by two-dimensional virtual anchors is easier to understand. Three-dimensional virtual anchors, due to their complex interaction formats and visual effects, might be limited in terms of ease of use. For perceived playfulness, the coefficient for two-dimensional virtual anchors is lower than that for three-dimensional ones, showing that students find three-dimensional virtual anchors more interesting to watch. This is in line with Kim (2011)[12] and others who noted that three-dimensional compared to two-dimensional provides better satisfaction and playfulness, possibly due to the richer visual experience and more dynamic interaction environment offered by three-dimensional virtual anchor technology. Additionally, in terms of perceived trust, the coefficient for two-dimensional virtual anchors is slightly greater than for three-dimensional ones, indicating that students' ability to establish a connection and identify with both types of virtual anchors is nearly the same. The minor difference in perceived trust might be related to individual preferences and specific interactions.

The current research findings underscore that perceived playfulness is a decisive factor in enhancing the user experience of virtual anchors. This discovery aligns with findings by Moon (2001)[14] and others, highlighting the critical role of perceived playfulness in the user experience. Therefore, actively enhancing the perceived playfulness of virtual anchor education is key to increasing student satisfaction and promoting the willingness to learn.

5 Conclusion

5.1 Theoretical Contributions

This study has made significant theoretical contributions to exploring the factors influencing satisfaction in the field of digital human teachers. Firstly, by extending the traditional Technology Acceptance Model (TAM), this research has considered the impacts of perceived usefulness, perceived ease of use, perceived playfulness, and perceived trust on user experience satisfaction, offering a new perspective for user experience research in virtual anchors applied in online education. This not only enriches the application of the TAM model in the emerging virtual education environment but also provides a more comprehensive theoretical framework for future research.

Secondly, the study has conducted an in-depth examination of the roles of perceived playfulness and perceived trust in the user experience of virtual anchors. Unlike existing literature, this study is the first to explicitly propose and verify the positive impact of perceived playfulness on perceived trust, unveiling the importance of playful experiences in virtual environments for building trust. This finding breaks new ground, emphasizing the need to fully leverage playfulness in designing virtual teaching content to enhance teaching effectiveness and satisfaction.

Furthermore, through empirical analysis of the differing impacts of two-dimensional and three-dimensional virtual anchors on user experience satisfaction, this study provides important guidance for the design and application of virtual anchors. The results show that perceived playfulness plays a more significant role in three-dimensional virtual anchors, while perceived ease of use is more crucial for two-dimensional virtual anchors. This not only offers

practical guidelines for the design of virtual anchors but also provides a theoretical basis for content innovation in the online education domain.

5.2 Practical Implications

Firstly, by thoroughly analyzing the effects of perceived usefulness, perceived ease of use, perceived playfulness, and perceived trust on user experience satisfaction, this study offers concrete guiding principles for the design of virtual teaching content and platforms. Particularly in terms of perceived playfulness, the research highlights the importance of introducing elements of fun into the virtual teaching environment, which is crucial for designing teaching content that can attract and maintain students' attention.

Secondly, the empirical analysis found that increasing the frequency and quality of interaction between virtual anchors and users helps build perceived trust, thereby enhancing user experience satisfaction. This provides practical strategies for online education platforms on how to improve learning outcomes and student satisfaction through enhanced interactivity.

Additionally, by comparing the different impacts of two-dimensional and three-dimensional virtual anchors on enhancing user experience satisfaction, this study offers a basis for education content providers in choosing the type of virtual anchor. This aids educational technology developers and content creators in selecting the most appropriate form of virtual anchor based on specific teaching goals and content characteristics.

5.3 Limitations and Future Research Directions

Firstly, the study's survey subjects were limited to elementary school students in a specific area, restricting the generalizability of the results. Future research could expand the survey scope to different provinces and regions nationwide, using a broader sample to enhance the representativeness and scientific validity of the results. This approach would help researchers gain a more comprehensive understanding of the educational effects of virtual anchors across different cultural and educational backgrounds.

Secondly, the choice of virtual anchors in this study was somewhat limited, primarily because the application of virtual anchors in the domestic education field is still in its early stages and lacks broad influence. Therefore, future research should consider increasing the variety of virtual anchor samples, especially those with high popularity and influence among students, to more accurately assess the impact of virtual anchors on learning satisfaction.

Lastly, although this study approached from students' personal perspectives to explore the impact of different types of virtual anchors on user experience satisfaction, there may be other influencing factors not considered. Hence, future research should incorporate more theories and variables, such as the learning environment, the quality of teaching content, and students' personal traits, which could affect user experience satisfaction. Moreover, considering the rapid development of technology and diverse educational needs, future studies should also explore the integration of virtual anchor technology with other educational technologies and how these technologies collectively influence learning outcomes and student satisfaction.

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