Edelweiss Applied Science and Technology
ISSN: 2576-8484
Vol. 8, No. 2, 73-83
2024
Publisher: Learning Gate
DOI: 10.55214/25768484.v8i2.693

Are we ready for education in Metaverse? PLS-SEM analysis

Binh-Hai Thi Nguyen[1], Tri-Quan Dang[2], Luan-Thanh Nguyen[2*], Thuy-Thanh Thi Tran[3]
[1]University of Finance-Marketing, UFM, Vietnam; haibinhnguyen@ufm.edu.vn (B-H.T.N).
[2]Ho Chi Minh City University of Foreign Languages-Information Technology, HUFLIT, Vietnam; tridq@huflit.edu.vn (T-Q.D); luannt@huflit.edu.vn (L-T.N.).
[3]Vinh University, Vinh City, Vietnam; thuyttt@vinhuni.edu.vn (T-T.T.T).

Abstract: The objective of this study is to investigate the adoption of met-averse education in Ho Chi Minh City, Vietnam, by employing the Theory of Planned Behavior (TPB) as the foundational theoretical framework. Metaverse education, utilizing immersive and interactive virtual environments for educational objectives, is an innovative and auspicious methodology in the contemporary digital realm. Data collection was conducted via judgmental sampling. Partial least squares structural equation modeling was used for the analysis. The results suggest a significant and positive impact of Consumer Intention (CI) on the practical use (AU) of the met-averse in the field of education. Furthermore, the factors of Perceived Behavioral Control (PBC), Subjective Norm (SN), and Perceived Value strongly influenced Consumer Intention (CI) in a positive manner. Moreover, Emotional Value (EV) and Social Value (SV) had a substantial impact on the Perceived Value (PV) of using the metaverse in educational contexts. Nevertheless, the lack of statistical significance in the relationship between Attitude towards Behavior (ATB) and Consumer Intention (CI) is recognized. This research not only addresses a significant gap in the theory of IS literature but also offers valuable insights for educators, policymakers, and developers. If you really understand the things that make people open to metaverse education, you can make big changes to plans and actions that are used to successfully add metaverse education to the regular school setting, especially in Ho Chi Minh City, Vietnam.

Keywords: *Education, Emotional value, Metaverse, Social value, TPB, Vietnam.*

1. Introduction

The emergence of the metaverse as a virtual reality phenomenon in the digital age is reflective of the ongoing transformation of society and the economy [1]. With its ability to create photorealistic, physics-compliant worlds inhabited by human avatars and artificial intelligence (AI) beings, the metaverse has become a new frontier for diverse applications, including gaming, social networking, and e-commerce [2]. In education, specifically, the metaverse offers a novel paradigm that promises immersive and interactive learning experiences that overcome the limitations of traditional and online education [3].

Utilizing the metaverse for educational purposes presents challenges and ethical concerns, including privacy, digital accessibility, and quality assurance, despite its potential. In addition, factors influencing its successful adoption by students and teachers in educational settings have yet to be thoroughly investigated [4].

This study aims to fill existing knowledge gaps by using the Theory of Planned Behavior (TPB) to examine the factors that influence the practical adoption of the metaverse in educational settings among students and educators in Ho Chi Minh City, Vietnam. The TPB provides a strong theoretical framework for explaining and predicting behavioral intention and behavior, taking into account attitudes, subjective standards, and perceived behavioral control. The idea incorporates extrinsic factors

History: Received: 16 November 2023; Revised: 8 January 2024; Accepted: 25 January 2024; Published: 23 February 2024
* Correspondence: luannt@huflit.edu.vn

such as social value and emotional value and can be used as a theoretical basis for interventions aiming at fostering behavioral changes, especially in the field of metaverse education [5].

The study comprises five sections: an introductory section, a literature review on the Theory of Planned Behavior (TPB), the study's framework, the creation of hypotheses, the research methods and results, a discussion section, and a conclusion with recommendations. This inquiry will provide significant insights for educators and policymakers who are interested in optimizing the metaverse's capacity to enhance learning experiences.

2. Literature Review

2.1. The Theory of Planned Behavior (TPB)

The Theory of Planned Behavior (TPB), which includes the concept of perceived behavioral control, is a cognitive framework that connects beliefs and conduct. This study examines how attitude, subjective norms, and perceived behavioral control influence behavioral intentions [6]. The enhancement of perceived behavioral control increases the ability of the Theory of Reasoned Action (TRA) to make accurate predictions within the broader framework of the Theory of Planned Behavior (TPB). This theoretical paradigm has been applied in various fields, enabling the investigation of connections between beliefs, attitudes, intentions, and behavior [7]. According to the TPB, behavioral intention is defined as the assessment of beliefs, social pressures resulting from these beliefs, and the perceived ability to affect actions [8]. Behavioral beliefs refer to individuals' expectations about the outcomes of their acts; normative views involve the expectations of important individuals in their social environment, and control beliefs are related to situations that either support or hinder their behavior. In addition, TPB recognizes the influence of external factors on beliefs and behavioral aspects [9].

In theoretical terms, the Theory of Planned Behavior (TPB) provides a comprehensive and logical framework for understanding and predicting the adoption of the metaverse in education. The current study examines the underlying cognitive factors that influence behavioral intention and actual use of metaverse in education, specifically attitudes and subjective norms. It allows for a detailed investigation and evaluation of the cognitive processes that govern these factors [10]. Furthermore, the theory recognizes the influence of external factors on the development and progression of beliefs, attitudes, subjective norms, and behavioral intentions [11].

In the field of metaverse education, the inclusion of perceived value, which includes emotional and social aspects, becomes important. This innovation boosts motivation by taking into account the emotional gratification and pleasure obtained from using the metaverse, in addition to the perceived advantages of social contact and collaboration with peers and teachers in a virtual setting. This complete approach enhances the existing elements of the TPB, providing a thorough comprehension of the factors that influence behavioral intentions in adopting the metaverse for educational purposes.

2.2. Research Model

This study aims to investigate and elucidate the factors influencing the practical application of the metaverse, a 3D digital realm that combines the physical and virtual worlds, in education. Using the Theory of Planned Behavior (TPB) as its theoretical foundation, this study develops a comprehensive model to investigate this phenomenon. Perceived value, attitude, subjective norm, perceived behavioral control, and consumer intention have been added to investigate metaverse adoption in education, as seen in Figure 1, based on prior research and TPB. The purpose of this analysis is to shed light on the intricate dynamics underlying the incorporation of the metaverse into educational settings.

2.3. Hypotheses Development

Emotional value, defined as the extent to which an individual perceives that employing new technology would improve their emotional well-being, contentment, and enjoyment, has been identified as a significant factor influencing adoption intentions in virtual reality and online gaming contexts [12]. Emotional value, in the context of this study, refers to students' and instructors' willingness to

Edelweiss Applied Science and Technology
ISSN: 2576-8484
Vol. 8, No. 2: 73-83, 2024
DOI: 10.55214/25768484.v8i2.693

adopt the metaverse in education if it positively influences their learning outcomes, motivation, and engagement. According to the TPB, emotional value can influence perceived value by shaping individuals' attitudes toward technology use. Moreover, emotional value may influence perceived value by influencing subjective evaluations of outcomes [13]. Emotional value is hypothesized to play a significant role in shaping perceived value as a crucial determinant. Thus, this study proposes:

H_1. Emotional value (EV) influences positively the perceived value (PV) of utilizing metaverse in education.

In social media and online communities, social value, defined as the perception of a technology's impact on social standing and connections, has been shown to strongly influence adoption intentions [14]. In this study, social value refers to how instructors and students perceive the metaverse's capacity to enhance social presence and interactions in education. Social value, according to the Theory of Reasoned Action, can shape perceived value by influencing attitudes toward technology adoption. Individuals with positive attitudes as a result of increased social status may experience greater learning and teaching benefits. Those with negative attitudes may perceive significance to be less significant. Consequently, social value is anticipated to have a substantial effect on perceived value [13].

H_2. Social value (SV) influences the perceived value (PV) of utilizing metaverse in education positively.

Perceived value is the extent to which a person thinks new technology will be worth the cost [15]. Many studies have found that perceived value influences e-commerce, e-learning, and in other contexts, adoption intentions [16-18]. Perceived value refers to students' and instructors' willingness to use the metaverse in education if the benefits outweigh the costs [11]. It reflects students' and instructors' views of the new system's economic value for education. The metaverse reduces costs, increases convenience, and expands resources. According to the TPB, attitudes and subjective standards influence choices, and perceived value affects consumer intention by influencing technology use [8]. Perceived value can also have an impact on consumers' subjective evaluations of results. Customer intention is influenced by perceived value [13]. Thus, the hypothesis:

H_3. Perceived value (PV) increases consumer intention (CI) to use the metaverse in education.

Attitude towards behavior (ATB) pertains to the degree to which an individual possesses a favorable or unfavorable assessment of a specific conduct [19]. Multiple empirical studies have emphasized the crucial significance of user attitude in influencing intentions for technology adoption [20, 21]. Studies on e-learning technology have demonstrated that consumers are more likely to adopt this technology when they have a positive attitude towards it [22]. Essentially, a greater inclination to embrace the metaverse in education is associated with an increased purpose to utilize it. ATB, or Augmented Teaching and Learning, is a vital but frequently neglected aspect of education in the metaverse. It reflects users' evaluations of the advantages and disadvantages of using this technology for learning. ATB has the capacity to impact users' motivation, engagement, contentment, and performance in the metaverse learning environment. Accordingly, this study stipulates that:

H_4. Attitude towards the behavior (ATB) positively influences consumer intention (CI) of using the metaverse in education.

Subjective norm (SN) refers to the perceived social pressure to perform or refrain from a particular behavior, influenced by influential people such as family, friends, classmates, and teachers Ajzen [6]. Baker, et al. [23] and Cheon, et al. [24] have demonstrated that SN strongly predicts technology acceptance and usage intentions in various contexts, including e-learning, online shopping, and social media [23, 24]. In the metaverse learning environment, SN can influence motivation, confidence, involvement, and satisfaction, making it a crucial yet frequently neglected educational construct.

H_5. Subjective norm (SN) positively influences consumer intention (CI) of using the metaverse in education.

Perceived behavioral control (PBC) is the perception of the ease or difficulty of performing a task, which reflects an individual's view of the available resources and opportunities that facilitate or impede behavior Ajzen [6]. Baker, et al. [23]; Cheon, et al. [24], and Chu and Chen [22] have demonstrated that PBC is a significant predictor of technology acceptance and usage intentions in e-commerce, e-learning, and social media contexts [22-24]. In the metaverse education context, PBC can influence

Edelweiss Applied Science and Technology
ISSN: 2576-8484
Vol. 8, No. 2: 73-83, 2024
DOI: 10.55214/25768484.v8i2.693

user confidence, perseverance, satisfaction, and performance, representing the perceptions of the feasibility and controllability of using metaverse technology for learning.

H_6. Perceived behavioral control (PBC) positively influences consumer intention (CI) of using metaverse in education.

According to the Theory of Planned Behavior (TPB), consumer intention is a crucial factor in technology adoption [6]. Research on mobile payments indicates that a strong intent to adopt a technology is correlated with its continued use [8]. In the context of metaverse education, an individual's motivation and desire to engage in the behavior are indicated by a higher intention to utilize metaverse technology. The impact of CI on user behavior, outcomes, and satisfaction in the metaverse learning environment is substantial.

H_7. Consumer intention (CI) positively influences the actual use (AU) of using metaverse in education.

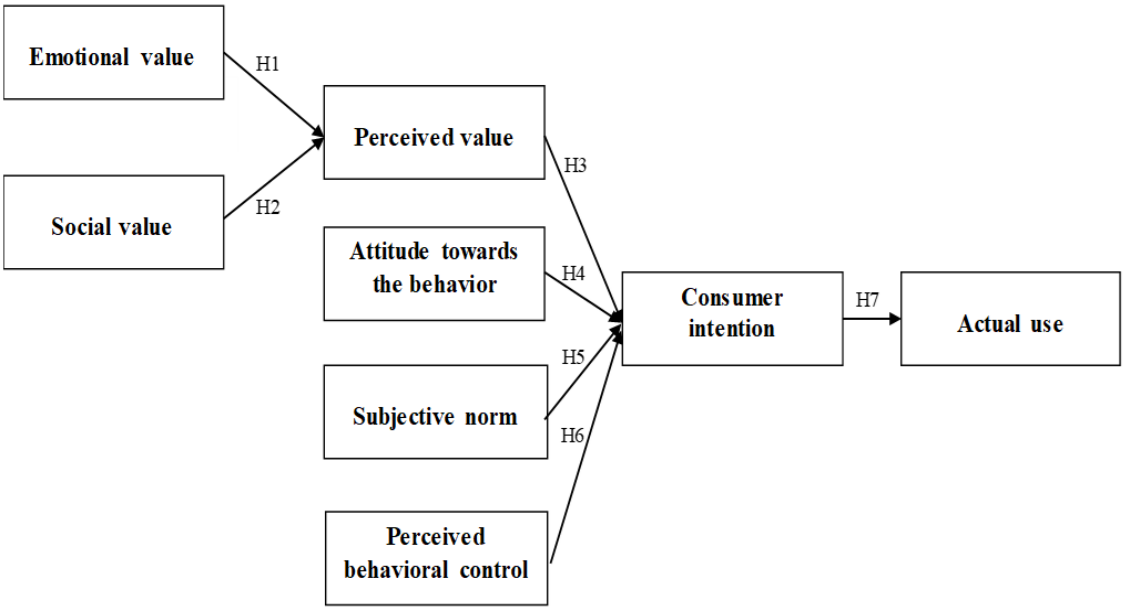

Figure 1.
Research model.

3. Methodology

3.1. Target Population and Demographic of Respondents

The study focuses on students utilizing metaverse technology in education in Ho Chi Minh City (HCMC), which is home to more than 80 percent of Vietnam's higher education institutions and online learning platforms [25]. The selection of HCMC was based on the size and diversity of its student body, which has varying levels of exposure to and familiarity with metaverse technology [25]. Due to the lack of a sample frame for HCMC metaverse users and student lists, this study employed non-probability sampling. Specifically, judgmental sampling was used, in which researchers selected accessible and representative samples based on prior research [26, 27]. For the study participants' demographics and their familiarity with the metaverse, among the participants, 39.33% were male, while 60.67% were female. The majority of participants fell within the age range of 18-25 (64.00%), and 73.00% were single. Regarding monthly income, the largest group (66.67%) reported earning between $501 and $1000 USD. In terms of education, a significant portion (84.00%) held a bachelor's degree, with 20.00% possessing a doctoral degree. Occupationally, 65.33% identified as students, while 28.42% were teachers. Regarding experience with the metaverse, 66.12% had been using or were aware of it for less than a year. This comprehensive data will play a crucial role in examining how these demographic

Edelweiss Applied Science and Technology
ISSN: 2576-8484
Vol. 8, No. 2: 73-83, 2024
DOI: 10.55214/25768484.v8i2.693

factors and metaverse experience might influence their attitudes towards metaverse technology in education.

3.2. Measure, Questionnaire Design, and Data Collection

The investigation utilized surveys as the selected approach for data collection due to their ability to gather research data from actual observations, making them particularly well-suited for investigating human behavior [28]. The study utilized Google Forms as the framework for conducting an electronic survey. In order to guarantee the content's authenticity, all items in the questionnaire were modified and revised after a thorough examination of pertinent literature. A group of specialists assessed the items to confirm their authenticity.

The questionnaire was initially modified from a prior study conducted in English and subsequently translated into Vietnamese, which is the official language of Vietnam and the primary language used by Vietnamese students and instructors. In order to ensure translation equivalence, the questionnaire was subjected to back-translation into English. We used key terms from different sources to come up with the concepts of social value (SV), emotional value (EV), perceived value (PV), attitude toward the behavior (ATB), subjective norm (SN), perceived behavioral control (PBC), consumer intention (CI), and actual use (AU) [6, 13, 15].

In order to facilitate measurement, a 7-point Likert scale was chosen. This scale ranges from "strongly disagree" (1) to "strongly agree" (7). The selection of this scale was based on its advantages, which include greater variability in responses and a decrease in neutral responses. As per the existing literature on Partial Least Squares (PLS), it is advised to have a sample size that is ten times the most intricate connection in the study model. As shown in reference [29] this would rest in a minimum sample size of 70. In addition, G*Power version 3.1, a statistical software, suggests that a minimum sample size of 103 is required. This recommendation takes into account an effect size (f2) of 0.15, an error probability (α) of 0.05, a power level (1-β) of 0.80, and seven predictors.

3.3. Common Method Biases

To address the potential problem of common method bias (CMB) arising from the data collected for both exogenous and endogenous variables, this study combines procedural and statistical approaches [11, 20]. First, respondent anonymity was ensured, and their responses were treated as confidential, eliminating concerns regarding the veracity of the assessments. The statistical aspect of Harman's single-factor analysis revealed that a single component explained only 36.12% of the total variation, which is below the 50% threshold. As a result, there is no significant CMB problem [16] confirming that the influence of CMB on the study outcomes is negligible.

3.4. Assessing the Outer Measurement Model

Before evaluating the hypotheses in the inner model, it is necessary to validate the outer model (measurement model) (structural model). The composite reliability (CR) and Dijkstra-Henseler (ρA) values for internal consistency reliability, which measure the consistency of the constructs, are presented in Table 1. The data indicate that the majority of these values exceed the threshold of 0.70 [20]. In addition, the CR levels shown in the same table surpass the 0.70 threshold established by Hair, et al. [29].

Edelweiss Applied Science and Technology
ISSN: 2576-8484
Vol. 8, No. 2: 73-83, 2024
DOI: 10.55214/25768484.v8i2.693

Table 1.
Loading, composite reliability, Dijkstra Henseler, and average variance extracted.

Latent construct	Items	Outer loading	ρ_A	Composite reliability	Average variance extracted (AVE)
ATB	ATB1	0.923	0.940	0.957	0.847
	ATB2	0.920			
	ATB3	0.922			
	ATB4	0.916			
AU	AU1	0.823	0.698	0.786	0.560
	AU2	0.849			
	AU3	0.531			
CI	CI1	0.931	0.900	0.933	0.822
	CI2	0.882			
	CI3	0.907			
EV	EV1	0.749	0.868	0.899	0.691
	EV2	0.861			
	EV3	0.862			
	EV4	0.849			
PBC	PBC1	0.927	0.929	0.949	0.822
	PBC2	0.924			
	PBC3	0.891			
	PBC4	0.884			
PV	PV1	0.885	0.883	0.919	0.740
	PV2	0.874			
	PV3	0.870			
	PV4	0.809			
SN	SN1	0.844	0.841	0.892	0.674
	SN2	0.824			
	SN3	0.834			
	SN4	0.782			
SV	SV1	0.845	0.819	0.857	0.602
	SV2	0.860			
	SV3	0.763			
	SV4	0.710			

The validity of the measurement model is then evaluated based on convergent and discriminant factors. Convergent Validity (CV) evaluates the similarity of items with similar underlying principles. CV is evaluated using the Average Variance Extracted (AVE) and outer loading values, as recommended by Dang, et al. [18]. Table 1 displays AVE values above 0.50 for all constructs, and nearly all outer loadings exceed 0.70, confirming the validity of the model.

Discriminant Validity (DV) guarantees that items score highly on their intended constructs and poorly on irrelevant constructs. According to Dang, et al. [30] Table 2 displays cross-loadings, which indicate generally high values for related constructs and low values for unrelated ones. This facilitates the DV calculation based on the results [19].

Edelweiss Applied Science and Technology
ISSN: 2576-8484
Vol. 8, No. 2: 73-83, 2024
DOI: 10.55214/25768484.v8i2.693

Table 2.
Cross loadings.

Items	ATB	AU	CI	EV	PBC	PV	SN	SV
ATB1	0.923	0.412	0.676	0.422	0.708	0.634	0.667	0.648
ATB2	0.920	0.367	0.679	0.365	0.707	0.630	0.667	0.631
ATB3	0.922	0.381	0.656	0.387	0.675	0.573	0.690	0.650
ATB4	0.916	0.367	0.646	0.402	0.710	0.622	0.702	0.654
AU1	0.346	0.823	0.324	0.384	0.322	0.267	0.334	0.254
AU2	0.350	0.849	0.345	0.241	0.305	0.390	0.335	0.383
AU3	0.217	0.531	0.121	0.223	0.236	0.176	0.255	0.292
CI1	0.665	0.372	0.931	0.434	0.706	0.656	0.760	0.588
CI2	0.574	0.277	0.882	0.386	0.628	0.618	0.624	0.535
CI3	0.714	0.381	0.907	0.490	0.761	0.681	0.717	0.613
EV1	0.360	0.329	0.344	0.749	0.411	0.346	0.359	0.380
EV2	0.315	0.303	0.411	0.861	0.409	0.415	0.394	0.354
EV3	0.331	0.257	0.384	0.862	0.365	0.399	0.367	0.306
EV4	0.410	0.358	0.455	0.849	0.421	0.507	0.454	0.431
PBC1	0.698	0.345	0.729	0.474	0.927	0.611	0.687	0.579
PBC2	0.738	0.359	0.680	0.384	0.924	0.591	0.681	0.615
PBC3	0.650	0.269	0.713	0.419	0.891	0.580	0.670	0.588
PBC4	0.677	0.413	0.682	0.470	0.884	0.626	0.713	0.628
PV1	0.554	0.330	0.639	0.469	0.541	0.885	0.586	0.637
PV2	0.543	0.356	0.637	0.436	0.560	0.874	0.570	0.588
PV3	0.601	0.360	0.633	0.442	0.622	0.870	0.598	0.580
PV4	0.602	0.292	0.567	0.404	0.561	0.809	0.625	0.680
SN1	0.697	0.318	0.607	0.410	0.693	0.582	0.844	0.615
SN2	0.625	0.399	0.589	0.355	0.637	0.589	0.824	0.572
SN3	0.641	0.331	0.617	0.378	0.606	0.564	0.834	0.547
SN4	0.484	0.299	0.715	0.417	0.559	0.537	0.782	0.411
SV1	0.586	0.278	0.615	0.441	0.559	0.624	0.582	0.845
SV2	0.631	0.303	0.586	0.340	0.621	0.692	0.576	0.860
SV3	0.403	0.335	0.340	0.323	0.381	0.412	0.421	0.673
SV4	0.530	0.372	0.382	0.271	0.458	0.456	0.398	0.710

During the process of hypothesis testing, the original sample of a route is used to assess its strength. A p-value less than 0.001 is considered significant [21, 27]. The structural model's path coefficients, t-values, and p-values are displayed in Table 3. Out of the seven hypotheses, six (H1, H2, H3, H5, H6, and H7) were supported, but H4 did not have empirical evidence. The results demonstrate a significant and beneficial impact of Consumer Intention (CI) on the actual use (AU) of the metaverse in the field of education ($\beta = 0.382$, $p < 0.001$). Furthermore, Perceived Behavioral Control (PBC) ($\beta = 0.308$, $p < 0.001$),Subjective Norm (SN) ($\beta = 0.299$, $p < 0.001$), and Perceived Value (PV) ($\beta = 0.236$, $p < 0.001$) had a strong positive influence on Consumer Intention (CI). In addition, Emotional Value (EV) ($\beta = 0.234$, $p < 0.001$), and Social Value (SV) ($\beta = 0.619$, $p < 0.001$) had a substantial impact on Perceived Value (PV) when using the metaverse for educational purposes. Nevertheless, as the p-values of H4 were above 0.001, the connection between Attitude towards conduct (ATB) and Consumer Intention (CI) was

Edelweiss Applied Science and Technology
ISSN: 2576-8484
Vol. 8, No. 2: 73-83, 2024
DOI: 10.55214/25768484.v8i2.693

considered statistically insignificant. This implies that the attitude towards conduct does not have a substantial influence on the intention to use the metaverse in education.

Table 3.
Hypotheses testing.

PLS path	Original sample (O)	Standard deviation (STDEV)	T statistics (|O/STDEV|)	P values	Remark
ATB -> CI	0.109	0.068	1.613	0.107	Unsupported
CI -> AU	0.382	0.054	7.059	0.000	Supported
EV -> PV	0.234	0.055	4.257	0.000	Supported
PBC -> CI	0.308	0.080	3.838	0.000	Supported
PV -> CI	0.236	0.063	3.732	0.000	Supported
SN -> CI	0.299	0.085	3.515	0.000	Supported
SV -> PV	0.619	0.052	11.863	0.000	Supported

4. Discussion

Prior research on user satisfaction and loyalty [12, 31] supports the conclusion that emotional value significantly influences perceived value when the metaverse is used in education. Due to the immersive and participatory nature of educational metaverses, users who experience positive emotions such as pleasure, amusement, curiosity, and excitement are more likely to view their use as valuable. Notably, well-known metaverse applications in education, such as VRChat, Minecraft Education Edition, Roblox Education, and Second Life Education, increase emotional value by offering virtual classrooms, labs, museums, and other enriching educational environments. In addition, social value (SV) moderately affects perceived value (PV) in metaverse education, consistent with previous research on social presence and engagement [32]. The interconnectedness of social presence and education in the metaverse promotes collaborative learning in a 3D digital environment by incorporating features such as realistic feedback, avatars, and gestures. Consequently, individuals view metaverse education as relevant and meaningful for their educational needs, resulting in enhanced social standing, image, and connections [33].

In accordance with prior research on online learning adoption [22] perceived value (PV) has a substantial influence on consumer intention (CI) to use the metaverse in education. When users perceive greater benefits and fewer costs associated with the use of metaverse technology, they are more likely to adopt it, resulting in greater acceptance and satisfaction with the technology.

Contrary to TPB, consumers' attitudes toward behavior (ATB) have little impact on their intention to use the metaverse in education [34]. This deviation from traditional technology adoption is attributable to the novelty of the metaverse, where individuals appear to possess a similar level of consciousness regardless of their initial attitudes.

Consistent with research on e-learning, online shopping, and social media, subjective norm (SN) positively affects consumer intention (CI) to utilize the metaverse in education [35]. Increased social pressure and influence increase the likelihood of educational metaverse adoption. Similar to its effect on e-learning adoption, perceived behavioral control (PBC) positively influences consumer intention (CI) to use the metaverse in education. The confidence and competence of users in using the metaverse for educational purposes increases their propensity to do so [36].

Consumer intention (CI) accurately forecasts metaverse education usage (AU), corroborating previous research on technology adoption and acceptance [23]. The adoption and utilization of the metaverse in education are driven by consumer intent, resulting in enhanced learning experiences and outcomes. Encouragement of targeted marketing and planning can facilitate the adoption of the metaverse in educational institutions and regions with low technological penetration [2]. In the end, consumer intent is the driving force behind the incorporation of the metaverse into educational practices.

Edelweiss Applied Science and Technology
ISSN: 2576-8484
Vol. 8, No. 2: 73-83, 2024
DOI: 10.55214/25768484.v8i2.693

5. Conclusion and Recommendation

In the digital age, metaverse education is an emerging and promising approach that presents new opportunities and challenges for students and teachers. It involves the educational use of immersive and interactive virtual environments. Using the Theory of Planned Behavior (TPB) as a theoretical framework, this study seeks to investigate the factors that influence the actual adoption of metaverse education in Ho Chi Minh City. This study gives useful real-world evidence from a developing country where metaverse education is still a new idea with a lot of potential and challenges [3, 5]. It does this by looking at how users' attitudes, beliefs, and ability to control their behavior affect their plans to use it and whether they actually do.

The findings of this study are anticipated to contribute to the existing literature on metaverse education and provide insights applicable to educators, policymakers, and developers interested in promoting and implementing this strategy in Ho Chi Minh City and beyond. Understanding the key factors that influence users' adoption or resistance to metaverse education will allow stakeholders to develop strategies to reinforce positive perceptions, attitudes, norms, and control factors. In addition, the research will facilitate the evaluation of metaverse education's effect on learning outcomes and user satisfaction, thereby contributing to the enhancement of design and delivery methods. The study's ultimate objective is to contribute to the successful incorporation of metaverse education into the educational landscape, thereby enhancing the quality and efficacy of learning experiences in the digital age.

Funding:

This study received no specific financial support.

Institutional Review Board Statement:

The Ethical Committee of the Ho Chi Minh City University of Foreign Languages-Information Technology, HUFLIT, Vietnam has granted approval for this study on 9 May 2023 (Ref. No. QTKD-2024-13-No 12).

Transparency:

The authors confirm that the manuscript is an honest, accurate, and transparent account of the study; that no vital features of the study have been omitted; and that any discrepancies from the study as planned have been explained. This study followed all ethical practices during writing.

Competing Interests:

The authors declare that they have no competing interests.

Authors' Contributions:

All authors contributed equally to the conception and design of the study. All authors have read and agreed to the published version of the manuscript.

References

[1] M. Mehta, G. Pancholi, and D. A. Saxena, "Metaverse changing realm of the business world: A bibliometric snapshot," *Journal of Management Development*, vol. 42, no. 5, pp. 373-387, 2023. https://doi.org/10.1108/jmd-01-2023-0006

[2] Y. K. Dwivedi *et al.*, "Metaverse marketing: How the metaverse will shape the future of consumer research and practice," *Psychology & Marketing*, vol. 40, no. 4, pp. 750-776, 2023. https://doi.org/10.1002/mar.21767

[3] J. Díaz, C. Saldaña, and C. Avila, "Virtual world as a resource for hybrid education," *International Journal of Emerging Technologies in Learning*, vol. 15, no. 15, pp. 94-109, 2020. https://doi.org/10.3991/ijet.v15i15.13025

[4] A. K. Upadhyay and K. Khandelwal, "Metaverse: The future of immersive training," *Strategic HR Review*, vol. 21, no. 3, pp. 83-86, 2022. https://doi.org/10.1108/shr-02-2022-0009

[5] Y. K. Dwivedi *et al.*, "Metaverse beyond the hype: Multidisciplinary perspectives on emerging challenges, opportunities, and agenda for research, practice and policy," *International Journal of Information Management*, vol. 66, p. 102542, 2022. https://doi.org/10.1016/j.ijinfomgt.2022.102542

[6] I. Ajzen, "The theory of planned behavior," *Organizational Behavior and Human Decision Processes*, vol. 50, no. 2, pp. 179-211, 1991.

[7] N. A. Jamil and N. K. N. Mat, "To investigate the drivers of online purchasing behaviour in Malaysia based on theory of planned behaviour (TPB): A structural equation modeling (SEM) approach," in *In International Conference on Management (ICM 2011) Proceeding Conference Master Resources*, 2011, pp. 453–460.

[8] A. Giovanis, I. Rizomyliotis, K. Konstantoulaki, and S. Magrizos, "Mining the hidden seam of proximity m-payment adoption: A hybrid PLS-artificial neural network analytical approach," *European Management Journal*, vol. 40, no. 4, pp. 618-631, 2022. https://doi.org/10.1016/j.emj.2021.09.007

[9] M. A. Fauzi, C. N. L. Tan, R. Thurasamy, and A. O. Ojo, "Evaluating academics' knowledge sharing intentions in Malaysian public universities," *Malaysian Journal of Library & Information Science*, vol. 24, no. 1, pp. 123-143, 2019. https://doi.org/10.22452/mjlis.vol24no1.7

[10] Q. Yang, C. Pang, L. Liu, D. C. Yen, and J. M. Tarn, "Exploring consumer perceived risk and trust for online payments: An empirical study in China's younger generation," *Computers in Human Behavior*, vol. 50, pp. 9-24, 2015. https://doi.org/10.1016/j.chb.2015.03.058

[11] T.-Q. Dang, P.-T. Tran, and L.-T. Nguyen, "Are you ready for tapping into the metaverse in higher education? Integrated by dual PLS-SEM and ANN approach BT - current and future trends on intelligent technology adoption: M. A. Al-Sharafi, M. Al-Emran, G. W.-H. Tan, and K.-B. Ooi, Eds," vol. 1. Cham: Springer Nature Switzerland. https://doi.org/10.1007/978-3-031-48397-4_4, 2023, pp. 63–84.

[12] E. Baek, H. J. Choo, X. Wei, and S.-Y. Yoon, "Understanding the virtual tours of retail stores: How can store brand experience promote visit intentions?," *International Journal of Retail & Distribution Management*, vol. 48, no. 7, pp. 649-666, 2020. https://doi.org/10.1108/ijrdm-09-2019-0294

[13] L. Zhang, Z. Shao, J. Zhang, and X. Li, "The situational nature of impulse buying on mobile platforms: A cross-temporal investigation," *Electronic Commerce Research and Applications*, vol. 56, p. 101204, 2022. https://doi.org/10.1016/j.elerap.2022.101204

[14] J. Frempong, J. Chai, E. M. Ampaw, D. O. Amofah, and K. W. Ansong, "The relationship among customer operant resources, online value co-creation and electronic-word-of-mouth in solid waste management marketing," *Journal of Cleaner Production*, vol. 248, p. 119228, 2020. https://doi.org/10.1016/j.jclepro.2019.119228

[15] V. A. Zeithaml, "Consumer perceptions of price, quality, and value: A means-end model and synthesis of evidence," *Journal of Marketing*, vol. 52, no. 3, pp. 2-22, 1988.

[16] L.-T. Nguyen, Y. K. Dwivedi, G. W.-H. Tan, E. C.-X. Aw, P.-S. Lo, and K.-B. Ooi, "Unlocking pathways to mobile payment satisfaction and commitment," *Journal of Computer Information Systems*, vol. 63, no. 4, pp. 998-1015, 2023. https://doi.org/10.1080/08874417.2022.2119444

[17] D. D. T. Viet, L. N. Thanh, and A. N. D. Hoai, "Extending UTAUT2 in mobile money adoption and actual use behavior: An empirical research in Vietnam during the Covid-19," *Industrielle Beziehungen. Zeitschrift für Arbeit, Organisation und Management*, vol. 10, no. 4, 2021. https://doi.org/10.53384/inbe.101390943.2779.1862003510

[18] T.-Q. Dang, G. W.-H. Tan, E. C.-X. Aw, K.-B. Ooi, B. Metri, and Y. K. Dwivedi, "How to generate loyalty in mobile payment services? An integrative dual SEM-ANN analysis," *International Journal of Bank Marketing*, 2023. https://doi.org/10.1108/ijbm-05-2022-0202

[19] B. H. T. Nguyen, T. H. Le, T. Q. Dang, and L. T. Nguyen, "What role does AI chatbot perform in the F&B industry? Perspective from loyalty and value co-creation: Integrated PLS-SEM and ANN techniques," *Journal of Law and Sustainable Development*, vol. 11, no. 4, pp. e794-e794, 2023. https://doi.org/10.55908/sdgs.v11i4.794

[20] L.-T. Nguyen, D. T. V. Duc, T.-Q. Dang, and D. P. Nguyen, "Metaverse banking service: Are we ready to adopt? a deep learning-based dual-stage sem-ann analysis," *Hum Behav Emerg Technol*, vol. 2023, p. 6617371, 2023. https://doi.org/10.1155/2023/6617371

[21] L.-T. Nguyen, T.-T. C. Phan, D.-V. T. Dang, and T.-T. T. Tran, "Mobile payment adoption in Vietnam: A two-staged SEM-ANN approach BT - current and future trends on intelligent technology adoption: Volume 1," M. A. Al-Sharafi, M. Al-Emran, G. W.-H. Tan, and K.-B. Ooi, Eds." Cham: Springer Nature Switzerland, 2023, pp. 209–228.

[22] T.-H. Chu and Y.-Y. Chen, "With good we become good: Understanding e-learning adoption by theory of planned behavior and group influences," *Comput Educ*, vol. 92-93, pp. 37–52, 2016. https://doi.org/10.1016/j.compedu.2015.09.013

[23] J. Baker, A. Parasuraman, D. Grewal, and G. B. Voss, "The influence of multiple store environment cues on perceived merchandise value and patronage intentions," *Journal of Marketing*, vol. 66, no. 2, pp. 120-141, 2002. https://doi.org/10.1509/jmkg.66.2.120.18470

[24] J. Cheon, S. Lee, S. M. Crooks, and J. Song, "An investigation of mobile learning readiness in higher education based on the theory of planned behavior," *Computers & Education*, vol. 59, no. 3, pp. 1054–1064, 2012. https://doi.org/10.1016/j.compedu.2012.04.015

[25] Ngoc Lan, "Sound prospects for metaverse in Vietnam," VnEconomy," Retrieved: https://vneconomy.vn/sound-prospects-for-metaverse-in-vietnam.htm [Accessed 6-4-2023], 2022.

[26] H.-B. Nguyen and L.-T. Nguyen, "Factors influence blockchain adoption in supply chain management among companies based in Ho Chi Minh city," presented at the In Conference Towards ASEAN Chairmanship 2023 (TAC 23 2021), 2021.

[27] L.-T. Nguyen, D.-T. Nguyen, K. N.-N. Ngoc, and D. T. V. Duc, "Blockchain adoption in logistics companies in Ho Chi Minh city, Vietnam," *Cogent Business & Management*, vol. 10, no. 2, p. 2216436, 2023. https://doi.org/10.1080/23311975.2023.2216436

[28] E. C.-X. Aw, G. W.-H. Tan, K.-B. Ooi, and N. Hajli, "Tap here to power up! mobile augmented reality for consumer empowerment," *Internet Research*, 2023. https://doi.org/10.1108/intr-07-2021-0477

[29] J. Hair, C. L. Hollingsworth, A. B. Randolph, and A. Y. L. Chong, "An updated and expanded assessment of PLS-SEM in information systems research," *Industrial Management & Data Systems*, vol. 117, no. 3, pp. 442-458, 2017. https://doi.org/10.1108/imds-04-2016-0130

[30] T. Q. Dang, L.-T. Nguyen, and T. N. T. Thuy, "The capability of E-reviews in online shopping integration of the PLS-SEM and ANN method," *International Journal of Professional Business Review*, vol. 8, no. 7, pp. 1–29, 2023. https://doi.org/10.26668/businessreview/2023.v8i7.2638

[31] Q. Zhang, S. K. Ariffin, C. Richardson, and Y. Wang, "Influencing factors of customer loyalty in mobile payment: A consumption value perspective and the role of alternative attractiveness," *Journal of Retailing and Consumer Services*, vol. 73, p. 103302, 2023. https://doi.org/10.1016/j.jretconser.2023.103302

[32] T. Oliveira, M. Thomas, G. Baptista, and F. Campos, "Mobile payment: Understanding the determinants of customer adoption and intention to recommend the technology," *Computers in Human Behavior*, vol. 61, pp. 404-414, 2016. https://doi.org/10.1016/j.chb.2016.03.030

[33] O. Hajjami and S. Park, "Using the metaverse in training: Lessons from real cases," *European Journal of Training and Development*, 2023. https://doi.org/10.1108/ejtd-12-2022-0144

[34] B. Luceri, T. T. Bijmolt, S. Bellini, and S. Aiolfi, "What drives consumers to shop on mobile devices? Insights from a meta-analysis," *Journal of Retailing*, vol. 98, no. 1, pp. 178-196, 2022. https://doi.org/10.1016/j.jretai.2022.02.002

[35] G. Wang, G. W.-H. Tan, Y. Yuan, K.-B. Ooi, and Y. K. Dwivedi, "Revisiting TAM2 in behavioral targeting advertising: A deep learning-based dual-stage SEM-ANN analysis," *Technological Forecasting and Social Change*, vol. 175, p. 121345, 2022. https://doi.org/10.1016/j.techfore.2021.121345

[36] I. A. Akour, R. S. Al-Maroof, R. Alfaisal, and S. A. Salloum, "A conceptual framework for determining metaverse adoption in higher institutions of gulf area: An empirical study using hybrid SEM-ANN approach," *Computers and Education: Artificial Intelligence*, vol. 3, p. 100052, 2022. https://doi.org/10.1016/j.caeai.2022.100052