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Training *with, about, for* Metaverse: A Mixed Methods Research on Training Pre-Service Teachers as Metaverse-Certified Practitioners

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Abstract

This mixed-method research aims to examine transformative affordances of the metaverse for pre-service teachers and investigate support mechanisms for technology-enhanced teacher training. Specifically, 40 pre-service teachers were involved in training *with, about, for* metaverse (TM) to convert high-stakes TOEIC test items into virtual content. Upon completion of the TM, participants were eligible to apply for nationally accredited private metaverse certificates to mark them as certified practitioners. To capture their multifaceted TM experience, this research employed surveys based on UTAUT (Unified Theory of Acceptance and Use of Technology) 2 constructs, as well as reflective journals and advanced analytics. The collected data were analyzed using quantitative techniques (*t*-tests, multiple regression analysis, and structural equation modeling) and qualitative methods (sentiment and content analysis) to offer a more comprehensive understanding of the technological training for pre-service teachers. The findings revealed that the overall reception of the TM experience among pre-service teachers was highly positive. Notable improvements were observed in facilitating conditions, effort expectancy, and hedonic motivation. Text-mining results also revealed how the TM framework transformed pre-service teachers' perspectives on teaching, testing, and learning. Based on the findings, the study contributes to the ongoing dialogue on effective technology integration in education.

Keywords: metaverse-certificate, pre-service teachers, UTAUT 2, technology-enhanced teacher training, TOEIC
Applicable levels: secondary, tertiary

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I. INTRODUCTION

As digital technology has evolved and made significant advancements, technology-enhanced education has generated sustained interest among researchers and teachers (Dunn & Kennedy, 2019; Lee & Hwang, 2022; Schneckenberg, 2009). To date, numerous studies have explored the use of Information and Communication Technology (ICT) that provides access to a vast range of educational resources and enables collaboration and communication among students and between students and teachers (Lim et al., 2015; Talebian et al., 2014). Artificial intelligence (AI) has become a potent educational tool by facilitating human-computer interaction as it offers customized and personalized learning experiences (Hew et al., 2022; Jeon, 2022). Advancements in augmented reality (AR) and virtual reality (VR) technologies have provided interactive and immersive learning experiences and enhanced the degree of learning achievement (Bhatt & Wood, 2020; De Back et al., 2023). Additionally, there has been a recent resurgence of interest in the use of the metaverse (Z. Chen, 2022; Hwang & Chein, 2022; Jeon et al., 2022). In this circumstance, it is important to introduce various technologies to pre-service teachers and educate them about how to utilize these technologies for future language teaching situations (Campbell et al., 2022; Tondeur et al., 2016).

In line with the era of educational transformation, this study aims to explore the integration of the metaverse that refers to technological hybridizations that combine multiple elements of emerging technologies such as AI, VR, AR, ICT and others (Hwang, 2023). To date, scholars and educators have identified numerous advantages tied to the adoption of the metaverse in education, such as cultivating digital identity (Park & Kim, 2022), fostering learning agency and affordances (Jeon et al., 2022), enhancing immersive learning experiences (Hwang et al., 2023), and promoting situated and experiential learning (Li & Yu, 2023). While previous studies have investigated the educational effects of metaverse technologies on students' learning affordances and motivation (Huang et al., 2019; Hwang, 2023), only a few studies (e.g., Jeon et al., 2022; Lee & Hwang, 2022) have focused on integrating these technologies for professional teacher development. To address this gap, this study aims to explore the integration of metaverse technology into pre-service teacher preparation and practice. It specifically examines how pre-service EFL (English as a Foreign Language) teachers can enhance their professional development through metaverse-based teaching training and to be metaverse-certified practitioners. The significance of this research lies not only in providing detailed descriptions of training *with, about, for* metaverse to inform the practical realm of teacher education but also in its ability to extend the UTAUT model by leveraging both quantitative and qualitative approaches, thereby offering a more comprehensive understanding of the contexts in which pre-service teachers undergo technological training. This holistic approach would offer a deeper understanding of the contexts in which pre-service teachers engage in technological training, addressing an essential aspect of teacher education.

II. THEORETICAL BACKGROUND

1. Training *with, about, for* Metaverse

The term "metaverse," which combines the words "meta" (beyond) and "universe," describes a virtually improved world where people gather using avatars for sociocultural interaction (Hwang, 2023). Although the metaverse differs from earlier iterations of virtual environments (VE), virtual worlds (VW), and multi-user virtual environments (MUVE) in terms of user freedom, persistent connection to real-life, and decentralized functions (Hwang & Chein, 2022; Zhang et al., 2022), this study considers MUVE and the metaverse as the same entity for teaching training purposes.

Numerous studies have highlighted the educational benefits that the metaverse offers to both teachers and students. For teachers, the metaverse enables flexible customization of virtual learning spaces tailored to specific learning goals, providing immersive experiences (Hwang et al., 2023). Pre-service teachers can leverage this feature to create immersive learning environments for educational purposes, facilitating varied forms of active learning activities (Jeon et al., 2022; Lee & Hwang, 2022). In addition, the metaverse provides students with 3D learning experiences beyond the limitations of traditional 2D learning tools (Wu et al., 2023). By offering a 3D spatial design and visualization, students can interact directly with learning materials, using features like zooming in and out rotating 3D objects (Mystakidis, 2022). In this way, students in the metaverse move beyond passive information consumption, actively participating in constructing experiential knowledge within this virtual environment (Deutschmann & Panichi, 2009).

While the metaverse is recognized for its significant contributions to education, the successful integration of metaverse technology in the classroom relies not only on the capability of teachers but also on their willingness to incorporate such technology into their teaching practices (Campbell et al., 2022; Nami, 2022). In other words, the disposition and preparedness of teachers to embrace these tools could serve as crucial factors in driving transformative education. Therefore, it is essential to provide relevant training courses for managing virtual classrooms, designing instructional materials, and facilitating interactive learning activities in the metaverse. As effective training and preparation have the potential to shape teachers' attitudes (Tondeur et al., 2016), it is critical to equip pre-service teachers with the ability to leverage the pedagogical benefits of the metaverse while also addressing implementation challenges.

This study refers to the use of the metaverse for teacher training which can be structured into three distinct categories: 1) Training *with* metaverse, 2) Training *about* metaverse, and 3) Training *for* metaverse (see Figure 1).

FIGURE 1

Training *with, about, for* Metaverse (TM)

First, training *with* metaverse entails using the metaverse as a tool to support learning processes. For example, C. Chen (2022) found that a VE simulation offered pre-service teachers' opportunities for low-stakes practice in managing classrooms and addressing challenging student behaviors within virtual teaching scenarios. The findings indicated that metaverse training enhances pre-service teachers' comprehension of concepts or subject matter that benefit from procedural knowledge or experiential learning, such as classroom dynamics management, handling student behaviors, and providing feedback. Second, training *about* metaverse focuses on acquiring knowledge about the metaverse and its educational implications. For instance, Cowie and Alizadeh's (2022) study sheds light on pre-service teachers' learning experiences with different types of VE software, encompassing technical aspects, applications, ethical considerations, and potential limitations of using virtual environments in classroom settings. Such training *about* metaverse would enable pre-service teachers to make informed pedagogical decisions about how, what, and when to incorporate VE into their teaching praxis. Last, training *for* metaverse is a goal-oriented process, which involves understanding how to leverage the metaverse to create and customize virtual content that can be seamlessly integrated into pre-service teachers' forthcoming pedagogical practices (Jeon et al., 2022; Lee & Hwang, 2022). In this process, the metaverse serves as a purpose in itself, rather than just a means, for educational practices. While several studies mentioned above can be respectively classified within the realm of TM, none have yet comprehensively explored all three distinct training processes designed for instructional training objectives.

2. The UTAUT Constructs and Teacher Training

In the realm of teacher training, the UTAUT model is pivotal to guide the development of technology training modules by pinpointing areas needing support for pre-service teachers' technological preparedness (Tiba & Condy, 2021; Wah & Hashim, 2021). In the UTAUT model, Venkatesh et al. (2003) identified four key constructs influencing an individual's use of technology. These four constructs, reconceptualized to align with this research, are as follows: 1) Performance expectancy (PE), wherein pre-service teachers' perception that a specific technology will enhance their educational practices leads to a higher likelihood of implementation; 2) Effort expectancy (EE), indicating that if pre-service teachers find a technology user-friendly, they are more likely to embrace it; 3) Social influence (SI), where the likelihood of technology adoption increases if pre-service teachers perceive endorsement from influential individuals such as colleagues, peers, or school administrators; 4) Facilitating conditions (FC), whereby the availability of resources and support significantly influences pre-service teachers' readiness to utilize technology. In addition to these four constructs, this research introduces a fifth construct, Hedonic motivation (HM), from the extended UTAUT 2 model (Venkatesh et al., 2012). Hedonic motivation emphasizes the pleasure and enjoyment derived from using technology, and this factor has been proven to significantly impact teachers' intention to integrate technology (Omar et al., 2019; Wu et al., 2021). Since the current study focuses specifically on pre-service teachers' technological training, the other two constructs of the UTAUT 2 model, price (cost for using technology) and habit (prior experience of using technology), were considered less relevant. Therefore, this research was conducted with the five constructs.

Empirical studies have demonstrated that these five constructs significantly predict teachers' intention to use technology in the classroom: PE predicts teachers' intention toward mobile device use in class (Adov et al., 2020); EE influences secondary school teachers' intentions to use mobile technology (Chao, 2019); SI affects teachers' intention to use technology in the class (Kim & Lee, 2020); FC, such as technology infrastructure, could either promote or hinder technology adoption (Wong et al., 2020); and HM, the joy and pleasure derived from using technology, is expected to positively affect teachers' intention to adopt technology for their pedagogical practices (Omar et al., 2019). While most existing UTAUT research is rooted in extensive quantitative analysis, utilizing structural equation models (Adov et al., 2020; Omar et al., 2019; Wu et al., 2021), multiple linear regression analysis (e.g., Ainley & Armatas, 2006; Syam & Kusuma, 2023; Tosuntaş et al., 2015), and *t*-tests (e.g., Bults et al., 2022; Mitchell et al., 2022; Syam & Kusuma, 2023), specific contexts like pre-service teachers' technological training require a more nuanced and targeted investigation. Moreover, emotional and experiential aspects have often been overlooked in prevailing UTAUT literature (Chao, 2019; Lee et al., 2016). There is a need for a qualitative approach to fully explore and interpret the UTAUT constructs (Tiba & Condy, 2021; Wah & Hashim, 2021).

This mixed-methods research aims to bridge this gap by leveraging both quantitative methods (*t*-tests, multiple regression analysis, structural equation model) and qualitative approaches (sentiment analysis and content analysis guided by the UTAUT constructs) to provide a more holistic insight into the contexts of pre-service teachers' technological training. The significance of this research lies not only in its ability to extend the UTAUT model in guiding the development of technology training modules but also in providing detailed descriptions of training *with, about, for* metaverse procedures to inform the practical realm of teacher education. Through this research, the following research questions are addressed:

1) What are pre-service teachers' overall emotional perceptions towards the TM experience indicated by sentiment analysis?
2) To what extent do the UTAUT 2 constructs explain the variance in outcomes from the pre-TM and post-TM?
3) What are the key themes present in the experiences of pre-service teachers with TM, indicated by content analysis guided by UTAUT 2 constructs?

III. METHOD

1. Research Participants

The participants of this study consisted of 40 Korean pre-service teachers who were enrolled in the Multimedia-Assisted English Education course during the second semester of 2022. For the purpose of describing the demographics, participant gender was categorized as male (n = 12) and female (n = 28). Previous years of teaching experience were divided into five categories: none (*n* = 16), less than 6 months (*n* = 14), 6-11 months (*n* = 5), 12-23 months (*n* = 4), and 24 months and above (*n* = 1). Participant age was grouped into four categories: 19-21 (*n* = 1), 22-24 (*n* = 33), 25-27 (*n* = 5), and 28 and above (*n* = 1). The participants' career goals were classified into three categories: education-related (*n* = 29), non-education-related (*n* = 3), and indeterminate (*n* = 8). The summary of their demographic information is presented in Table 1.

TABLE 1
Demographic Information of the Study Participants

Categories	Variables	*n* (%)
Gender	Male	12 (30%)
	Female	28 (70%)
Age	19-21	1 (2.5%)
	22-24	33 (82.5%)
	25-27	5 (12.5%)
	28 and above	1 (2.5%)
Years of teaching	None	16 (40.0%)
	Below 6 months	14 (35.0%)
	6 -11 months	5 (12.5%)
	12-23 months	4 (10.0%)
	24 months and above	1 (2.5%)
Career goals	Education-related	29 (72.5%)
	Non education-related	3 (7.5%)
	Indeterminate	8 (20.0%)

2. Research Procedures

The research process involved three stages as summarized in Table 2. First, to identify the main content for TM, both internal and external analyses were conducted. Internally, a needs analysis was carried out with 442 college students at a local private university in South Korea, where the main research took place, spanning from the second semester of 2021 to the first semester of 2022. Within this cohort of 442 students, 198 (42.76%) majored in natural/science fields, 191 (43.21%) in humanities/social sciences, 23 (5.21%) in arts and physical education, and 39 (8.82%) in other fields. With an open-ended question of 'What English area is in the most need?' presented to the 442 students, 257 (58.14%) directly mentioned the high-stakes TOEIC (Test of English for International Communication). Externally, a literature review confirmed the strong learning desire for TOEIC among college students due to its decisive role in graduation, career opportunities, and job applications (Kang, 2021; Yoon, 2021). Along the line, we selected TOEIC as the main content for TM to motivate pre-service teachers, who are also college students with TOEIC graduation requirements.

TABLE 2
Research Stages and Timeline

	Timeline		Research stages
	2021-2, 2022-1		Research preparation
1	2021-2, 2022-1		Needs analysis
2	2022-1		Curriculum design
3	2022-1		Developing metaverse certificate course
			Main research
4	2022-2	Week 1-3	Developing metaverse certificate course
5	2022-2	Week 4-7	Training *about* metaverse
6	2022-2	Week 8-13	Training *for* metaverse
7	2022-2	Week 14	Metaverse fair (Sharing and giving feedback each other)
8	2022-2	Week 15	Award a metaverse certificate

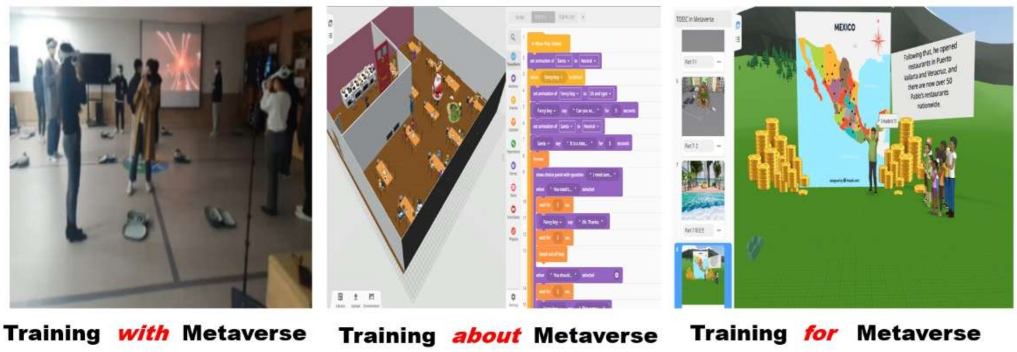
Second, once the main TM content, TOEIC, was identified, the curriculum structure was devised. This involved the sequencing of topics, the allocation of instructional time, and the selection of instructional materials for TM, including AR, VR, AI, and metaverse platforms to ensure the curriculum aligned with objectives. Third, this study established a partnership with a private association and developed a nationally accredited private certification known as the ‘Metaverse English Education Specialist Certificate,’ which was approved and registered by the Ministry of Education in Korea.

FIGURE 2
Metaverse English Education Specialist Certificate

Such endeavor intends not only to add a layer of credibility to the TM program but also to offer support for pre-service teachers in their pursuit of career opportunities. (Figure 2 illustrates the certificate’s impact on a pre-service teacher, currently teaching at a high school in 2023: 1) certification issuance on June 15, 2022, 2) certification awarding on December 28, 2022, and 3) certification utilization on a resume in February 2023.

Following the research preparation phase, the main research was conducted in the second semester of 2022. Initially, training *with* metaverse occurred during the first to third weeks of the semester. In this stage, pre-service teachers immersed themselves in a diverse array of metaverse experiences with VR headsets, operating joysticks to explore commercially available virtual contents. Such firsthand exposure aims to spark inspiration for their own virtual creations. Following their hands-on experiences, the training *about* metaverse took place from the 4th to the 7th week of the semester, where pre-service teachers were educated about the concepts, features, functions, and considerations related to using metaverse technology. In this stage, the participants received training *about* metaverse, including AR, VR, AI, Coding, among others to equip themselves with the requisite knowledge and skills to use these technologies to develop their own virtual TOEIC content. Finally, training *for* metaverse occurred from the 8th to the 13th week after the pre-service teachers had familiarized themselves with the metaverse interface and became quite well-versed with the technologies. During this phase, participants created immersive TOEIC contents with diverse technological resources for educational purposes (see Figure 3).

FIGURE 3
Training *with, about, for* Metaverse for Certified Practitioners



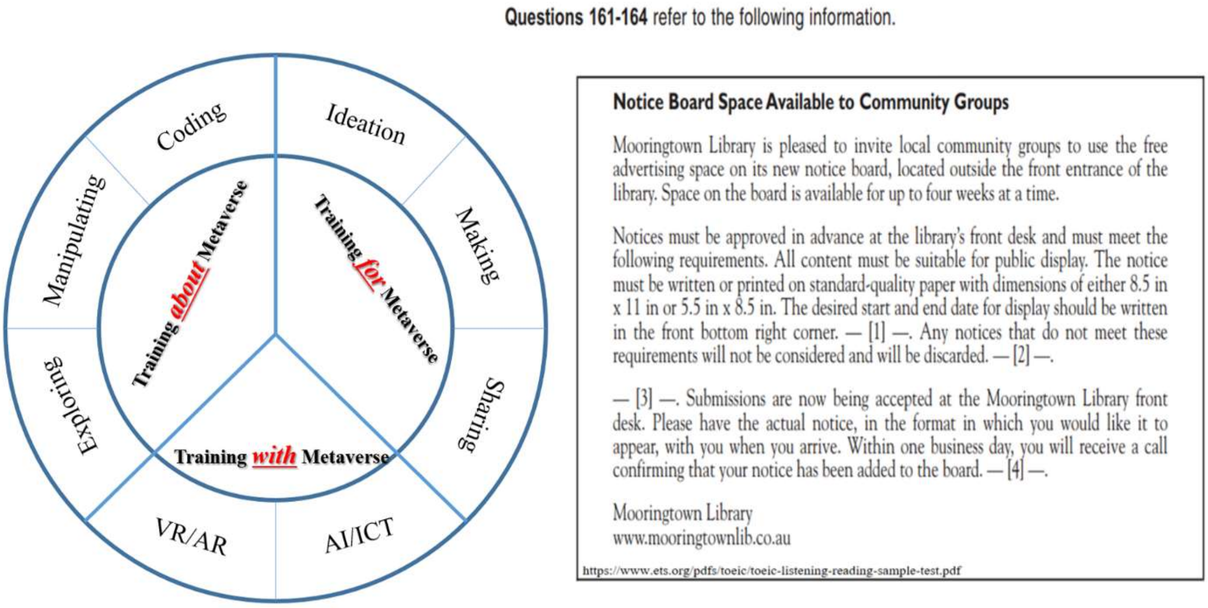
Following this, in the 14th week, a metaverse fair was held, where the participants showcased their immersive TOEIC content creations and received feedback from each other. Concluding the process in the 15th week, participants were granted the 'Metaverse English Education Specialist Certificate,' which could potentially enhance their professional credentials as metaverse practitioners.

3. TM Stages Based on TOEIC

The provided example illustrates how the TM (Training *with, about, for* metaverse) framework is implemented using a sample reading question sourced from the official TOEIC website. Pre-service teachers selected a question from the practice test items (https://www.ets.org/pdfs/toeic/toeic-listening-reading-sample-test.pdf) that they wanted to transform from textual reading passages to immersive virtual content.

FIGURE 4

Training *about, with, for* Metaverse Framework and Sample TOEIC Item



Questions 161-164 refer to the following information.

Notice Board Space Available to Community Groups

Mooringtown Library is pleased to invite local community groups to use the free advertising space on its new notice board, located outside the front entrance of the library. Space on the board is available for up to four weeks at a time.

Notices must be approved in advance at the library's front desk and must meet the following requirements. All content must be suitable for public display. The notice must be written or printed on standard-quality paper with dimensions of either 8.5 in x 11 in or 5.5 in x 8.5 in. The desired start and end date for display should be written in the front bottom right corner. — [1] —. Any notices that do not meet these requirements will not be considered and will be discarded. — [2] —.

— [3] —. Submissions are now being accepted at the Mooringtown Library front desk. Please have the actual notice, in the format in which you would like it to appear, with you when you arrive. Within one business day, you will receive a call confirming that your notice has been added to the board. — [4] —.

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https://www.ets.org/pdfs/toeic/toeic-listening-reading-sample-test.pdf

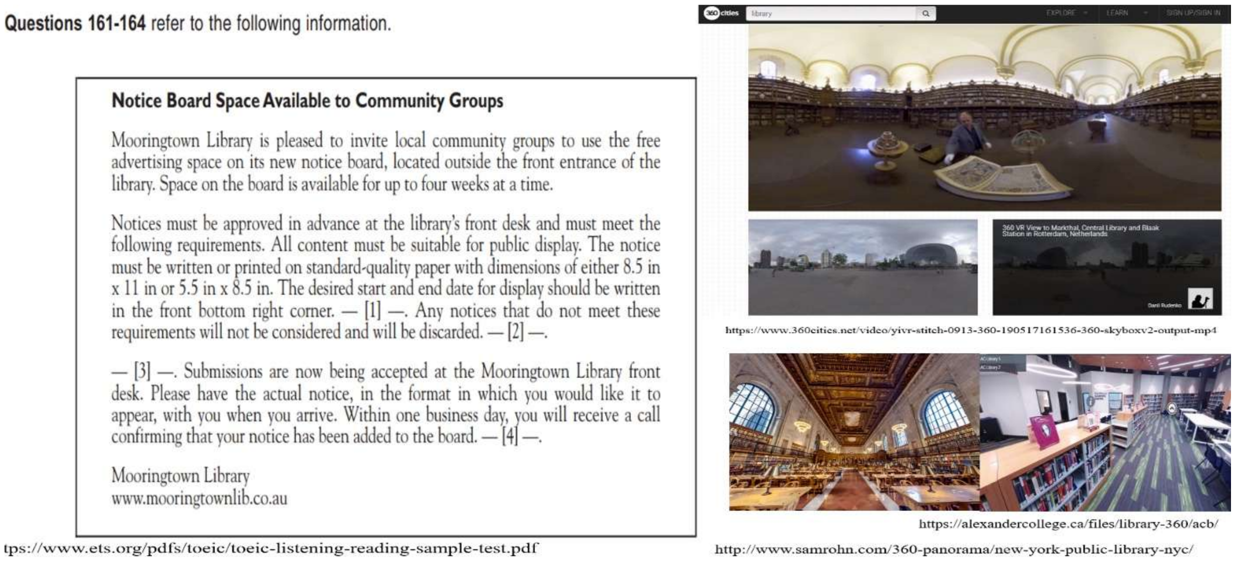
In Figure 4, the TM framework is displayed alongside the selected TOEIC sample item for virtual content creation. By using the chosen reading passage about the provision of free advertising space at Mooringtown Library for local community groups, the following sections demonstrate how the TM framework is applied.

1) Training *with* Metaverse

The initial phase of training *with* metaverse aimed to serve as a springboard to inspire the subsequent stages of virtual content creation. During this phase, the pre-service teachers engaged in virtual libraries located in English-speaking countries by leveraging existing resources like the 360-degree library, YouTube VR, and others (see Figure 5). To note that this stage was designed not merely as a cursory introduction; rather, it is aimed to highlight the limitations of such ready-made contents in meeting specific educational purposes. For instance, if pre-service teachers wanted to incorporate such existing immersive contents for teaching topics such as Mooringtown Library reading passages, they would likely find that such pre-made materials might not be aligned or appropriate for their own instructional objectives.

Thus, through engagement with virtual libraries and a recognition of the limitations of such pre-made contents, the initiative strategically paved the way for introducing CoSpaces Edu, a user-friendly personalized VR content creation tool.

FIGURE 5
Training *with* Metaverse for TOEIC Library VR Creation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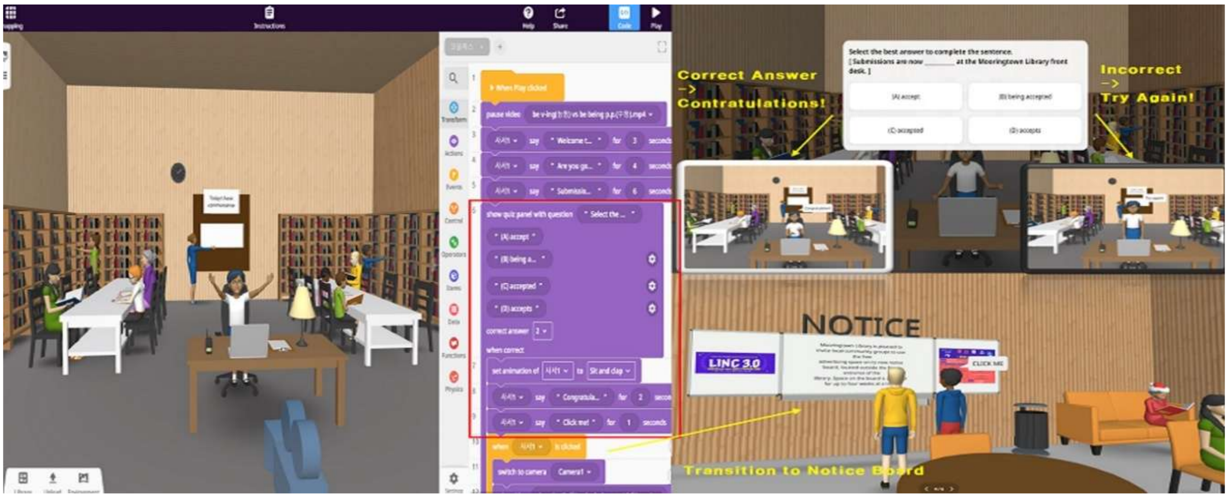
2) Training *about* Metaverse

In the training *about* metaverse stage, participants acquired the requisite knowledge and skills required to utilize emerging technologies for developing their own virtual TOEIC contents. A substantial portion of the training revolved around hands-on engagement with immersive platforms like CoSpaces Edu, which stands out for its customizable attributes according to individual needs and drag-and-drop block coding features to seamlessly embed interactive components within virtual contents, offering imaginative and creative possibilities.

FIGURE 6
Training *about* Metaverse for TOEIC Library VR Creation

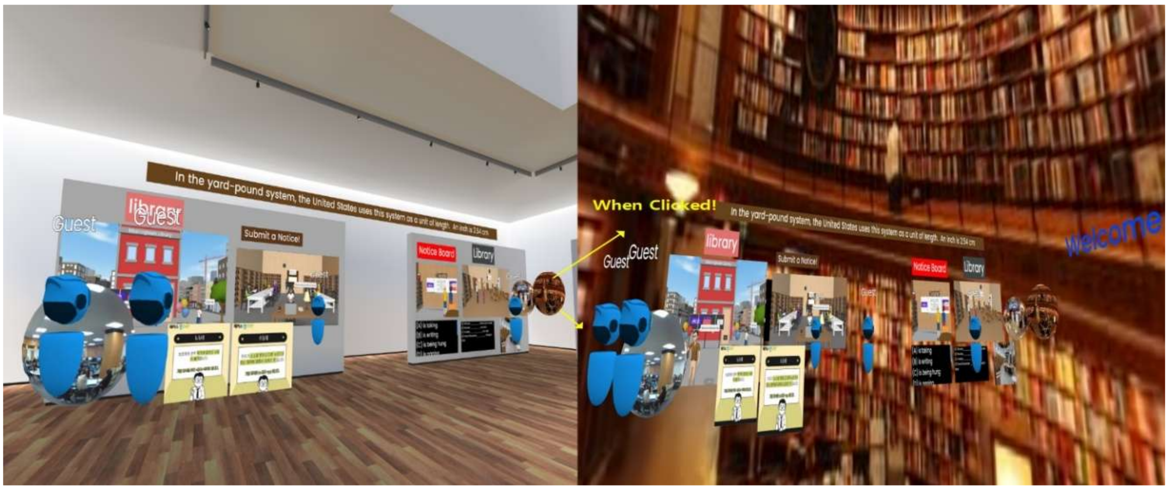


For instance, beyond simply replicating the physical environment of the library, the pre-service teachers incorporated interactive elements using block coding to enhance the educational impact. To illustrate, participants coded a quiz about the notice board regulations where users receive "congratulations" real-time message for a correct answer, and a "try again" prompt for an incorrect one (see Figure 6). By navigating and operating a range of VR creation functions, this training *with* metaverse equipped pre-service teachers with the necessary knowledge and skills to utilize these technologies to develop their own virtual TOEIC items.

2) Training *for* Metaverse

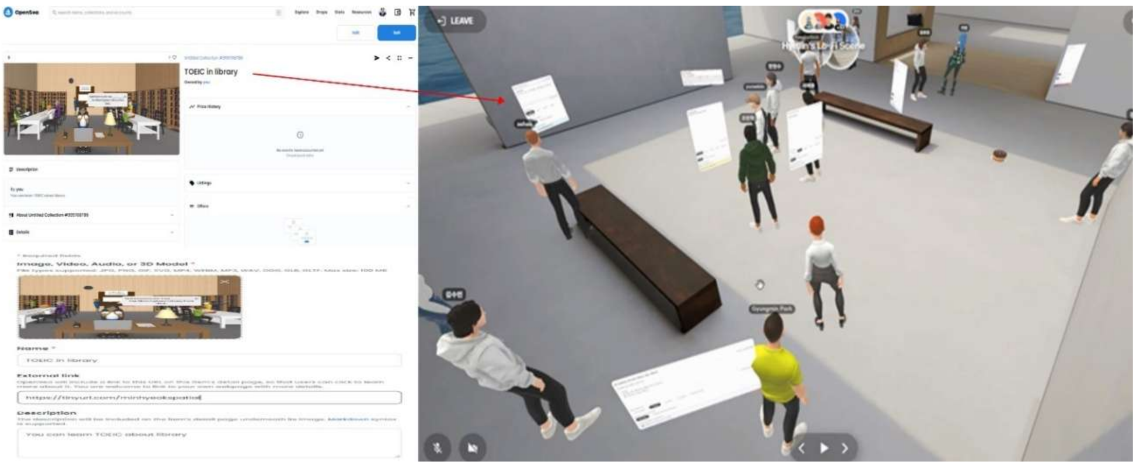
During the training *for* metaverse phase, the metaverse serves as an end in itself, transcending its role as a means. Within this stage, pre-service teachers had the opportunity to fully embrace the transformative potential of the metaverse, reshaping the way of teaching and learning. To this end, they adopted the identities of digital avatars and exhibited their VR creations on the FrameVR metaverse platform to connect, share knowledge and interact. Stepping into the FrameVR exhibition, participants can actively engage with a variety of displays. For instance, by clicking on the 360-degree library sphere, they are instantaneously transported into a three-dimensional virtual representation of the library (see Figure 7).

FIGURE 7
Training *with* Metaverse for TOEIC Library VR Creation



Such immersive experiences could offer a multi-sensory and spatial understanding of TOEIC reading passages, wherein real and virtual identities converge to enrich learning experiences with the metaverse as a focal point.

FIGURE 8
Showcasing TM Outcomes on OpenSea Registration



In the final stage of training *for* metaverse, participants took the initiative to share and register their innovative VR creations on OpenSea, a decentralized marketplace for digital crypto assets (see Figure 8). By doing so, pre-service teachers were not only showcasing their personalized creations to a broader audience, but also learning about the process of listing and trading digital assets, a fundamental aspect to become metaverse-certified practitioners. Then, participants shared their insights, self-reflection, challenges, and accomplishments from their experience in Spatial VR, a metaverse platform, along with the results of their OpenSea registration.

4. Data Collection and Analysis

This research employed a mixed-methods approach, integrating quantitative data from questionnaires with qualitative insights from contextualized narratives extracted from reflective papers. This approach allowed for a comprehensive analysis through data triangulation, enriching the study with a deeper and more nuanced understanding. The quantitative data were drawn from pre- and post-intervention questionnaires, revolved around the key constructs of the UTAUT 2 model to discern changes in these constructs (see Appendix A). The quantitative measures indicated high reliability with a Cronbach's alpha coefficient of 0.951, exceeding the 0.70 threshold for internal consistency. The survey responses were analyzed by inferential *t*-test, multiple linear regression, and the structural equation model (see Table 3). In parallel, the qualitative data encompassing reflective journals documenting pre-service teachers' perceptions of the pros, cons, and future potential of TM were analyzed through sentiment analysis via Orange3 and in-depth text mining via KH Coder. To ensure integration across the different data sources, the qualitative and quantitative findings were interpreted within the five UTAUT 2 constructs.

TABLE 3

Factor Analysis of the Survey Constructs

Constructs	Indicators	MSA Kaiser-Meyer-Olkin (KMO) test	Factor Loading (Estimate)	Z-value	95% CI	
					Lower	Upper
Perceived	PE1	0.84	0.725***	11.58	0.60	0.84
Expectancy	PE2	0.90	0.663***	10.70	0.54	0.78
(PE)	PE3	0.86	0.716***	10.51	0.58	0.84
Effort	EE1	0.84	0.858***	9.28	0.67	1.04
Expectancy	EE2	0.83	0.903***	8.86	0.70	1.10
(EE)	EE3	0.93	0.931***	9.26	0.73	1.12
Social	SI1	0.88	0.626***	8.25	0.47	0.77
Influence	SI2	0.90	0.685***	9.34	0.54	0.82
(SI)	SI3	0.93	0.641***	9.80	0.51	0.77
Facilitating	FC1	0.82	1.037***	9.60	0.82	1.24
Conditions	FC2	0.83	0.957***	9.19	0.75	1.16
(FC)	FC3	0.92	0.968***	9.63	0.77	1.16
Hedonic	HM1	0.92	0.659***	9.59	0.52	0.79
Motivation	HM2	0.85	0.732***	10.49	0.59	0.86
(HM)	HM3	0.89	0.766***	9.83	0.61	0.91

*** $p < 0.001$

To verify the reliability of each construct as well as to ascertain the associations between the constructs and their corresponding indicators, the Kaiser-Meyer-Olkin (KMO) test for sampling adequacy was utilized. The KMO values ranged from 0.826 to 0.939, indicating a high level of sampling adequacy with all factor loadings for the indicators were statistically significant, suggesting a strong association between the constructs and a robust foundation for data interpretation.

IV. RESEARCH FINDINGS

1. Emotional Responses of the TM Experience

The pre-service teachers' overall perception of the TM experience was first examined through the lens of emotions, conveyed through their reflective journals. These emotions, ranging from positive (such as happiness, joy, and excitement) to negative (like anger, fear, and sadness), can reflect not only the level of contentment derived from the TM experience but also influence their future engagement with the technology (Kim & Lennon, 2013). In this light, the emotional responses of pre-service teachers can serve as a barometer to gauge the overall effectiveness of TM in teacher training and to inform insights for future iterations (Azzaro & De Dios Martínez Agudo, 2018; Mei-jung, 2014). To capture the emotional responses of the pre-service teachers, the sentiment analysis was conducted with Vader and SentiArt in Orange 3 and as indicated in Table 4.

TABLE 4

Factor Analysis of the UTAUT 2 Survey Constructs

Classifiers		*M* ± *SD*	*Min*	*Max*
Vader	Positive	0.13 ±0.69	0.00	0.44
	Negative	0.06 ±0.94	0.00	0.22
	Neutral	0.74 ±0.26	0.00	1.01
	Compound	0.35 ±1.67	-0.99	0.99
SentiArt	Sentiment	0.66 ±0.48	-0.18	1.40
	Anger	-0.19 ±1.06	-0.77	0.36
	Fear	0.48 ±0.73	-0.70	1.14
	Disgust	0.16 ±1.60	-0.98	0.63
	Happiness	0.81 ±0.46	0.00	1.57
	Sadness	0.34 ±0.75	-0.26	1.05
	Surprise	0.60 ±0.58	-0.62	1.37
Liu-Hu	Single	4.13 ±1.76	-7.14	33.33

The analysis showed that the overall results pointed to a predominantly positive sentiment towards TM. The average compound score of Vader, which utilizes a lexicon-based approach wherein individual words are allocated scores reflecting positive, negative, neutral, and compound sentiments, registers at 0.357. This suggests that the overarching sentiment associated with the TM experience was predominantly positive. This inclination towards positivity can be substantiated by the results derived from SentiArt, which leverages machine learning algorithms to annotate sentiment scores, linking certain words and phrases within the text to their corresponding emotional states.

Among the emotional states identified in the journal entries, the preeminent ones were of a positive affective valence, with happiness ($M = .81$, $SD = .46$) being the most prominent and trailed by surprise ($M = .61$, $SD = .58$). In line with the obtained mean score of 4.14 ($SD = 1.77$) using the Liu-Hu rule-based approach, this also suggests a predominantly positive orientation towards the TM experience. Given that the successful integration of technology hinges upon positive attitudes towards it, the participants' overwhelmingly positive responses towards the TM experience suggest promising potential. Along the way, there is a need to delve deeper into identifying specific factors that shape the overall perception of TM and how these components could pave the way for insights into an improved training experience.

2. Changes Resulting From the TM Experience

1) Differences in Pre- and Post-TM of UTAUT 2 Constructs

To identify the transformative effects of TM on the participants' perceptions towards the UTAUT 2 constructs, *t*-test was conducted to compare the mean differences between the before-and-after investigation phases (see Table 5).

TABLE 5

Paired-Samples *t*-Test Analysis Results Comparing Pre- and Post-TM

Constructs	Pre-test (*M* ± *SD*)	Post-test (*M* ± *SD*)	*t*	*p*	Effect size
PE	4.21 (±0.69)	4.15 (±0.75)	0.46	0.648	0.07
EE	3.31 (±0.92)	3.73 (±0.96)	-2.18	0.035	-0.34
SI	4.07 (±0.74)	4.24 (±0.63)	-1.23	0.225	-0.19
FC	3.11 (±1.07)	4.09 (±0.75)	-5.34	<.001	-0.84
HM	3.94 (±0.78)	4.28 (±0.69)	-2.13	0.039	-0.33
IU	3.74 (±0.91)	4.15 (±0.84)	-2.10	0.042	-0.33

The results revealed that the most substantial change occurred in FC, followed by EE, and HM, with a negative effect size, suggesting that TM led to improvements in participants' perceived capability of using technology (FC), perceived ease to learn technology (EE), and increased pleasure derived from using technology (HM). In particular, there is a considerable increase in FC from the pre-test (*Mpre* = 3.11, *SD* = ±1.07) to post-test (*Mpost* = 4.09, *SD* = ± 0.75) phases, with a quite large effect ($p < .001$, *ES* = -0.84) attributed to the TM experience. This would suggest that after the TM experience, participants felt more supported and equipped to use technology and believed that technical infrastructure exists to support technology use. Along the line, HM or the pleasure and fulfillment experienced, improved significantly from the pre-test (*M* = 3.94, *SD* = ±0.78) to the post-test (*M* = 4.28, *SD* = ±0.69) with a moderate effect size ($p = 0.039$, *ES* = -0.33). HM is known as a significant construct that can drive individuals to adopt and utilize technology beyond functional purposes, where enjoyment often outweighs utilitarian factors (Moon & Kim, 2001; Venkatesh et al., 2012). Along the line, EE displayed a significant increase ($p = 0.035$), with mean scores rising from 3.31 (±0.92) to 3.73 (±0.96), implying that the pre-service teachers found it easier to use the VR-creation technology (CoSpaces Edu) after the TM intervention. In terms of the differences observed, notably, a slight decreased mean score was observed in PE, or "the degree to which an individual believes that using the system will help him/her to attain gains in job performance" (Venkatesh et al., 2003, p. 447). Although the decrease is statistically insignificant ($p = 0.648$) with a small effect size (0.07), it might suggest that either pre-service teachers' perceptions of the usefulness of VR for pedagogical practices remained relatively high throughout or there is a minor effect of the TM on PE.

2) Variances in Pre- and Post-TM Explained by UTAUT 2 Constructs

The multiple linear regression analyses were conducted for the pre- and post-TM stages to capture the specific influences of the predictors on attitudes towards utilizing the metaverse at different stages of the intervention. By analyzing the data separately for each stage, this study aimed to examine how the effects of factors may change as participants gain training experience with the metaverse technology.

TABLE 6
Multiple Linear Regression Analysis of Pre- and Post-TM

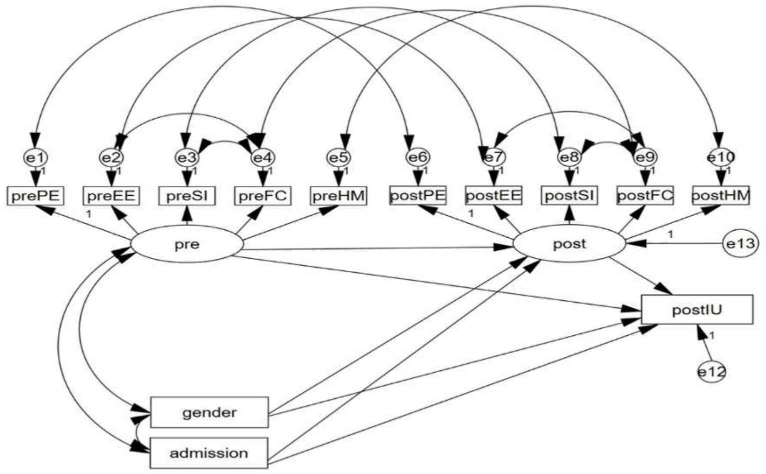
	Pre-TM					Post-TM				
	B	*SE*	*β*	*t*	*Sig.*	*B*	*SE*	*β*	*t*	*Sig.*
Intercept	-0.24	0.50		-0.47	0.637	-0.98	0.44		-2.20	0.034
PE	-0.07	0.20	-0.05	-0.35	0.726	-0.08	0.14	-0.07	-0.58	0.564
EE	0.35	0.12	0.36	2.96	0.006	0.10	0.09	0.11	1.04	0.305
SI	0.17	0.23	0.14	0.72	0.471	0.72	0.20	0.54	3.47	0.001
FC	-0.12	0.10	-0.14	-1.21	0.234	-0.25	0.17	-0.22	-1.46	0.152
HM	0.70	0.23	0.60	3.04	0.004	0.71	0.18	0.58	3.90	< .001
R^2			0.73					0.80		
Adj R^2			0.69					0.77		
F			19					28.5		
p			< .001					< .001		

As seen in Table 6, In the pre-TM stage, the model significantly predicted pre-service teachers' attitudes towards utilizing the metaverse ($R^2 = 0.73$, $p < 0.001$). Among the predictors, EE had a significant positive effect ($\beta = 0.36$, $t = 2.96$, $p = 0.006$), indicating that the participant's perception of ease of use and simplicity influenced their attitudes in the pre-TM stage. SI also had a significant positive effect ($\beta = 0.14$, $t = 0.72$, $p = 0.471$), indicating that participant perceptions of social support and influence played a role in shaping their attitudes in the pre-TM stage. However, PE, FC, and HM did not have significant effects on participant attitudes in the pre-TM stage. Participant perceptions of ease of use (EE) and support from others (SI) positively influenced their attitudes in the pre-TM stage. In the post-TM stage, the model remained significant ($R^2 = 0.80$, $p < 0.001$). HM emerged as a significant predictor ($\beta = 0.58$, $t = 3.90$, $p < 0.001$), indicating that participant enjoyment and satisfaction derived from utilizing the metaverse had a strong positive effect on their attitudes in the post-TM stage. These results suggest that the factors influencing participants' attitudes towards utilizing the metaverse differ between the pre-TM and post-TM stages, with effort expectancy and social influence being significant predictors in the pre-TM stage and hedonic motivation being the key predictor in the post-TM stage. These findings suggest that the factors influencing attitudes towards Metaverse differ between the pre-TM and post-TM stages, highlighting the changing importance of different motivational factors as the participants gain experience with the technology. These results highlight the importance of maximizing enjoyment derived from tasks and promoting positive peer influences in educational interventions to enhance outcomes in the TM framework.

3) Analyzing TM Through Structural Equation Modeling

Given that UTAUT 2 constructs are interrelated, structural equation modeling (SEM) was conducted to provide a comprehensive understanding of these interrelated factors influencing technology acceptance and use (see Figure 9).

FIGURE 9
The UTAUT 2 Constructs and TM Experience



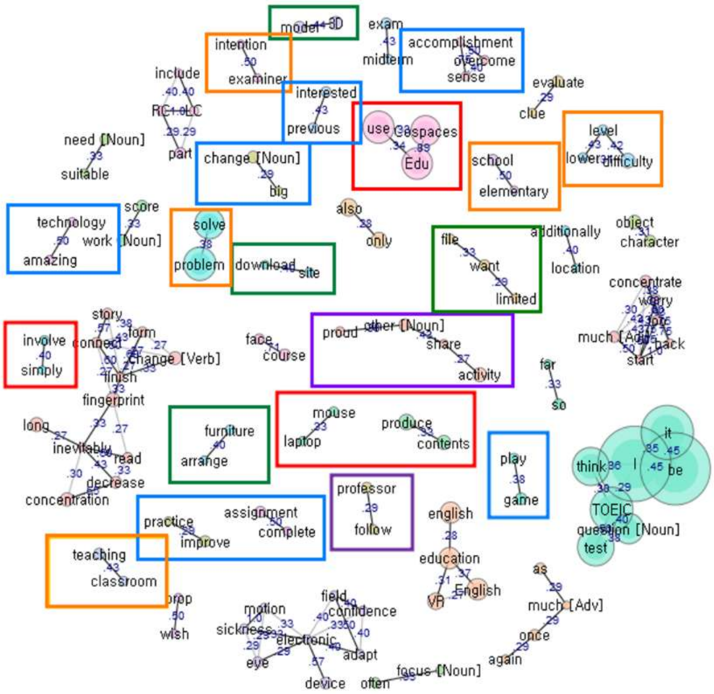
			Estimate	S.E.	C.R.	P
post	<---	pre	.333	.172	1.939	.052
post	<---	gender	-.540	.231	-2.333	.020
post	<---	admission	-.085	.206	-.415	.678
prePE	<---	pre	1.000			
preEE	<---	pre	.876	.233	3.754	***
preSI	<---	pre	1.180	.153	7.737	***
preFC	<---	pre	.963	.288	3.343	***
preHM	<---	pre	1.216	.156	7.795	***
postPE	<---	post	1.000			
postEE	<---	post	1.009	.222	4.548	***
postSI	<---	post	.885	.129	6.868	***
postFC	<---	post	.945	.163	5.781	***
postHM	<---	post	1.000	.135	7.408	***
postIU	<---	post	1.230	.174	7.079	***
postIU	<---	pre	-.191	.118	-1.617	.106
postIU	<---	gender	.002	.161	.015	.988
postIU	<---	admission	-.282	.134	-2.105	.035

Overall, the SEM analysis results support the effectiveness of TM in boosting participant intention to use (IU) of Metaverse after training. All pre-training factors (PE, EE, SI, FC, and HM) were positively related to the pre-training phase, and most were statistically significant ($p < 0.001$). In the post-training phase, previous experience (pre) had a significant positive effect (*estimate* = 0.333, $p = 0.052$) on the outcomes (post). The SEM analysis highlighted that the TM experience had a significant influence on post-training IU (Intention to Use) scores (*estimate* = 1.23, $p < 0.001$). In contrast, factors such as admission (*estimate* = -0.085, $p = 0.678$) and gender (*estimate* = -0.54, $p = 0.02$) had no significant impact on post-training outcomes. Post-training outcomes are significantly influenced by pre-training experiences (*estimate* = 0.333, $p = 0.052$). The results suggest that the TM had a considerable impact on these post-training outcomes, indicating its effectiveness in fostering favorable conditions for acceptance and usage among the participants.

3. Text-Mining of TM Under the UTAUT 2 Constructs

To probe deeper into the participants' TM experiences, a keyword co-occurrence via KH Coder is performed to unveil underlying thematic patterns within the journal entry data. By applying a Subgraph-Modularity technique using the Minimum Spanning Tree algorithm with Jaccard-based edge filtering, a set of lexemes with a coefficient exceeding the 0.25 threshold were identified. This finding sheds light on a deeper understanding of the pre-service teachers' TM experience, which might not be observable via statistical analyses.

FIGURE 10
The Co-Occurrence Network Analysis of TM Experience



UTAUT Constructs	Co-occurance Network of Words
Effort Expectation	Cospaces Edu-Use (r = 0.34) Produce-Contents (r = 0.33) Involve-Simply (r = 0.40) Mouse-Laptop (r = 0.33)
Hedonic Motivation	Technology-Amazing (r = 0.50) Play-Game (r = 0.38) Sense-Accomplishment (r =0.75) Previous-Interested (r = 0.43)
Perceived Expectancy	Lower-Difficulty Level (r = 0.43) Examiner-intention (r = 0.50) Need-Suitable (r = 0.34) Elementary-School (r =0.34)
Facilitating Conditions	3D-Model (r = 0.44) Download-Site (r = 0.40) Arrange-Furniture (r = 0.40) File Want-Limited (r = 0.29)
Social Influence	Professor-Follow (r = 0.29) Proud-Other (r = 0.31) Share-Activity (r = 0.27) Face-Course (r = 0.71)

Figure 10 illustrates a visual network representation of the propensity of key terms co-occurring within the textual data. Analyzing this occurrence network of words in tandem with the journal entry excerpts organized around the UTAUT 2 constructs enables us to explore the interplay, thereby shedding light on the intricate dynamics of the TM experience.

1) Effort Expectation: TM Reduces Entry Barriers With Technology

For the construct of Effort Expectation, the keywords such as “CoSpaces Edu-Use” (r = 0.34), “Produce-Contents” (r = 0.33), “Involve-Simply” (r = 0.40), and “Mouse-Laptop” (r = 0.33) exhibit a significant co-occurrence. This indicates that pre-service teachers perceived using CoSpaces Edu (“CoSpaces Edu-Use”) for producing virtual TOEIC contents (“Produce-Contents”) as easy and straightforward in that this user-friendly VR creation tool, CoSpaces, involves simply (“Involve-Simply”) a drag-and-drop interface that can easily be operated with a mouse and a laptop (“Mouse-Laptop”). The results align with the following journal entry data:

> P19: After experiencing the CoSpaces, I felt it was convenient and easy to use this program. Moving, resizing, and editing are very convenient and simple.
> P38: It [CoSpaces] is easy to create what you want. There was no great difficulty in entering code after learning the basics of scratch in the first grade.

These responses emphasize that despite the advanced nature of metavese technologies, user-friendly VR creation platforms like CoSpaces can notably reduce entry barriers. Especially, considering that the pre-service teachers are not specialized in computer-related fields and have relatively limited technical skills, utilizing low- or no-code software like CoSpaces Edu, as demonstrated in this study, could enhance their perceived ease of use and reduce their effort expectancy in utilizing VR creation programs. Moreover, it seems that familiarity with Scratch, a similar block-based coding language, facilitates an easy transition to using CoBlocks. This indicates that early exposure to one form of technology can be transferred and applied to another, making the process of adopting new technologies less daunting for novices.

2) Hedonic Motivation: TM Fosters Satisfaction and Accomplishment

The co-occurrence of terms under the HM category, like "Technology-Amazing" (r = 0.50), "Play-Game" (r = 0.38), "Sense-Accomplishment" (r = 0.75), and "Previous-Interested" (r = 0.43), suggests that the participants derived quite a high level of enjoyment and satisfaction from the TM experience. Notably, the high correlation with "Sense-Accomplishment" (r = 0.75) alludes to the fact that the TM experience provided a sense of accomplishment, suggesting the significance of experiential enjoyment derived from the technology. The increased hedonic motivation can also be observed in the following journal entry data:

> P38: I thought it was really amazing to see works that used various technologies and made them unique as well as what I learned.
> P7: I felt proud that I created a game that others could enjoy.
> P28: It was exciting to explore a new format for the TOEIC test, which was previously limited to pen-and-paper.
> P24: Although it took a lot of time to create content, I felt a sense of accomplishment.
> P22: I felt proud that I could generate more diverse ideas and apply them to CoSpaces Edu.

The analysis of textual data showed clear evidence of HM, reflecting pleasure and enjoyment derived from the technology use, which aligns with abovementioned sentimental analysis results (Happiness, M = .81, SD = .46). The participants appreciated the sense of achievement from mastering various technologies, expressed enthusiasm about transforming pen-and-paper testing to a new format for the TOEIC test, and felt a sense of pride and fulfillment in generating diverse ideas and applying them to create virtual contents. These findings collectively emphasize the positive aspects of the participants' engagement with TM, highlighting its potential to enhance educational practices.

3) Perceived Expectancy: TM Transforms Pedagogical Perspectives

The PE construct aimed to assess participant beliefs about the effectiveness of metaverse in pedagogical practice. The terms such as "Lower-Difficulty Level" (r = 0.43), "Examiner-Intention" (r = 0.50), "Need-Suitable" (r = 0.34), and "Elementary-School" (r = 0.34) indicate that the TM experience alters the pre-service teachers" perceived expectancy about their role as well as the nature of teaching, testing, and learning. This aligns with the following reflections derived from the journal data.

> P20: I felt that the difficulty level of the TOEIC questions in the metaverse could be lower compared to the existing TOEIC problems. It seems to provide more information that helps understand the problem and find the answer.
> P32: I think it will be a good tool for lowering the psychological barriers to entry into TOEIC and making it possible for all age groups to study interestingly.
> P18: The disadvantage is that the student may interpret the problem differently from the examiner's intention.
> P19: When I think of the metaverse-applied test, I think of a fun and accessible test format first rather than a theoretical and hard test format.

The journal entries provide compelling evidence supporting the potential of metaverse in reducing psychological barriers to TOEIC, making the test preparation process more engaging and accessible for all age groups, and potentially alleviating test-related anxiety with supportive testing experiences. However, the importance of ensuring alignment between examiner intentions and student interpretations in metaverse-based test formats was also emphasized, highlighting the need for careful test design to ensure valid evaluation. The findings collectively highlight the transformative power of the metaverse in shaping perceptions toward testing, teaching, and learning, underscoring its promising role in revolutionizing pedagogical practices.

4) Facilitating Conditions: TM Necessitates Infrastructure and Resource

The FC construct demonstrates a co-occurrence of terms like “3D-Model” (r = 0.44), “Download-Site” (r = 0.40), “Arrange-Furniture” (r = 0.40), and “File Want-Limited” (r = 0.29), suggesting that participants perceive the necessity for adequate infrastructure and resources to facilitate the use of technology effectively. This is reflected in the following journal entries:

> P28: Initially, I believed I could easily create the educational environment as I envisioned. However, I encountered limitations in the available models and faced difficulties in manipulating them.
> P40: The most difficult thing was to get a 3D model that CoSpaces Edu basically didn’t have. This is because there were many paid ones, and even if they were downloaded, they were not transferred as I saw on the site. It was disappointing that it was difficult to place the desired objects.

The findings underscore the importance of providing sufficient infrastructure and resources to foster independent use of technology. More specifically, the accessibility of resources, ease of handling models, and transferability of downloaded resources could serve as potential barriers for facilitating conditions in the context of advanced technology use in education. Any shortcomings may inhibit the perceived ease of use and application of these technologies.

5) Social Influence: TM Requires Social Dynamics

Finally, under Social Influence, the co-occurrence of “Share-Activity” (r = 0.27), “Proud-Other” (r = 0.31), and “Professor-Follow” (r = 0.29) signifies the importance of peer perception and societal norms in adopting technology. The provided journal entry data affirms the influence of social dynamics.

> P40: There were students who made it well like experts, so I was impressed while watching it.
> P22: The professor explained the metaverse in an interesting manner… The explanations were easy to follow, and the professor provided detailed and kind assistance when I had personal questions.

The textual data indicate that the pre-service teachers’ astonishment and admiration for their peers seem to spark their motivational force to hone their skills and refine their work. Moreover, the professor’ supportive guidance and explanations contributed to a sense of progress among the participants, enriching their TM experience. The data thus emphasizes the pivotal role of social influences, which can significantly impact the participants’ propensity to incorporate technologies into their future pedagogical endeavors.

V. DISCUSSION

Recognizing the importance of both the metaverse and teacher training in the realm of educational transformation, this study formulated a curriculum tailored for training teachers in the metaverse. Central to this research were three fundamental questions that underpinned the investigation.

First, it probed the overarching emotional responses of pre-service teachers towards the TM experience, with these sentimental reactions serving as a means to gauge the overall effectiveness of TM in teacher training and to provide insights for future improvements. Overall, the TM experience was mostly well-received by pre-service teachers, as evidenced by the sentiment analysis: an average compound score of 0.357 from the Vader lexicon, affective valence of happiness (M = .81, SD = .46) and surprise (M = .61, SD = .58) in SentiArt, and a strong positive orientation score of 4.14 through Liu-Hu, all corroborating positive attitudes towards TM. Parallelly, a study by Azzaro and De Dios Martínez Agudo (2018) examined the emotions of 32 foreign language teachers towards technology with an adapted UTAUT model. They also discovered a significant correlation between user behavior and positive attitudes, with a score of sb = 0.45 (p = 0.001), and between behavior and happiness, at sb = 0.3 (p = 0.021). These positive emotions stem from the curiosity to discover new content, the enhancement of making teaching enjoyable, interesting, and fun, and the motivation to engage students, all of which are consistent with the current findings.

Second, it investigated the extent to which the UTAUT 2 constructs illuminated differences in outcomes before and after engaging with the TM experience. In particular, diverging from the previous UTAUT 2 literature, this research ventures into exploring the multifaceted experience through various analytic methods: the *t*-test, multiple regression analysis, and SEM. As indicated by t-test results, notable improvements were detected in facilitating conditions (FC: $t = -5.34$, $p < 0.001$), effort expectancy (EE: $t = -2.18$, $p = 0.035$), and hedonic motivation (HM: $t = -2.13$, $p = 0.039$), where participants reported feeling more capable and supported in using technology, finding it easier to learn, and deriving more pleasure from usage. In addition, multiple regression analysis revealed a shift in significant predictors of attitudes towards metaverse adoption from the pre- to post-TM stages. Initially, EE ($\beta = 0.3621$, $p = 0.006$) and SI ($\beta = 0.14$, $p = 0.471$) were significant, but following the TM experience, HM ($\beta = 0.58$, $p < 0.001$) emerged as a key influential factor with the improved model fit from Pre-TM ($R^2 = 0.73$, $p < 0.001$) to Post-TM ($R^2 = 0.80$, $p < 0.001$). The findings suggest that initially, for pre-service teachers, factors like ease of use (EE) or the influence of peers and colleagues (SI) influenced their attitudes. However, after the TM experience, pre-service teachers' motivation driven by the pleasure and fulfillment from using the technology (HM) became a more influential factor, accompanied by an improved model fit from pre-TM ($R^2 = 0.73$) to post-TM ($R^2 = 0.80$). In alignment with this, prior research (Omar et al., 2019; Wu et al., 2021) also highlighted that hedonic motivation, which underscores the intrinsic motivation and satisfaction from technology use, has been instrumental in impacting teachers' intentions toward technology integration. Concurrently, hedonic motivation emphasizes the pleasure and enjoyment derived from using technology, and this factor has been proven to have a significant impact on teacher intention for technology integration (Omar et al., 2019; Wu et al., 2021). This underscores the importance of designing teacher training curricula to evoke pleasure and enjoyment in the process of technology integration.

Furthermore, SEM further bolstered the effectiveness of the TM experience in fostering pre-service teachers' intentions to use the metaverse after the training. The analysis highlighted the substantial influence of the TM experience on post-training IU scores (estimate = 1.23, $p < 0.001$), while the pre-service teachers' previous experience also exhibited a positive impact on post-training outcomes (estimate = 0.333, $p = 0.052$). These findings underscore the vital role of the TM experience in augmenting pre-service teachers' motivation and readiness to incorporate Metaverse into their future teaching practices. In a similar vein, Demirli (2013) observed that while pre-service teachers were favorable towards ICT, their usage was restricted to basic functions due to inadequate training. Along this line, Azzaro and De Dios Martínez Agudo (2018) underscored the importance of giving all teachers robust technology training, especially during their learning-to-teach period, to harness the full potential of digital competency. Third, the research endeavored to unveil the main themes anchored in the UTAUT 2 constructs as manifested in the TM experiences via content analysis. The text-mining results revealed these overwhelmingly positive responses associated with the TM experience. This transformative experience not only reshapes perspectives on teaching, testing, and learning but also fosters an eagerness to embrace innovative tools and methodologies.

VI. CONCLUSION

The pedagogical potential of the metaverse has gained acknowledgment in academic circles. However, its actual integration into the classroom depends on the willingness of teachers, who play a pivotal role in liberating traditional teaching paradigms. Teacher hesitancy towards incorporating technology often arises from a lack of familiarity and understanding. This underscores the necessity for a well-structured teacher training curriculum that facilitates the transition to transformative teaching methods. However, the challenge lies in the scarcity of specific training strategies and support mechanisms to prepare upcoming educators, who will serve as catalysts for educational transformation.

Against this backdrop, this mixed-methods research develops a metaverse-certified course and delves into support mechanisms to empower practitioners certified in metaverse education. The research employs questionnaires and reflective papers, utilizing the UTAUT 2 model as a foundational framework. The study outcomes indicate that the transformative metaverse experience, characterized by excitement and a sense of achievement, epitomizes a paradigm shift within the realm of educational transformation. The pedagogical and theoretical implications of this research are far-reaching. Firstly, the study findings highlight the transformative potential of the metaverse in education, presenting it as a revolutionary tool that can alter the way educational content is delivered and experienced. Moreover, the study illuminates the emotional dimensions of technology integration in teaching. The sense of excitement and achievement reported by pre-service teachers suggests that effective training can positively influence teacher attitudes toward the adoption of technology in educational settings. Furthermore, from a theoretical standpoint, the findings hold significant value in its capacity to enhance the UTAUT model by harnessing both quantitative and qualitative methods. This comprehensive approach not only deepens our understanding of the environments in which pre-service teachers receive technological training but also addresses a crucial facet of teacher education. While valuable insights have been yielded from our research, it is important to acknowledge its limitations. The sample size is relatively small, and the one-semester timeframe of the intervention may not have fully allowed the entire spectrum of potential effects stemming from training *with, about, for* the metaverse to unfold.

As the educational community strives to prepare future educators for the challenges of the digital era, this research emphasizes the significance of holistic training and experiential learning. These factors are crucial in ensuring that educators are well-equipped to harness the full potential of technological advancements and create meaningful educational experiences. On a practical level, this study highlights the necessity for robust teacher training that not only enables the incorporation of technology but also provides ample resources, technical support, and a positive learning-to-teach environment.

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APPENDIX

A Questionnaire Survey

Perceived Expectancy

Q1. The metaverse holds promise for enhancing pedagogical practices.

Q2. The metaverse has the potential to facilitate the comprehension of complex concepts that are challenging to experience in the real world.

Q3. The metaverse can contribute to more effective attainment of educational objectives.

Effort Expectancy

Q4. Acquiring the skills necessary to utilize the metaverse is expected to be straightforward.

Q5. Utilizing the metaverse for various tasks is anticipated to be uncomplicated.

Q6. Explaining the functionalities of the metaverse to others is likely to be simple.

Social Influence

Q7. I see myself using the metaverse as a means to stay aligned with the demands of the current digital age.

Q8. Proficiency in the metaverse is imperative and is associated with positive societal impacts.

Q9. I anticipate receiving support from individuals around me (colleagues, students, administrators, etc.) for my metaverse usage.

Facilitating Conditions

Q10. I believe I can independently navigate and utilize the metaverse without external guidance or formal instruction.

Q11. I possess a foundational understanding of the technologies that underpin the metaverse (such as AR/VR).

Q12. I feel capable of applying the metaverse in diverse ways within real classroom settings.

Hedonic Motivation

Q13. Integrating the metaverse into education has the potential to inject more excitement and dynamism into classes.

Q14. Learning how to effectively implement the metaverse is intriguing and aligns with my personal needs.

Q15. Gaining knowledge about the metaverse is crucial and carries a societal significance.

Intention to Use

Q16. I have intentions of regularly engaging with the metaverse.

Q17. I plan to include the metaverse in my day-to-day activities.