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Educational Metaverse For Teaching And Learning In Higher Education of Pakistan

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Abstract:

With the development of information and communications technology, The application of augmented and virtual realities is expanding in potential area of education. The concept of Metaverse in education has received a great deal of attention. As it has been emerged as a novel version of digital technology (Hwang & Chien, 2022). The metaverse is transforming education (Han, 2022) by promoting communication and supporting immersive learning. The metaverse is also projected to dramatically boost e-learning by making virtual learning environments more lifelike and learning more engaging and experiential. It gives the students and teachers a lot of freedom in terms of real-time interaction (Zhao, et al., 2022; Wang, et al., 2022). There are no research studies which divulge the adoption of metaverse by teachers and students in higher education of Pakistan. To bridge the gap, this research study was conducted which analyzed the adoption/acceptance of educational metaverse by university teachers and students of Pakistan by employing UTAUT model. UTAUT is an integrated model of technology acceptance which deals with six constructs EE, PE, SI, FC, BI and UB. The design of this study was mixed method followed by pragmatic paradigm. Quantitative and qualitative methods were employed to deal with questionnaire and interview data. Sample of the study was taken from four universities of Lahore, where 315 students and 10 teachers were selected as sample. Findings of the study revealed that teachers and students both had positive intentions towards adopting educational metaverse in their teaching and learning. It was further recommended that university administration should make it possible to utilize educational metaverse by developing infrastructure, conducting trainings, and providing technical support to teachers and students.

Keywords: Metaverse; education; UTAUT; adoption; technology acceptance; Augmented reality; virtual reality; virtual environments;

Introduction:

With the utilization of the internet, masses in this digital world are very much familiar with internet-based technologies which has caused great changes in lives. Moreover, internet and the associated technologies lead to the emergence of numerous novel technologies. The emergence of digital and immersive technologies, such as Extended Reality (XR), Virtual Reality (VR) and Augmented Reality (AR), have influenced all arenas of human lives in current digitalized world. The development of digital, immersive and hyper-realistic environments may form the virtual twins, digital twins and three dimensional (3D) immersive experiences that produce unique interactions between spaces, technologies and masses (Prabhakaran et al., 2022). Metaverse is one of these technologies which has emerged with the advancement of the concept of the virtual world (Dionisio et al., 2013).

The term ‘Metaverse’ is derived from two words, meta and universe, which can be referred to as the superior universe as it is a computer-generated universe beyond the physical

world. In 2021 however, metaverse got more familiarity when founder of "Facebook" a social networking site, Mark Zuckerberg established the parasol company 'Meta' to acquaint Facebook and its affiliated companies with the Metaverse environment. The Metaverse, according to Kraus (2022), seems to be the epicenter of social interaction online in the future.

The fundamental notion of Metaverse is to develop a digital space which strengthens the social interaction to be similar to the contact in physical perspectives (Alvim, 2022). The metaverse is an extension of internet in virtual 3D context (Cui, et al., 2022; Locurcio, 2022) and an effective online learning space (Khansulivong, et al., 2022,) that emboldens a profound indulgence (Wang, et al., 2022). It provides the users with a great deal of autonomy and openness for real-time interaction (Zhao, et al., 2022; Wang, et al., 2022). The concept behind Metaverse is to design an effusively immersive realm where people may generate their avatars which may interact with other people and the settings in the virtual space to replicate the human collaboration and interaction in real world (Alvim, 2022).

Talan & Kalinkara (2022) provide a discourse on the criteria to distinguish a virtual space from a metaverse. That is:

Realism: Metaverse users have feeling that they are psychologically and emotionally taking part in an alternate space. The users' behavior similar to physical reality is one of the criteria of Metaverse in immersive reality context.

Ubiquity: Accessibility of Metaverse through various devices such as tablets, mobiles, desktop computers etc. is one of the features of metaverse. This feature implies that the users are recognized in the metaverse space similar to everyday life identification with their distinguished peculiar traits such as their physical characteristics and identity evidences.

Interoperability: It is the ability of diverse platforms and systems to exchange information, and communication within two different metaverse spaces in accordance with some set standards of exchanging information and transporting the avatars, behaviors and objects.

Scalability: The scalability criteria is linked to the simultaneous avatars in the Metaverse, the complexity and number of objects, and interaction dimensions of concurrent users in compliance with the support of metaverse server architecture which allows the synchronized existence of multiple people.

For enhanced understanding of potential of metaverse and its applications, recent research studies have explained an estimate of exponential growth of metaverse globally, sizable utilization of immersive technologies and presentation of new products in the near future (Gartner, 2022). As post-pandemic world has emphasized the digital learning and importance of technological advancements in the classroom is also highlighted, the potential of the metaverse in the field of education has attained increasing attention. The metaverse is transmuting the education (Han, 2022) by endorsing communication and accompanying immersive learning.

Some research studies related to application of metaverse in the field of education exist and are point of attention for many researchers which allow improved understanding of education and its qualifications in a Metaverse space. Gökçe Narin (2021) examined researches related to the Metaverse in education. Findings of his study revealed that most commonly used forms of learning and teaching in metaverse were blended learning, student-oriented learning, Mobile learning and inquiry-based learning. According to Yue (2022), Metaverse technology will enhance the pace, breadth, depth and speed of educational processes and transform the student-teacher relationship as educational metaverse interrupts the divide between students and teachers. Qin (2022) explores in his study that heavy investments are continued to be made in educational metaverse by the magnates and China has taken a lead (Mailett, Mathieu & Sicotte, 2015).

In the 3D online virtual classes, teachers are the owners of virtual spaces and creators of e-

content and personalized curricula. As students act as co-owners of virtual spaces and co-creators of the personalized curricula, the educational metaverse can stipulate blended, rich, direct and knock-on learning opportunities. (Chan et al., 2021; Mystakidis et al., 2021; De la Peña et al., 2010). The educational metaverse let the teachers to design and develop virtual environments in which students can collaborate and learn. This assists the teachers and students in provisions of mirrored spaces for engaging them in teaching and learning activities with a sway of ubiquity. It enables teachers and students to share, create, and review meta-content by utilizing AR/VR to enhance the teaching-learning process (Bardhan, 2022).

Jeon & Jung (2021) determined that metaverse platforms are vital tools utilizing which the teachers and learners can enhance their immersion and motivation in teaching and learning processes. The educational metaverse allows them to create the actual feelings for utilizing innovative learning methods and attain experiences of self-directed learning. Furthermore, the implications of employing the educational metaverse system at different levels of study are established by Farjami et al. (2011), Han (2020), and Kanematsu et al. (2013).

There are no studies found which focus on summarizing the finding related to adoption, acceptance and use of educational metaverse in higher education of Pakistan. To cover this gap, this study is conducted to find out the behavioral intentions and adoption behavior of university teachers and students regarding use of educational metaverse in higher education of Pakistan.

The Unified Theory of Acceptance and Use of Technology (UTAUT)

Numerous technology acceptance theories and models are employed in different contexts and varying cultural settings regarding acceptance or adoption of digital technology in many studies which yielded different results. Venkatesh et al. (2003) integrated eight technology acceptance models to construct the UTAUT model. UTAUT has made many contributions to the literature. UTAUT provides an empirical insight into technology acceptance by comparing these prominent eight models of technology acceptance.

i) TRA (Theory of Reasoned Action) presented by Fishbein and Ajzen (1975),
ii) TPB (The Theory of Planned Behavior) presented by Ajzen (1991),
iii) TAM (Technology Acceptance Model) presented by Davis (1989),
iv) The Combined-TAM-TPB presented by Taylor and Todd (1995),
v) MPCU (Model of PC Utilization) presented by Thompson et al. (1991),
vi) MM (Motivational Model) presented by Davis et al., (1992),
vii) SCT (Social Cognitive Theory) presented by Bandura (1986), and
viii) IDT (Innovation Diffusion Theory) presented by Rogers (1995)

Similarities found among these eight models were combined to construct the UTAUT Model. According to Venkatesh et al. (2003), the theoretical model of UTAUT implies that the behavioral intentions determine the actual use of technology. Four key constructs EE, PE, SI and FC directly affect perceived likelihood of technology adoption/acceptance. Table 1 below illustrates the constructs of UTAUT model.

Table 1: Constructs of UTAUT Model

Constructs	Definition	References
Effort Expectancy (EE)	"the degree to which an individual believes that using the system will help him or her to attain gains in job performance".	Thong & Xu (2016); Zhou, Lu & Wang (2010); Venkatesh et al. (2003);
Performance Expectancy (PE)	"the degree of ease associated with the use of the system"	Chauhan & Jaiswal (2016); Gupta, Dasgupta & Gupta (2008); Venkatesh et al. (2003);
Social Influence (SI)	"the degree to which an individual perceives those important others believe he or she should use the new system"	Chauhan & Jaiswal (2016); Zhou, Lu & Wang (2010); Venkatesh et al. (2003)
Facilitating Conditions (FC)	"the degree to which an individual believes that an organization and technical infrastructure exists to support the use of the system"	Venkatesh et al. (2003)

METHODOLOGICAL FRAMEWORK OF STUDY:

This research is descriptive in nature and is based on pragmatic paradigm and research design of this research study is mix method along with sequential Transformative design. However, the quantitative method followed by deductive approach and qualitative method followed by inductive approach is pursued in this research study. Furthermore, The quantitative method is applied to deal with data collected by administering survey questionnaire and qualitative method is applied to deal with the data collected by conducting interviews. The present study focused on the following research questions.

Table 2: Methodological Framework of Study

Research paradigm	Pragmatism
Research Design	Mix Method – Sequential Transformative Design
Research Method	Quantitative & Qualitative Methods
Research Approach	Deductive & Inductive Approaches
Research Technique	Survey
Research Tools	Questionnaire, Interview

THEORETICAL FRAMEWORK OF STUDY:

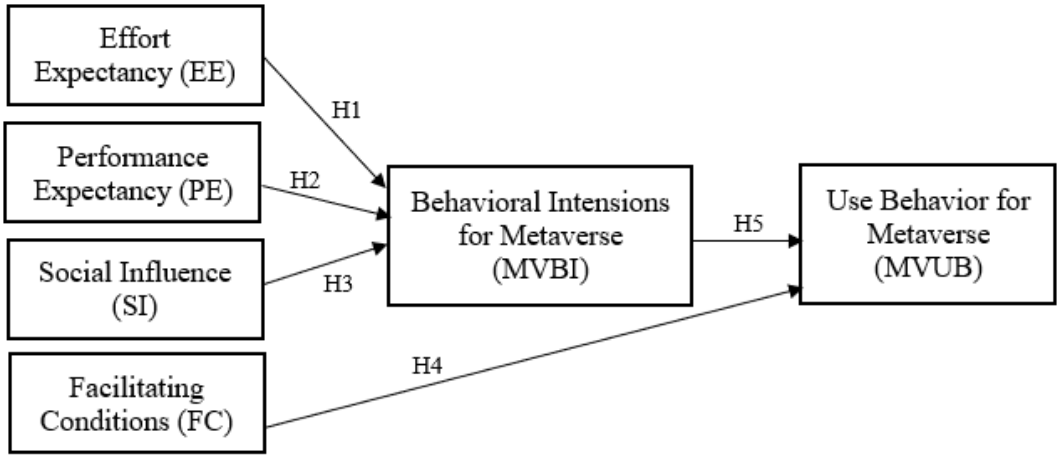

Figure 1: Theoretical Framework: UTAUT Model

The research study aimed at determining the adoption intentions of university students regarding Educational Metaverse for their learning purposes. Figure 1 illustrates the theoretical framework of the study which employs UTAUT Model developed by Venkatesh et al. (2003). The UTAUT Model comprises two endogenous variables (MVBI, MVUB) and four exogenous variables (EE, PE, SI, FC).

RESEARCH HYPOTHESES

H_1: Effort Expectancy (EE) positively influences Behavioral Intentions (MVBI) to use Educational Metaverse for learning by university students.

H_2: Performance Expectancy (PE) positively influences Behavioral Intentions (MVBI) to use Educational Metaverse for learning by university students.

H_3: Social Influence (SI) positively influences Behavioral Intentions (MVBI) to use Educational Metaverse for learning by university students.

H_4: Facilitating Condition (FC) directly influences Educational Metaverse Use Behavior (MVUB) for learning by university students.

H_5: Behavioral Intentions to use Educational Metaverse (MVBI) directly influences Educational Metaverse Use Behavior (MVUB) for learning by university students

SAMPLE SIZE AND SAMPLING

Total 315 students from 4 universities of Lahore were selected as sample in which the 6th, 7th, and 8th semester students of BS (4-Year) Programs were included on the basis of using digital technologies in their learning. Additionally, the students of MS/M.Phil. programs were also selected as part of sample. 10 university teachers were also taken as sample from selected 4 universities on the basis of awareness and utilization of digital technologies in profession.

DATA COLLECTION AND DATA ANALYSIS

Data from 315 students was collected by administering a survey questionnaire which was designed on the basis of five-point Likert Scale representing the responses from strongly agree to strongly disagree. The interview was prepared by the researchers based on the literature (Uluyol & Eryılmaz, 2014). Data from 10 university teachers was collected by conducting interviews. All interviews were conducted through digital means because of flexibility and availability to the respondents. The quantitative data were analyzed using SPSS and AMOS software whereas interview data was analyzed by utilizing NVIVO software.

ANALYSIS OF QUANTITATIVE DATA

This part of the research explains the analysis of quantitative data collected through survey questionnaire

Descriptive Statistics of UTAUT Constructs and Indicators:

Table 3: *Descriptive Statistics for Adoption of Educational Metaverse by University Students*

Constructs	Indicators	N	M	SD
EE	EE1	315	3.58	0.851
	EE2	315	4.23	1.325
	EE3	315	4.05	0.618
	EE4	315	3.91	1.62
	EE5	315	4.35	1.06
PE	PE1	315	3.99	0.562
	PE2	315	4.38	0.847
	PE4	315	4.22	0.669
	PE5	315	3.61	1.123
SI	SI2	315	3.87	0.528
	SI3	315	3.94	1.623
	SI4	315	4.32	0.894
FC	FC1	315	2.65	1.905
	FC2	315	2.89	0.887
	FC4	315	3.45	0.569
MVBI	MVBI1	315	4.21	1.102
	MVBI2	315	4.36	1.854
	MVBI3	315	3.95	0.993
MVUB	MVUB1	315	3.82	0.458
	MVUB3	315	4.61	1.369
	MVUB4	315	4.23	0.992

Table 3 is illustrating the descriptive statistics of UTAUT constructs and indicators. The mean values (approx. 4.0) of EE, PE, SI, MVBI and MVUB indicators imply the students' agreement towards adopting educational metaverse in their learning whereas the mean value of FC depicts the students' disagreement towards considering FC as an important indicator for the adoption of educational metaverse for their learning.

VALIDITY AND RELIABILITY TESTS:

i) Cronbach Alpha Reliability

Table 4 depicts the reliability of UTAUT constructs calculated by using SPSS. It is shown in the table that all the constructs have good reliability values i.e. > 0.7 (Sekaran, 2003).

Table 4: Cronbach Alpha Reliability

Constructs	N	A
Effort Expectancy (EE)	5	.79
Performance Expectancy (PE)	4	.85
Social Influence (SI)	3	.81
Facilitating Conditions (FC)	3	.77
Behavioral Intentions (MVBI)	3	.82
Use Behavior (MVUB)	3	.81

ii) Composite Reliability (CR) and Convergent Validity

A statistical software for Structured Equation Modeling AMOS 20.0 was used to calculate the Composite Reliability and Construct Validity of Questionnaire. AVE was calculated to find the convergent validity of the research tool.

Convergent validity is the function of association between two different measurement scales which are supposed to measure the same concept, and is achieved when multiple indicators operate in a consistent manner (Gefen & Straub, 2005). The results of Factor Loadings, Composite Reliability (CR) and Convergent Validity (AVE) are shown below in Table 5.

Table 5: Factor Loadings, Composite Reliability (CR) and Convergent Validity (AVE)

Constructs	Indicators	Factor Loadings	CR	AVE
Effort Expectancy (EE)	EE1	0.811	0.882	0.712
	EE2	0.770		
	EE3	0.794		
	EE4	0.661		
	EE5	0.832		
Performance Expectancy (PE)	PE1	0.705	0.839	0.567
	PE2	0.779		
	PE4	0.821		
	PE5	0.700		
Social Influence (SI)	SI2	0.817	0.796	0.661
	SI3	0.695		
	SI4	0.742		
Facilitating Conditions (FC)	FC1	0.641	0.747	0.598
	FC2	0.698		
	FC4	0.772		
Behavioral Intentions for Metaverse (MVBI)	MVBI1	0.884	0.834	0.728
	MVBI2	0.671		
	MVBI3	0.809		
Use Behavior for Metaverse (MVUB)	MVUB1	0.727	0.778	0.640
	MVUB3	0.693		
	MVUB4	0.781		

iii) Calculation of Discriminant Validity:

To calculate discriminant validity, the square root of AVE was taken for latent constructs to be correlated. Diagonal bold values in table 6 illustrate that square root of AVE is higher than the pairwise correlations for all the constructs. Therefore, the psychometric characteristics of tool are acceptable in terms of discriminant validity (Fornell & Larcker, 1981).

Table 6: Discriminant Validity Matrix

	EE	PE	SI	FC	MVBI	MVUB
EE	**.843**					
PE	.687	**.752**				
SI	.528	-.702	**.813**			
FC	.761	.475	.409	**.773**		
MVBI	.343	.666	.731	.209	**.853**	
MVBU	.552	.710	.659	.689	.464	**.800**

Table 7: Model Fit Indices

	Fit Indices	Cut off Values	Calculated Values	Fitness	Reference
Parsimonious Fit	$\chi 2$/df	> 3	5.896	Acceptable Fit	Kline (1998)
Incremental Fit	CFI	> .90	.928	Acceptable Fit	Fan et. al. (1999)
	GFI	> .80	.951	Best Fit	Kline (2005)
	NFI	> .90	.974	Good Fit	James, Mulaik & Brett (1982)
	TLI	0-1	.903	Good Fit	Hu & Bentler (1999)
Absolute Fit	RMSEA	< .08	.066	Acceptable Fit	Hair et al. (2006)
	SRMR	< .05	.083	Yes	Diamantopoulos & Siguaw (2000)

Table 7 illustrates the construct validity of the research tool by providing the absolute fit, incremental fit and parsimonious fit for the model. Figures show good fitness of model as chi-square/df, CFI, GFI, NFI, TLI, RMSEA and SRMR values depict that actually calculated values of all indices lie within the range of cut-off values. All the indices recommend good fitness of model which implies to good construct validity.

FINDINGS AND RESULTS OF QUANTITATIVE DATA

Many researches on technology acceptance have taken place in last two decades and numerous new models have emerged as result. UTAUT model of technology adoption/acceptance, presented by Venkatesh et al. (2003), suggests that three variables EE, PE and SI have directly affect MVBI and FC directly influences MVUB. Whereas there is a direct relationship between MVBI and MVUB.

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Table 8: Hypotheses Testing

Hypotheses	p Value	Influence	Decision
H_1	.001	Significant	Accepted
H_2	.000	Significant	Accepted
H_3	.001	Significant	Accepted
H_4	.107	Insignificant	Rejected
H_5	.003	Significant	Accepted

The present research highlights further understanding of the acceptance of Educational Metaverse for learning of university students by employing UTAUT model. The findings of the study demonstrate that Effort Expectancy EE (p=.001), Performance Expectancy PE (p=.000) and Social Influence SI (p =.001) significantly influence the behavioral intentions of students using educational metaverse for learning (MVBI). However, the results suggest that the influence of Facilitating Conditions FC on Use Behavior of Students for Educational Metaverse (MVUB) is statistically insignificant (p =.107). Furthermore, there is statistically significant relationship between MVBI and MVUB (p = .003). Resultantly, H_1, H_2, H_3 & H_5 were accepted while H_4 was rejected.

Table 9: Exogenous and Endogenous Variables' Relationship

Path	Estimate	S.E.	C.R.	P
MVBI < --- EE	.549	.299	2.604	.001
MVBI < --- PE	.673	.608	1.909	.000
MVBI < --- SI	.415	.332	0.586	.001
MVUB < --- FC	-.019	.267	-3.044	.107
MVUB < --- MVBI	.676	.624	1.074	.003

STRUCTURAL MODEL

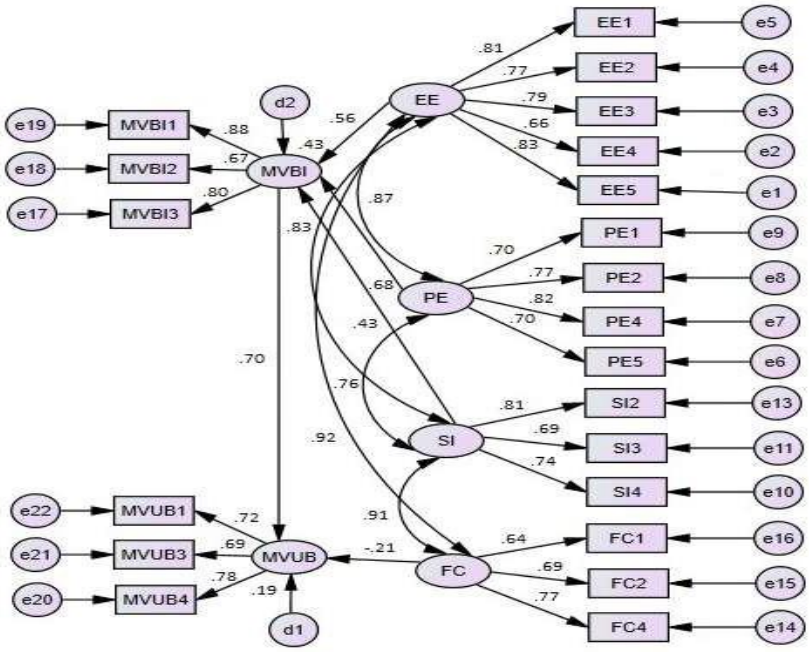

Figure 2: Structural Modeling Analysis

Figure 2 and Table 8 elucidate the relationship between endogenous variables (MVBI & MVUB) and exogenous variables (EE, PE, SI & FC). Figure 2 illustrates the results of table 8 which clearly depict except FC, that university students have positive intentions towards accepting Educational Metaverse for their learning. Findings further highlight that university teachers must educate the university students towards the importance of educational metaverse as learning facilitator. However, on the other hand, university students expect to annex training, awareness and support from university administration, teachers and technical personnel to use educational metaverse for their learning intents.

ANALYSIS OF INTERVIEWS DATA:

A semi-structured interview was conducted with teachers of universities. Interview data was analyzed using Nvivo software to code the data and find the appropriate themes from interview data. The researcher developed codes to identify the themes. This way of analyzing interview data was considered suitable for this study to get a good structure of broad amount of data collected. The themes derived from the data are shown in the figure 3.

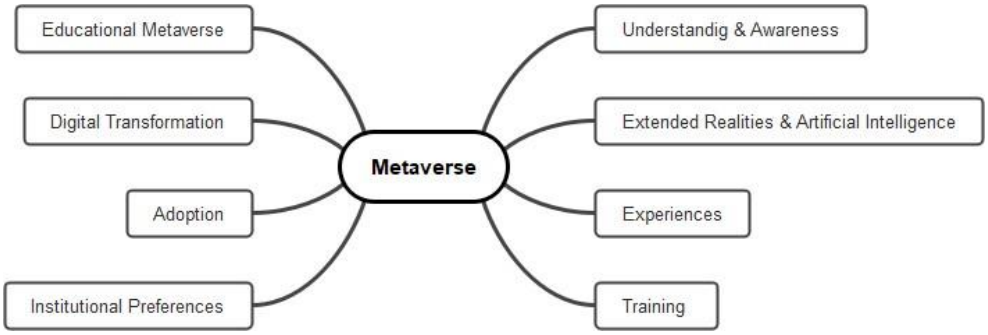

Figure 3: Themes Derived from Interview Data

EVALUATION CRITERIA OF INTERVIEW:

This study follows the evaluation criteria of qualitative data presented by Bryman & Bell (2015) by developing findings which are valid and accurate. These criteria include i) Credibility, ii) Transferability, iii) Dependability and iv) Confirmability. The Credibility refers to how believable and accurate the findings just like internal validity in quantitative research. Transferability is parallel to the external validity and refers to the application of findings in other contexts. Dependability indicates that the findings are being likely to apply more times than in this research, which is parallel to the criteria of reliability in the quantitative research. Confirmability denotes if the researchers have included their own values to high level in the research study. (Sunders et al., 2009; Bryman & Bell, 2015).

FINDINGS OF INTERVIEW:

The interviewees were asked about their awareness and understanding about Metaverse where it was seen that almost all the respondents were had very less familiarity and understanding of metaverse and its functions. Findings revealed that 7 out of 10 university teachers had no awareness and understanding of metaverse as respondent 8 said that

"… I really don't know what the metaverse is. I have never heard about it …."

Whereas 2 university teachers had inconsequential or very lesser familiarity with metaverse and its functions. However only 1 university teacher expressed that she knows about metaverse and she have familiarity with the functions and features of Metaverse. She said that:

"…. Metaverse is an emerging modern form of internet which connects physical world with virtual world and humans act as digital humans in a metaverse".

In continuing interviews, the respondents were asked about role of extended realities and artificial intelligence in metaverse. Almost all the respondents were not having much familiarity about these technologies in the context of metaverse. However, some university teachers were aware of extended

realities (Virtual Reality, Augmented Reality, Mirrored Realities) and artificial intelligence without the context of metaverse, as respondent no. 5 assumed that:

"….. I have heard about the virtual and augmented reality in games and films. I also know the importance of Artificial Intelligence in this digital era and in future. However, how these realities and AI works with metaverse is an unknown domain for me ……".

When the respondents were asked about their experiences in metaverse, 9 out of 10 respondents aforesaid that they never had any experiences to work with metaverse. only one respondent expressed that

"…. I play online games with using metaverse environment and AI technologies making the games more immersive, interactive and virtual ….".

Interviewees were next asked their familiarity with Educational Metaverse. Only one university teacher mentioned that:

"…… I have read some research articles about educational use of metaverse but how does it operate and what is its usefulness is a grey area for me ……".

Nine respondents of interview refused to have any knowledge about educational metaverse. But a positive perception towards metaverse could be witnessed throughout the results of interviews.

Respondent 7 replied a question that

"… although neither I know about educational metaverse nor I have ever experienced with it but as it is the time of digitalization, it seems good to know that a very novel and innovative technology has emerged in the domain of education which will hopefully become common in near future and all professionals will be get benefitted from it….".

In response to the question of digital transformation of teaching, most of the respondents had expectations that educational metaverse will bring a positive change in teaching and learning patterns. As one of the respondents told that:

"…. As digital and online technologies are diffusing swiftly, there seems the possibility of metaverse to take over the teaching and learning by bringing digital transformation in educational practices in near future…".

In response to the interview question about institutional preferences to develop an infrastructure feasible and compatible to metaverse, all the respondents articulated that their universities/institutions neither have any policy nor the preferences and intentions to digitally transform the educational practices by integrating educational metaverse in formal educational practices. Almost all (9 out of 10) university teachers had intentions to adopt educational metaverse in their teaching as innovation. Only one respondent refused to show his intentions towards adopting metaverse in his teaching in coming future.

Interviewees, in response to the last question of interview, agreed that their universities must establish a training system and technical support system to bring metaverse into action as the most innovative prospective trend in education. As one of the respondents countered that:

"…it is dire need of time that universities my establish proper digital infrastructure to introduce metaverse in teaching and learning. Also, the administration should conduct training sessions for university teachers to make them learn about metaverse so that they may transform their teaching practices".

Conclusions and Discussion:

This research study provides an insight into the behavior of teachers and students of public and private universities of Pakistan towards using Educational Metaverse for teaching and learning. The study concludes that behavioral intentions of university students to use Educational Metaverse (MVBI) are positively influenced by EE, PE and SI. While FC and MVBI directly influence MVUB. Moreover, EE, PE and SI significantly predict the students' behavioral intentions to use educational metaverse while FC is insignificant to predict the behavioral intentions of university students to use educational metaverse for their learning purposes. The interview results conclude that although university teachers have not much awareness about the potential of educational metaverse in teaching but they have general familiarity about metaverse as an emerging technology as

they know come metaverse-based games. University teachers intend to adopt educational metaverse in their teaching as an emerging digital trend of present and future. Resultantly, both university teachers and students have positive intensions towards adoption of educational metaverse for teaching and learning. For this, they look towards university administration to develop a digital infrastructure which supports educational metaverse. It is therefore essential for administrators and technical personnel to ensure the provision of infrastructure, training and technical support to the teachers and students for utilizing educational metaverse in teaching and learning. The study also implies that when intervention to incorporate educational metaverse in teaching and learning is provided to students and teachers, they will know and acknowledge the value of educational metaverse and advise their colleagues and peers to utilize educational metaverse. Furthermore, universities' administration should consider to provide digital infrastructure, training, technical support to promote the adoption and utilization educational metaverse in teaching and learning in higher education.

REFERENCES

1. Ajzen, I. (1991). The theory of planned behavior. Organizational Behavior and Human Decision Processes, 50(2), 179- 211.
2. Alfaisal, R., Hashim, H., & Azizan, U. H. (2022). Metaverse system adoption in education: a systematic literature review. Journal of Computers in Education, 1-45.
3. Alvim, L. (2022). How the metaverse could impact the world and the future of technology. ABC News. Available at: https://abcnews.go.com/Technology/metaverse-impact-world- future technology/ story?id=82519587.
4. Analytics Insight. (2022). Metaverse is the future: The companies building virtual offices. Analytics Insight.
5. Attuquayefio, S. & Addo, H. (2014). Using the UTAUT model to analyze students' ICT adoption. International Journal of Education and Development using ICT, 10(3),. Open Campus, The University of the West Indies, West Indies.
6. Bandura, A. (1986). Social foundations of thought and action: A social cognitive theory. Englewood Cliffs, NJ: Prentice Hall.
7. Bardhan, A. EXPANSION OF SPACE IN METAVERSE COMMUNICATION AND ITS PROBABLE IMPACT. Society Language and Culture. A Multidisciplinary Peer-Reviewed Journal, 2(4), ISSN - 2583-0341.
8. Bentler, P. M., & Bonett, D. G. (1980). Significance tests and goodness of fit in the analysis of covariance structures. Psychological Bulletin, 88(3), 588–606. https://doi.org/10.1037/0033- 2909.88.3.588
9. Bollen, K.L. 1989. Structural Equations with Latent Variables. New York: John Wiley.
10. Browne, M. W., & Cudeck, R. (1993). Alternative ways of assessing model fit. In K. A. Bollen and J. S. Long (Eds.), Testing structural equation models (pp. 136-162). Newbury Park, CA: Sage.
11. Chan, C.-S., Bogdanovic, J. and Kalivarapu, V. (2021) 'Applying immersive virtual reality for remote teaching architectural history', Education and Information Technologies. doi: 10.1007/s10639-021-10786-8.
12. Chen, F. F. (2007). Sensitivity of goodness of fit indexes to lack of measurement invariance. Structural equation Modeling, 14(3), 464–504. https://doi.org/10.1080/1070551070130 1834
13. Cui, H., Xu, Z., & Yao, C. (2022, June). Will the Metaverse Be the Future of the Internet? In 2022 8th International Conference on Humanities and Social Science Research (ICHSSR 2022) (pp. 2165-2170). Atlantis Press.
14. Dahan, N. A., Al-Razgan, M., Al-Laith, , Alsoufi, M. A., Al-Asaly, M. S., & Alfakih, T. (2022). Metaverse framework: A case study on E-learning environment (ELEM). Electronics, 11(10), 1616.
15. Davis, F., Bagozzi, R., & Warshaw, P. (1992). Extrinsic and Intrinsic Motivation to Use Computers in the Workplace. Journal of

Applied Social Psychology, 22(14), 1111–1132.

16. Davis, F.D. (1989). Perceived Use- fulness, Perceived Ease Of Use, And UserAcceptance. MIS Quarterly , 13(3), 319-340.
17. Diamantopoulos, A. & Siguaw, J. A., (2000). Introduction to LISREL: A guide for the uninitiated. London: SAGE Publications, Inc.
18. Dionisio, J. D. N., Burns W. G. B., & Gilbert, R. (2013). 3D virtual worlds and the Metaverse: Current status and future possibilities. ACM Computing Surveys (CSUR), 45(3), 1-38.
19. Fan X, Thompson B, Wang L (1999) Effects of sample size, estimation methods, and model specification on structural equation modeling fit indexes. Struct Equ Modeling 6(1):56–83.
20. Farjami, S., Taguchi, R., Nakahira, K. T., Nunez Rattia, R., Fukumura, Y., & Kanematsu, H. (2011). Multilingual problem-based learning in metaverse. In Knowledge-Based and Intelligent Information and Engineering Systems: 15th International Conference, KES 2011, Kaiserslautern, Germany, September 12-14, 2011, Proceedings, Part III 15 (pp. 499-509). Springer Berlin Heidelberg.
21. Fishbein, M., & Ajzen, I. (1975). Belief, attitude, intention and behaviour: An introduction to theory and research. Addison-Wesley. Gartner (2022). Predicts 2022: 4 Technology Bets for Building the Digital Future.
22. Gökçe Narin, N. (2021). A content analysis of the Metaverse articles. Journal of Metaverse, 1(1), 17-24.
23. Han, D. (2022). Exploration for Educational Application of Metaverse: Focusing on Implication for Use in English Education. Robotics & AI Ethics, 7, 10-21.
24. Han, D. (2022). Exploration for Educational Application of Metaverse: Focusing on Implication for Use in English Education. Robotics & AI Ethics, 7, 10-21.
25. Hu, L.-t., & Bentler, P. M. (1998). Fit indices in covariance structure modeling: Sensitivity to under parameterized model misspecification. Psychological Methods, 3(4), 424–453.
26. Hwang, G. J., & Chien, S. Y. (2022). Definition, roles, and potential research issues of the metaverse in education: An artificial intelligence perspective. Computers and Education: Artificial Intelligence, 3, 100082.
27. James, L., Mulaik, S., & Brett, J. M. (1982). Causal Analysis: Assumptions, Models, and Data. Sage Publications.
28. Jeon, J., & Jung, S. K. (2021). Exploring the educational applicability of metaverse-based platforms. Korea Association of Information Education, 8 (50), 361-368.
29. Joreskog, K. G., & Sorbom, D. (1996). LISREL8 User's reference guide. Mooresville Scientific Software.
30. Kanematsu, H., Kobayashi, T., Barry, D. M., Fukumura, Y., Dharmawansa, A., & Ogawa, N. (2014). Virtual STEM class fornuclear safety education in Metaverse. Procedia Computer Science, 35, 1255–1261
31. Khansulivong, C., Wicha, S., & Temdee, P. (2022, January). Adaptive of New Technology for Agriculture Online Learning by Metaverse: A Case Study in Faculty of Agriculture, National University of Laos. In 2022 Joint International Conference on Digital Arts, Media and Technology with ECTI Northern Section Conference on Electrical, Electronics, Computer and Telecommunications Engineering (ECTI DAMT & NCON) (pp. 428-432). IEEE.
32. Kim, J. (2021). Advertising in the Metaverse: Research Agenda. Journal of Interactive Advertising, 21(3), pp.141- 144.
33. King, W.R & He, J. (2006). A meta-analysis of the technology acceptance model. Information & management, 43(6), pp.740–755.
34. Kline, R. B. (1998). Principles and practice of structural equation modeling. Guilford Press.
35. Kline, R. B. (2005). Principles and practice of structural equation modeling (2nd ed.). Guilford Press.
36. Kraus, S., Kanbach, D. K., Krysta, P. M., Steinhoff, M. M., & Tomini, N. (2022). Facebook and the creation of the Metaverse: Radical business model innovation or incremental transformation? International

37. Journal of Entrepreneurial Behavior & Research.
38. Kwok, A.O.J & Koh, S.G.M. (2021). COVID-19 and Extended Reality (XR). Current issues in tourism, 24(14), pp.1935–940.
39. Lee, L-H., Braud, T., Zhou, P., Wang, L., Xu, D., Lin, Z., Kumar, A., Bermejo, C & Hui, P. (2021). All One Needs to Know about Metaverse: A Complete Survey on Technological Singularity, Virtual Ecosystem, and Research Agenda. Journal of Latex Class Files, 14(8), pp.1-66
40. Li, M., & Yu, Z. (2022). A systematic review on the metaverse-based blended English learning. Frontiers in Psychology, 13.
41. Locurcio, L. L. (2022). Dental education in the metaverse. British Dental Journal, 232(4), 191-191.
42. MacCallum, R.C., Browne, M.W., and Sugawara, H., M. (1996), "Power Analysis and Determination of Sample Size for Covariance Structure Modeling," Psychological Methods, 1 (2), 130-49.
43. Maillet, É., Mathieu, L., & Sicotte, C. (2015). Modeling factors explaining the acceptance, actual use and satisfaction of nurses using an Electronic Patient Record in acute care settings: An extension of the UTAUT. International journal of medical informatics, 84(1), 36-47.
44. Min, T., & Cai, W. (2022). Portrait of decentralized application users: an overview based on large-scale Ethereum data. CCF Transactions on Pervasive Computing and Interaction, 4(2), 124-141.
45. Mughal, M. Y., Andleeb, N., Khurram, F. A., Ali, M. Y., Aslam, M. S., & Saleem, M. N. (2022). Perceptions of teaching-learning force about metaverse for education: a qualitative study. Journal of Positive School Psychology, 6(9), 1738-1745.
46. Mystakidis, S., Berki, E., & Valtanen, J. P. (2021). Deep and meaningful e- learning with social virtual reality environments in higher education: A systematic literature review. Applied Sciences, 11, 2412.
47. Prabhakaran, A., Mahamadu, A. M., & Mahdjoubi, L. (2022). Understanding the challenges of immersive technology use in
48. the architecture and construction industry: A systematic review. Automationin Construction, 137, 104228.
49. Qin, H. X., Wang, Y., & Hui, P. (2022). Identity, crimes, and law enforcement in the metaverse. arXiv preprint arXiv:2210.06134. Rogers, E.M. (2003). Diffusion of innovations (5th ed.). New York: Free Press.
50. Tabachnick, B. G., & Fidell, L. S. (2007). Using multivariate statistics (5th ed.). Allyn & Bacon/Pearson Education.
51. Talan, T., & Kalınkara, Y. (2022). Students' opinions about the educational use of the metaverse. International Journal of Technology in Education and Science (IJTES), 6(2), 333-346.
52. Taylor, S. and Todd, P. (1995) 'Decomposition and crossover effects in the theory of plannedbehavior: a study of consumer adoption intentions', International Journal of Research inMarketing, Vol. 12, No. 2, pp.137–156.
53. Thompson, R., Higgins, C., & Howell, J. (1991). Personal Computing: Toward a Conceptual Model of Utilization. MIS Quarterly, 15(1), 124–143.
54. Thong, J. Y. L., Venkatesh, V., Xu, X., Hong, S. J., & Tam, K. Y. (2011). Consumer acceptance of personal information and communication technology service. IEEE Transactions on Engineering Management, 58(4), 613-625.
55. Venkatesh, V., Morris, M., Davis, G. & Davis, F. (2003). User acceptance of information technology: Toward a unified view. MIS Quarterly, 27(3), 425–478.
56. Wang, F. Y., Qin, R., Wang, X., & Hu, B. (2022). Metasocieties in metaverse: Metaeconomics and m etamanagementn for metaenterprises and metacities. IEEE Transactions on Computational Social Systems, 9(1), 2-7.
57. Wang, Y., Zhang, X., Chen, Y. & Hu, L., & (2022). The metaverse in education: Definition, framework, features, potential applications, challenges, and future research topics. Frontiers in Psychology, 13.
58. Yue, K. (2022, January). Breaking down the barrier between teachers and students by using metaverse technology in education:

based on a survey and analysis of Shenzhen City, China. In 2022 13th International Conference on E- Education, E-Business, (IC4E). pp. 40-44.

59. Zhang, X., Chen, Y., Hu, L., & Wang, Y. (2022). The metaverse in education: Definition, framework, features, potential applications, challenges, and future research topics. Frontiers in Psychology.

60. Zhao, J., Metwally, Tlili, A., Huang, R., Shehata, B., Liu, D., & A. H. S. (2022). Is Metaverse in education a blessing or a Curse? : A combined content and Bibliometric Analysis. Smart Learning Environments, 9(1), 1-31.

61. Zhao, Y., Jiang, J., Chen, Y., Liu, R., Yang, Y., Xue, X., & Chen, S. (2022). Metaverse: Perspectives from graphics, interactions and visualization. Visual Informatics.