International Journal of Evaluation and Research in Education (IJERE)
Vol. 14, No. 5, October 2025, pp. 3601~3611
ISSN: 2252-8822, DOI: 10.11591/ijere.v14i5.34836

Teaching in the digital frontier: what drives metaverse adoption in education?

Cadelina Cassandra[1], Mohamad Noorman Masrek[2], Fadhilah Aman[2]
[1]Department of Information System, School of Information Systems, Bina Nusantara University, Jakarta, Indonesia
[2]Faculty of Information Science, Universiti Teknologi MARA, Shah Alam, Malaysia

Article Info

Article history:

Received Feb 3, 2025
Revised Jun 17, 2025
Accepted Jul 9, 2025

Keywords:

Education
High school
Intention
Metaverse
Teacher

ABSTRACT

The rapid evolution of digital technologies has caused dramatic changes in various areas, including education. Metaverse has become a very popular topic recently, many schools and university announce the development of metaverse, but until now there is no clear implementation of the idea and some schools cancelled to continue the implementation. One of the reasons behind it because of the lack of preparedness, reluctant from teachers, and there is no initial investigation about how the teachers will accept this technology. Several factors may influence the intention of the teachers. The purpose of this study is to analyze the factors that affect high school teachers' intentions to use metaverse technology. By doing so, the institution can prepare for the real implementation. This study employs quantitative methods and survey techniques by developing a well-structured questionnaire from the theoretical framework. A total of 334 responses were collected and analyzed using SmartPLS software. The findings reveal that 14 hypotheses out of 18 hypotheses were significant and four others were not significant. Social influence (SI), performance expectancy (PE), effort expectancy (EE), and facilitating condition (FC) positively influence teachers' behavioral intention (BI) to use metaverse applications. On the flip side, personal innovativeness (PI) does not significantly impact performance and EE. Trialability (TR) and corporeity (CR) also do not influence EE. However, hedonic motivation (HM), compatibility (CO), TR, interactivity (IN), and persistence are significant factors for performance and EE.

Corresponding Author:

Mohamad Noorman Masrek
Faculty of Information Science, Univesiti Teknologi MARA
Shah Alam, Selangor, Malaysia
Email: mnoorman@uitm.edu.my

1. INTRODUCTION

Education is critical to shape the character and success of the nation. Delivering appropriate and quality material from early school is essential for students to study. However, the quality of Indonesian education still needs more attention. Education observers also suspect that most schools in Indonesia still adopt the 2.0 education system, and this also causes the country to lag behind other developed countries. It is time for Indonesia to change to education system 4.0 by using modern learning media.

To overcome these concerns, one of the government efforts through the Ministry of Education, Culture, Research, and Information Technology has formulated an independent learning policy where students can learn from any source and study across different schools or universities. This effort is a breakthrough that requires schools to be more creative in using technology to reach students from all over the country so the education quality will be more universal. With this condition, schools must adopt technology

to increase education quality. Interactive technology may be a solution to overcome students' lack of motivation. For example, learning with metaverse-based applications.

Metaverse is very suitable for education because of its features, such as connecting people, representing the physical world, and real-time communication. The public increasingly recognized the metaverse with the second life game in 2003, providing a virtual place for people to interact [1]. Metaverse is famous since the announcement of the metaverse project by Mark Zuckerberg in mid of 2021 [2]. The metaverse is also considered appropriate to be applied in the current era of education because it is ideal for case-based learning [3].

In Indonesia, metaverse is still a new term, but the educational sectors have begun to develop it in Indonesia. Even in 2021, the Banten Government plans to implement a metaverse in 14 schools in Banten, Indonesia. But after several condition, the idea was cancelled. There are several reasons behind this cancellation, one of the reasons is because of the lack of teacher's readiness and intention to adopt such technology. This brings us to the core issue which is the successful implementation of educational innovations like the metaverse depends on the acceptance of teachers. Yet, existing studies on metaverse adoption in education have predominantly focused on students or the technological infrastructure, leaving a significant gap in understanding teachers' perspectives. The novelty of this research is to find the factors that will influence the teachers in Indonesia would like to use metaverse technology. Many research is also interested in the new technology of the metaverse. However, there is limited research that focuses on the teachers as the subject of acceptance of using this technology. The role of the teacher is significant. Teachers must find and analyze students' behavior in the metaverse-based application. Teachers must be able to design classes and learning plans that can support students in solving problems [4]. Ultimately, students' motivation to learn through online platforms will increase [5].

2. METHOD

This study uses quantitative research methodology. Quantitative research is scientific research that emphasizes the analysis of numerical data processed by statistical methods, quantitative research aims to develop and use mathematical models, theories, or hypotheses related to existing problems.

2.1. Theoretical framework

This study combines unified theory of acceptance and use of technology (UTAUT) and diffusion innovative theory (DIT) as two powerful models to measure technology acceptance as the leading theory. The UTAUT model explains the adoption of the technology, while the dimensions in DIT, such as relative advantage, complexity, and compatibility (CO), are also a major reasons for innovative invention adoption [6]. Therefore, adopting information systems or information technology using UTAUT or DIT will complete each other and a stronger model can be built by combining these two models.

In addition, this research will investigate the individual willingness to adopt new innovative technology. This could enhance the adoption model. Individual innovativeness or individual willingness to try out a new technology is known as personal innovativeness (PI) [3]. Therefore, it will be appropriate to add PI to this research. Other research also combines this theory in the acceptance model and DIT [7]. Furthermore, this research will provide a new theory related to the characteristic of metaverse as the dimension, the unique dimension of the object character, will bring more accurate results for this research. The metaverse characteristic will also be added to the study. Based on the literature review and previous research, the proposed model is shown in Figure 1.

This study finds the factors of teachers' behavioral intention (BI) in using metaverse application. BI is the core determinant of the actual usage in various intention model [8]. It refers to the users' perception of they want to use the new system. BI can significantly influence the actual usage of the new technology [9]. In education, BI provides insights into teachers' and students' motivation and readiness to adopt new tools, methods, and practices [8]. Several factors that could affect the BI are social influence (SI), performance expectancy (PE), effort expectancy (EE), and facilitating condition (FC). SI is defined as the level of influence from people in the surroundings, in the context of learning, this factor is a factor that can determine use in the system [10]. PE refers to the users' opinion that using the system of innovation will increase their performance. EE is defined as how easy it is for a new system or technology to be used by users. EE is very important in determining how users are willing to use new technology, including in learning or education [8]. FC refers to the users' belief in technical infrastructure that could support the process. This FC will measure the confidence of the users to use the application and, in the end, will promote the intention to use it [11].

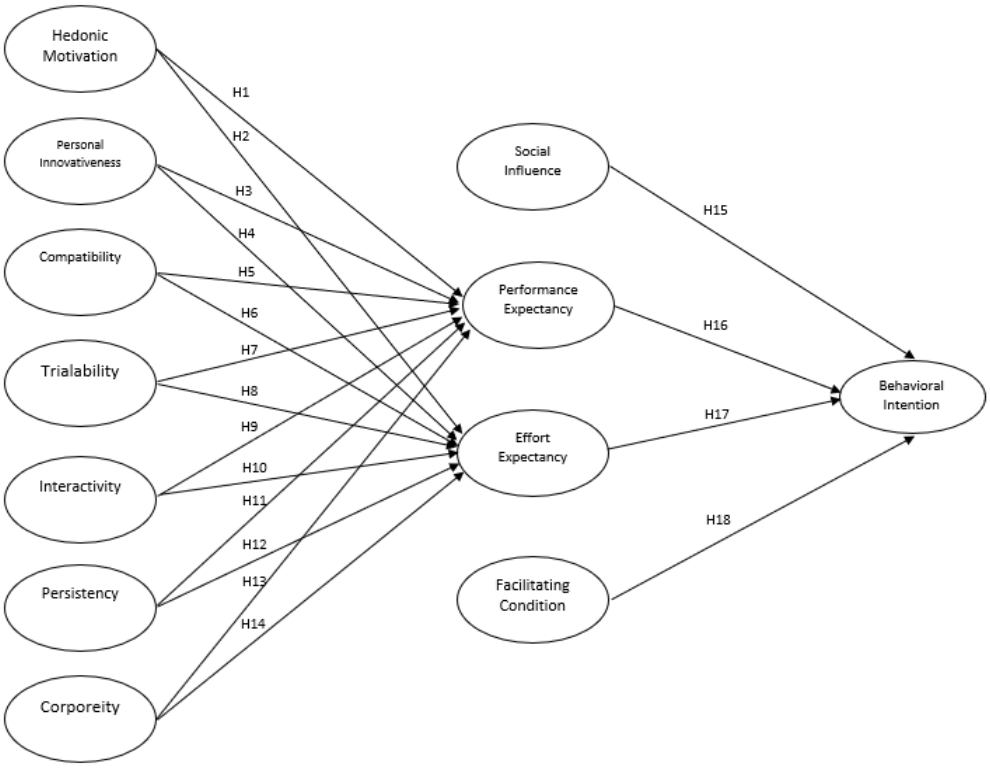

Figure 1. Proposed theoretical framework

Both of PE and EE can be affect by several factors. Hedonic motivation (HM) refers to the pleasure obtained from the use of technology. PI play an important role in the technology adoption theory, especially in the perceived usefulness and ease of use [7]. PI can affect perceived usefulness and perceived ease of use in technology acceptance model (TAM), or these two factors also known as PE and EE [3]. CO Refers to the expectation of the users if the innovation is compatible with their standards such as consistent with the value provided, needs, and expectations. Trialability (TR) refers to the users assuming they must experience the technology before deciding whether to adopt it [7].

To address the novelty of this research, three novelty variables added into this research, they are come from metaverse characteristic. Interactivity (IN) is characteristic of metaverse. It refers to the users' interaction with the platform and other users, ensuring real-time, interoperable, and synchronous learning. Through these characteristics, the metaverse provides interaction among users. Users have to be able to interact in real time in the platform. They can meet others and share with others [3]. Persistency (PR) is the other metaverse characteristic. It refers to users feeling "live" in the platform, ensuring data continuity such as identity, payment, and communication and ensuring it saves even when users are not using the virtual platform. PR is the key feature of metaverse and is important in the platform [3]. Corporeity (CR) is the third characteristic of metaverse. CR allows users to interact with the system in their own sense, such as using avatars, and virtual entities that represent the users [3]. These characteristics allow users to have their own identities in the virtual world [12]. CR could influence PE and EE because the activity could be carried out more efficiently and effectively with this feature.

2.2. Population and sample

The questionnaire will be distributed online and will target active senior high school teachers. In 2022, Indonesian Government planed 14 schools will use metaverse in teaching and learning, these 14 schools are selected because of the readiness of the infrastructure and technology. The population of the selected school is 840 teachers.

Simple regression analysis requires 50–100 sample sizes for most research situations. There are many ways to determine the sample size. From the table, the population of teachers is 840 teachers, and to choose the sample, this study uses the Krejcie and Morgan table guideline [13]. Based on the table, the minimum sample size required is 265 respondents. The sampling technique for this study is purposive convenience, which means the respondents will be collected from the chosen school, but any teachers may be involved if they want.

2.3. Survey instrument

The questionnaire adopts a Likert scale. Writing a Likert scale with 4 points or less is not recommended, and the most ideal is 7 points. Still, it is also mentioned that there is a bias if there is a neutral answer choice for an odd number of choices because respondents will tend to answer neutral option. Therefore, this study uses 6 points with the following details: scale 1=strongly disagree, scale 2=disagree, scale 3=moderately disagree, scale 4=moderately agree, scale 5=agree, and scale 6=strongly agree. A total of 48 questions related to the variable were developed and ready to be distributed to the teachers.

2.4. Data analysis

This study used structural equation modeling (SEM) to assess if a measurable variable or indicator effectively describes or expresses a number of factors. SEM is a multivariate technique incorporating multiple regression and factor analysis elements. It enables researchers to investigate a number of dependence relationships between latent variables at the same time [14]. The data analysis will be supported by SmarPLS software version 4.

3. RESULTS AND DISCUSSION

The questionnaires were distributed online using Google Forms. A total of 334 responses were collected. This study uses all of the responses. All of the respondents are teachers from the selected schools, and the teachers are exposed to the metaverse application.

3.1. Descriptive analysis

This study also evaluates the descriptive statistics. The purpose of descriptive statistics is to arrange and summarize data systematically. The statistics entail condensing and displaying the arrangement of interconnected variables in the investigation. The study documented the values of mean, standard deviation, standard error, and variance. Table 1 detailed the descriptive statistics of each variable which include the mean, standard deviation, standard error, and variance.

Based on Table 1, the overall mean score for the descriptive analysis of all variables is 4.82. This average indicates that, on a scale of measurement used in the study, respondents generally showed a moderate level of agreement regarding the use of metaverse applications for teaching and learning purposes. The result suggests a positive perception among respondents, although not at the highest level of agreement, highlighting an openness to adopting metaverse technology in educational settings while still possibly reflecting some reservations or the need for further familiarity with the technology.

Table 1. Descriptive analysis

Variables	Mean	Std. Dev	Std. Error	Var
HM	4.89	0.95	0.04	0.91
PI	4.83	0.99	0.05	0.99
CO	4.71	1.01	0.05	1.04
TR	4.86	0.96	0.05	0.94
IN	5.07	0.60	0.11	0.50
PR	4.83	0.96	0.05	0.93
CR	4.85	0.95	0.05	0.91
SI	4.68	1.04	0.05	1.09
PE	4.78	0.85	0.11	0.79
EE	4.78	0.99	0.05	0.99
FC	4.76	1.04	0.05	1.13
BI	4.83	0.99	0.05	0.98
Overall mean	4.82			

3.2. Measurement model assessment

This study assesses the convergent validity refers to how well a construct explains the variance in its indicators. Convergent validity is measured by the average variance extracted (AVE). A minimum acceptable AVE is 0.50 [14]. Besides that, internal consistency dependability also tested, it refers to how well indicators measuring the same construct correlate. One of the measurements is to measure the composite reliability and Cronbach's alpha, The higher number suggests a better degree of reliability [14]. The suggested value of Cronbach's alpha is >0.6 [15]. Table 2 shows the internal consistency of the reliability value of each variable.

Table 2 presents the reliability result, showing that all Cronbach's alpha, CR (rho_a) and CR (rho_c) exceed 0.6 while AVE values exceed 0.5, thus confirming the reliability of all variables. Next is to evaluate discriminant validity. This metric evaluates how different a construct is from others in the structural model.

This research uses Fornell and Lacker's criterion because this technique is the most technique used for discriminant validity test. Every construct should have an average variance shared with its measure that is higher than the variance shared with other constructs. In this instance, the correlations for all reflective constructions were smaller than the diagonal or the square root of AVE [14]. Table 3 shows the result of discriminant validity by using Fornell and Lacker analysis.

Table 3 presents the results of the discriminant validity assessment using the Fornell and Larcker criterion. The diagonal elements (highlighted) represent the square root of the AVE for each construct. Each diagonal value is greater than the corresponding inter-construct correlations in its row and column, confirming that each construct shares more variance with its own indicators than with other constructs. Therefore, all constructs exhibit satisfactory discriminant validity.

Table 2. Internal consistency reliability value

Variables	Cronbach's alpha	CR (rho_a)	CR (rho_c)	AVE
BI	0.821	0.824	0.882	0.651
CO	0.815	0.817	0.878	0.643
CR	0.808	0.808	0.874	0.635
EE	0.810	0.811	0.876	0.638
FC	0.811	0.812	0.876	0.638
HM	0.799	0.799	0.869	0.624
IN	0.608	0.612	0.836	0.718
PE	0.781	0.783	0.873	0.696
PI	0.734	0.739	0.849	0.653
PR	0.814	0.815	0.877	0.642
SI	0.774	0.775	0.869	0.689
TR	0.737	0.739	0.884	0.792

Table 3. Discriminant validity–Fornell and Lacker analysis

Variable	BI	CO	CR	EE	FC	HM	IN	PE	PI	PR	SI
BI	0.807										
CO	0.783	0.802									
CR	0.727	0.719	0.797								
EE	0.754	0.751	0.664	0.799							
FC	0.702	0.686	0.587	0.725	0.799						
HM	0.622	0.747	0.628	0.664	0.620	0.790					
IN	0.652	0.695	0.725	0.675	0.574	0.640	0.847				
PE	0.737	0.777	0.745	0.732	0.689	0.736	0.716	0.834			
PI	0.699	0.760	0.709	0.660	0.617	0.729	0.720	0.749	0.819		
PR	0.723	0.736	0.739	0.687	0.654	0.716	0.705	0.793	0.718	0.838	
SI	0.724	0.789	0.673	0.735	0.663	0.683	0.655	0.744	0.703	0.768	0.830
TR	0.598	0.703	0.636	0.611	0.623	0.713	0.631	0.736	0.726	0.740	0.660

3.3. Structural model assessment–hypothesis testing

This part shows the result of structural model assessment and hypothesis testing decision. The hypothesis result is based on t-statistic and p-value presented on the table. The hypothesis will be supported if the result of t-statistic is >1.96 and p-value <0.05 [14]. Another test also presents in this table such as f-square, variance inflation factor (VIF), R-square, and Q-square.

The goal of (f2) evaluation is to determine predator constructs' degree of effect size of an endogenous construct. Regarding the degree of effect size, the suggested f2 values of 0.35, 0.15, and 0.02 are regarded as large, medium, and small. VIF value is to ensure the data is free from multicollinearity, recommended value of VIF is <5 [14]. The R^2 indicates the amount of variance in the dependent variable that can be explained by the various independent variables connected to it. A value of 0.75 is considered substantial, 0.50 is moderate, and 0.25 is weak [14]. Aside from the R-square, the Q-square also measured in this study. The value of Q square is good if the value is >0. The degree of the effect can be categorized into several categories. The value of 0.02 is weak, 0.15 is moderate, and above 0.35 is strong. Table 4 presents the summary of structural model assessment result including the value of t-statistic, p-value, f-square, VIF, R-square, VIF, R-square, and Q-square.

As shown in Table 4, a total of 18 hypotheses were tested in this study. The results indicate that fourteen hypotheses were supported, meaning that the proposed relationships between the constructs were statistically significant. Meanwhile, four hypotheses were not supported, suggesting that these relationships did not achieve statistical significance and thus were rejected. These findings imply that most of the theoretical assumptions in the research model were validated by the data, while a few relationships require further investigation or may be influenced by contextual factors specific to the study setting.

Table 4. Result of structural model assessment

Hypothesis	Relationship	T statistics	P values	Decision	f-square	VIF	R-square	Q-square
H1	HM→PE	2.273	0.012	Supported	0.020	2.979	0.758	0.750
H3	PI→PE	1.554	0.060	Not supported	0.008	3.476		
H5	CO→PE	2.895	0.002	Supported	0.040	3.473		
H7	TR→PE	2.514	0.006	Supported	0.024	2.889		
H9	IN→PE	1.746	0.040	Supported	0.012	2.770		
H11	PR→PE	4.329	0.000	Supported	0.068	3.485		
H13	CR→PE	2.741	0.003	Supported	0.034	2.982		
H2	HM→EE	1.664	0.048	Supported	0.013	2.979	0.632	0.605
H4	PI→EE	0.079	0.469	Not supported	0.000	3.476		
H6	CO→EE	4.426	0.000	Supported	0.111	3.473		
H8	TR→EE	0.304	0.381	Not supported	0.000	2.889		
H10	IN→EE	3.317	0.000	Supported	0.031	2.770		
H12	PR→EE	2.032	0.021	Supported	0.015	3.485		
H14	CR→EE	1.212	0.113	Not supported	0.008	2.982		
H15	SI→BI	3.169	0.001	Supported	0.048	2.777	0.678	0.676
H16	PE→BI	3.997	0.000	Supported	0.063	2.865		
H17	EE→BI	4.100	0.000	Supported	0.085	3.018		
H18	FC→BI	2.559	0.005	Supported	0.046	2.437		

3.4. Discussion

3.4.1. The relationship between social influence and behavioral intention

The relationship between SI and BI is found significant. In other words, the hypothesis is accepted. SI is defined as the level of influence from people in their surroundings. The influence of people can be a factor that can determine the intention of the system use [10]. SI greatly determines BI in educational metaverse. Another study also in line with the result of this study. The influence not only from the people in work, the SI can come from the people closest to the individual, such as family, friends, siblings, and cousin [9]. The study from Wang and Shin [16] found that social impact and social needs can contribute to the intention of using metaverse applications for teaching and learning. The result indicates that the usage or adoption of metaverse application for teachers can be influence by the people surround the individuals. In addition, the result of the study can provide practical advice to the institution and government as educational policy makers to promote metaverse.

3.4.2. The relationship between performance expectancy and behavioral intention

The relationship between PE and BI is significant. The hypothesis is accepted. Several studies found the same result that PE positively influence intentions to use technology. A study from Lee [17] agree that PE could influence the BI in the metaverse platform. The result also shows the significant result. Another similar research from Teng *et al.* [12] also shows the same result based on student perception of using the metaverse platform, the result indicates that students believe if using metaverse application can support their learning performance.

To explain the result, teachers may argue that using metaverse applications provides a creative and engaging approach, which can increase student motivation and engagement. So, if the teachers belief that metaverse application can increase their performance, they will use the application [18]. The result of the study supports the assumption that users are likely to utilize a system if they think that it will render their performance become more efficient and effective.

3.4.3. The relationship between effort expectancy and behavioral intention

The relationship between EE and BI was found significant. Several studies have the same results that EE affect BI. A study from Khalil *et al.* [18] which discusses the implementation of metaverse in Pakistani education support the result of this study. According to the result, EE have a positive effect on user intentions [18]. If the metaverse supposed to be easy to use, it can increase self-confidence to use the technology, making users more likely to adopt metaverse. Other studies also present the same results which support the finding of this study. When people believe that a technology requires little effort and is relatively easy to learn and use, they are more likely to want to use it [10].

3.4.4. The relationship between facilitating condition and behavioral intention

The relationship between FC and BI is found to be significant. The result of this study is in line with study from Nikolopoulou *et al.* [8]. The study investigates the mobile learning behavior and found FC as one of the important factors that could influence the behavior intention of student. FC will influence the intention to use the new technology. It will measure the users' confidence in using the application and, ultimately, promote the intention to use. Furthermore, there are also the same study that investigated the factors of

acceptance in metaverse in education [11], who found at the facilitation conditions positively influenced BI to use metaverse applications. Metaverse is a high-end technology that requires a high requirement of network and other supporting condition.

3.4.5. The relationship between hedonic motivation and performance expectancy

The relationship between HM and PE is significant. The result of this study is in line with the study conducted by Al-Adwan *et al.* [19], which found that perceived enjoyment positively influences PE when using metaverse applications for teaching and learning. In other words, teachers may think technology can help them to increase their work performance if they enjoy using the applications [19]. If teachers take pleasure in the technology, they are more likely to consider it beneficial, which has a favorable impact on the expectations placed on their students' performance.

3.4.6. The relationship between hedonic motivation and effort expectancy

Based on the result, the relationship between HM and EE is significant. Several previous studies have the similar result with this study. According to Choi [20], hedonism can influence EE. A person with hedonism will be more likely to get involved and excited about work they do. This will increase the level of involvement and lead to a feeling that the work is more pleasurable and less demanding, positively influencing the expectation of effort by making the task seem easier to perform.

3.4.7. The relationship between personal innovativeness and performance expectancy

Based on the result, the relationship between PI and PE found not significant. It indicates that teachers' PI do not relate to teachers' PE. The result of this study found contradicts with several studies that indicates a positive relationship, such as study from Qolbi *et al.* [21]. Although many previous study that contradict with the study, there is study that found PI not significant to predicts the intention to use, a study from Khasawneh *et al.* [22] found PI does not have a significant influence on intention to use of digital wallets. Another study that aligns with the result is from Kumar and Dami [23], who found PI shows no significant influence on perceived usefulness or PE for millennials to use e-money card. Personal innovation may only lead to increase the performance if the innovative people believe the new technology is compatible with their responsibility.

3.4.8. The relationship between personal innovativeness and effort expectancy

Based on the result, the relationship between PI and EE is not significant. This result because of metaverse is a new concept and not many schools implement this technology. Many people think metaverse is difficult to use, complex, and the resources is not available. If this is in the user mind, they cannot innovate and their idea cannot be used. Even for innovative people, this may cause doubts about whether the application is easy to use, Another study that aligns with the result is from Kumar and Dami [23], who found PI does not significantly influence the perceived ease of use. Teachers may be innovative, but if they are under significant time pressure, they might only expect that they can learn and implement a new technology with considerable effort.

3.4.9. The relationship between compatibility and performance expectancy

Based on the result, the relationship between CO and PE is significant. The result of this hypothesis is also in line with another research. CO can be a factor that can influence perceived usefulness, or PE. Furthermore, in Metaverse apps, the user intention depends on the platform's strengths and limitations, including performance, customization, and CO [24]. When a technology aligns with the user's goal, it enhances the probability that the user would regard the technology as advantageous for attaining those goals. Another research that supports this finding is by Akour *et al.* [7], who indicates CO positively influences PE for metaverse application adoption.

3.4.10. The relationship between compatibility and effort expectancy

Based on the result, the relationship between CO and EE is significant. The hypothesis that CO positively influence the EE is accepted. The significance is shown by the finding that the t-value is 4.426 and the p-value is 0.000. This indicates that the teacher's EE increases if CO increases. According to Akour *et al.* [7], CO is a critical factor in influencing teachers' perceptions of the amount of work required to adopt and use educational technologies effectively, the result of this research also indicates that CO positively influence EE because CO makes sure that the metaverse helps and improves the educational goals and aims. So, it is very important by the institution to ensure the alignment of the technology with the current teaching method because it can increase the perceived ease of use, reduce the effort, and at the end will increase the intention to use.

3.4.11. The relationship between trialability and performance expectancy

Based on the result, the relationship between TR and PE is significant. The result of this study is also supported by Almarzouqi *et al.* [3] who said if people need to try a new application and the innovation provided and in a learning context, perceived TR has been used to investigate the satisfaction of metaverse applications in medical education. Users who can experiment with a technology are more likely to be satisfied and continue using it [25]. This can happen because TR allows users to experience the innovation directly. Users can evaluate the effectiveness of the innovation in meeting their requirements or resolving their issues firsthand during this encounter. Another study also found if TR could increase the intention of use due to the familiarity of the system which indicates the increasing of performance [26].

3.4.12. The relationship between trialability and effort expectancy

Based on the result, the relationship between TR and EE is not significant. However, a study found contradicts with this result, TR can significantly influence the satisfaction in using metaverse application according to Handoko *et al.* [27]. However, this study also in line with Aziz and Wahid [28] who found TR is not significant in determine the adoption in Manufacturing company. One reason TR is not significant is that teachers may have several perceptions. Even when teachers can test out a new technology or technique, their judgments of the continuous effort needed to incorporate it into their teaching practice may remain the same from that trial. Therefore, TR may not impact EE.

3.4.13. The relationship between interactivity and performance expectancy

Based on the result, the relationship between IN and PE is significant. Metaverse has unique characteristics that distinguish it from other applications. One of these is IN. In a learning context, IN means a group of people learning and doing activities together. They can communicate and discuss without limitation of space and time [12]. It also refers to the ability of users to actively engage with the virtual environment and each other in real-time. According to Arghashi and Yuksel [29], IN is a component in AR Technology and it is very important in determining the perceived usefulness to increase user engagement. IN in metaverse applications allows teachers to collect instantaneous feedback and assessment data on students' advancement.

3.4.14. The relationship between interactivity and effort expectancy

Based on the result, the relationship between IN and EE is significant. This IN will happen like in the physical world. IN can support collaborative learning and enable access to all learning resources [7], increasing the performance of every user and helping them perform a task better. IN can also help users to communicate with each other and solve problems. Metaverse applications have interactive features and interfaces, which may lessen teachers' perceived effort to explore and use these technologies. When teachers demonstrate their work with interactive feature provided by metaverse, they are more likely to perceive using the metaverse as a manageable application [30].

3.4.15. The relationship between persistency and performance expectancy

Based on the results of the data analysis, the hypothesis of PR positively influencing the performance expectation application is supported. The result of this study is significant because PR is the key feature of the metaverse and is important in the platform [3]. In a persistent metaverse, teachers can create educational material that lasts a long time. Teachers can create lessons, simulations, or virtual schools that students can access anytime, even after the first class. As a result, students can learn and review at their own pace, which allows for online learning and review. When teachers see that the things, they teach continue to help students in the long run, they may feel like their work is more meaningful and improve their performance.

3.4.16. The relationship between persistency and effort expectancy

Based on the result, the hypothesis that PR positively influences the EE application is supported. Persistence in metaverse apps keeps simulated worlds, assets, identities, events, and data in the same state and continuity over time. This feature is important to make the experiences in the metaverse feel more interesting and immersive. It also gives users a feeling of being present and belonging. Under persistence, users can save and keep their virtual activities even after they log out [31].

Therefore, good persistence will make teachers perceive that metaverse applications reduce their efforts in using the application. This is because all previous activities are stored and even previously provided material sources can be accessed again and of course the teacher's effort becomes easier. Persistence may affect EE for this reason. PR is novel variable added in this research, very limit study discusses about PR in any relationship. The result of this study will give contribution to enrich metaverse study.

3.4.17. The relationship between corporeity and performance expectancy

Based on the result, the t-value is 2.741 and the p-value is 0.003 which means the hypothesis CR positively influence PE is accepted. The ways that users act, present, and interact in the digital space are all part of CR. Most of these metaverse applications offer avatar creation or virtual versions of the users that exist in this virtual world, which can be further edited. For instance, people can change their avatar's appearance, clothes, trinkets, and details to make it look more like themselves or as a reflection of their style [32]. Another study also in line with the results, according to Akour *et al.* [7] that CR will bring reality to the virtual world, meaning that users can feel like being in their real world, and it could increase their performance in doing things similar to their real-life. When user is in a digital place but can interact with avatars or other virtual characters that represent themselves, users can feel like they have power and control in the virtual world through their avatars, and it will improve the quality of their work and their performance.

3.4.18. The relationship between corporeity and effort expectancy

The hypothesis of CR positively influence the EE application is not supported. The result supported by Barta *et al.* [33] that the creation of avatar is complicated in metaverse application which can affect the EE. This result may be due to certain conditions of the study. The CR feature in metaverse applications may positively influence users' participation as well as users' degree of immersion within the virtual environment. On the other hand, various factors may positively and negatively influence users' expectation of effort with regard to the usage of the application: complexity of interaction, technical issues, learning curve, choices for customizing, social dynamics, and perceived usefulness. Regarding motivating users to spend time investigating and interacting with the metaverse application, CR may not influence the EE.

4. CONCLUSION

The study shows that most teachers are interested in metaverse apps for education. Some variables that have the positive impacts are SI, PE, EE, and FC. The findings also indicate that PI does not significantly impact performance and EE, TR and CR also do not influence EE. However, HM, CO, TR, IN, and persistence positively influence performance and EE. Based on the result, some recommendations need to be focused from the institution to ensure the successful of the implementation. Institution has to develop clear policies and guidelines for metaverse teaching, ensure the infrastructure availability such as internet connection, and compatible devices. Institution also needs to prepare the hands-on training to increase the confident of the teachers. To leverage the SI, school can build a community for the educators to share their best practices and provide rewards for the success teachers in using metaverse application. This research will give insights to practitioners, especially the teachers who will use the new technology for teaching and learning. This research will give insight to the school and educators on how to support the teaching and learning more interactively by using metaverse technology. This research will also give some new insights to the government in extending the recent breakthrough of independent study to support equal study across schools in the country. Although this research's objective is achieved, some limitations of this study can be improved for future research. The sample group might not fully show the range of experiences, views, and levels of technological proficiency that teachers have in senior high schools. This could lead to an inaccurate picture of how people feel about metaverse adoption rates or views towards these technologies. Future studies can also implement the mixed method by understanding the school's readiness to implement the metaverse application. The interview method can be used by using more diverse and representative sample methods to get a broader range of views on how teachers feel about using the metaverse.

ACKNOWLEDGEMENTS

The authors would like to thanks to all respondents who contribute to this study, thank you to the experts for the contribution on the pre-test validation. This study also acknowledge the AI tools usage in paraphrasing and writing refinement, however all the analysis and idea are original from the authors.

FUNDING INFORMATION

The authors thanks to gratitude to Bina Nusantara University and Universiti Teknologi MARA for providing the funding for this study and preparing the facilities and resources needed for doing the research.

AUTHOR CONTRIBUTION

This journal uses the Contributor Roles Taxonomy (CRediT) to recognize individual author contributions, reduce authorship disputes, and facilitate collaboration.

Name of Author	C	M	So	Va	Fo	I	R	D	O	E	Vi	Su	P	Fu
Cadelina Cassandra	✓	✓	✓	✓	✓	✓		✓	✓	✓			✓	
Mohamad Noorman Masrek	✓	✓							✓	✓		✓		
Fadhilah Aman	✓								✓	✓		✓		

C : **C**onceptualization
M : **M**ethodology
So : **So**ftware
Va : **Va**lidation
Fo : **Fo**rmal analysis
I : **I**nvestigation
R : **R**esources
D : **D**ata Curation
O : Writing - **O**riginal Draft
E : Writing - Review & **E**diting
Vi : **Vi**sualization
Su : **Su**pervision
P : **P**roject administration
Fu : **Fu**nding acquisition

CONFLICT OF INTEREST STATEMENT

All authors declare there is no conflict of interest for doing this research in financial or personal. All authors agree for each of the research stage.

DATA AVAILABILITY

The datasets collected and analyzed during this investigation are not publicly available to protect the privacy of participants. However, the corresponding author [MNM] can provide upon reasonable request.

REFERENCES

[1] W. Suh and S. Ahn, "Utilizing the Metaverse for Learner-Centered Constructivist Education in the Post-Pandemic Era: An Analysis of Elementary School Students," *Journal of Intelligence*, vol. 10, no. 1, p. 17, Mar. 2022, doi: 10.3390/jintelligence10010017.

[2] A. M. Aburbeian, A. Y. Owda, and M. Owda, "A Technology Acceptance Model Survey of the Metaverse Prospects," *AI*, vol. 3, no. 2, pp. 285–302, Apr. 2022, doi: 10.3390/ai3020018.

[3] A. Almarzouqi, A. Aburayya, and S. A. Salloum, "Prediction of User's Intention to Use Metaverse System in Medical Education: A Hybrid SEM-ML Learning Approach," *IEEE Access*, vol. 10, pp. 43421–43434, 2022, doi: 10.1109/ACCESS.2022.3169285.

[4] B. Kye, N. Han, E. Kim, Y. Park, and S. Jo, "Educational applications of metaverse: possibilities and limitations," *Journal of Educational Evaluation for Health Professions*, vol. 18, p. 32, Dec. 2021, doi: 10.3352/jeehp.2021.18.32.

[5] J.-E. Yu, "Exploration of Educational Possibilities by Four Metaverse Types in Physical Education," *Technologies*, vol. 10, no. 5, p. 104, Sep. 2022, doi: 10.3390/technologies10050104.

[6] M. Al-kfairy, S. Ahmed, and A. Khalil, "Factors impacting users' willingness to adopt and utilize the metaverse in education: A systematic review," *Computers in Human Behavior Reports*, vol. 15, p. 100459, Aug. 2024, doi: 10.1016/j.chbr.2024.100459.

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

[8] K. Nikolopoulou, V. Gialamas, and K. Lavidas, "Habit, hedonic motivation, performance expectancy and technological pedagogical knowledge affect teachers' intention to use mobile internet," *Computers and Education Open*, vol. 2, p. 100041, Dec. 2021, doi: 10.1016/j.caeo.2021.100041.

[9] U.-K. Lee and H. Kim, "UTAUT in Metaverse: An 'Ifland' Case," *Journal of Theoretical and Applied Electronic Commerce Research*, vol. 17, no. 2, pp. 613–635, Apr. 2022, doi: 10.3390/jtaer17020032.

[10] F. Yang, L. Ren, and C. Gu, "A study of college students' intention to use metaverse technology for basketball learning based on UTAUT2," *Heliyon*, vol. 8, no. 9, p. e10562, Sep. 2022, doi: 10.1016/j.heliyon.2022.e10562.

[11] S. H. Alshammari and M. E. Alrashidi, "Factors Affecting the Intention and Use of Metaverse," *International Journal of Information and Communication Technology Education*, vol. 20, no. 1, pp. 1–14, Apr. 2024, doi: 10.4018/IJICTE.342591.

[12] Z. Teng, Y. Cai, Y. Gao, X. Zhang, and X. Li, "Factors Affecting Learners' Adoption of an Educational Metaverse Platform: An Empirical Study Based on an Extended UTAUT Model," *Mobile Information Systems*, vol. 2022, pp. 1–15, Aug. 2022, doi: 10.1155/2022/5479215.

[13] R. V. Krejcie and D. W. Morgan, "Determining Sample Size for Research Activities," *Educational and Psychological Measurement*, vol. 30, no. 3, pp. 607–610, Sep. 1970, doi: 10.1177/001316447003000308.

[14] J. F. Hair, G. T. M. Hult, C. M. Ringle, M. Sarstedt, N. P. Danks, and S. Ray, *Partial Least Squares Structural Equation Modeling (PLS-SEM) Using R*. Cham: Springer International Publishing, 2021, doi: 10.1007/978-3-030-80519-7.

[15] M. A. Arilaha, J. Fahri, I. Buamonabot, and M. A. Arilaha, "Customer Perception of E-Service Quality: An Empirical Study in Indonesia," *Journal of Asian Finance*, vol. 8, no. 6, pp. 287–0295, 2021, doi: 10.13106/jafeb.2021.vol8.no6.0287.

[16] G. Wang and C. Shin, "Influencing Factors of Usage Intention of Metaverse Education Application Platform: Empirical Evidence Based on PPM and TAM Models," *Sustainability*, vol. 14, no. 24, p. 17037, Dec. 2022, doi: 10.3390/su142417037.

[17] K.-A. Lee, "A Study on Immersive Media Technology in the Metaverse World," *Journal of The Korea Society of Computer and Information*, vol. 26, no. 9, pp. 73–79, 2021, doi: 10.9708/jksci.2021.26.09.073.

[18] A. Khalil, A. Haqdad, and N. Sultana, "Educational Metaverse for Teaching and Learning in Higher Education of Pakistan," *Journal of Positive School Psychology*, no. 2, pp. 1183–1198, 2023,

[19] A. S. Al-Adwan, N. Li, A. Al-Adwan, G. A. Abbasi, N. A. Albelbisi, and A. Habibi, "Extending the Technology Acceptance Model (TAM) to Predict University Students' Intentions to Use Metaverse-Based Learning Platforms," *Education and Information Technologies*, vol. 28, no. 11, pp. 15381–15413, Nov. 2023, doi: 10.1007/s10639-023-11816-3.

[20] Y. Choi, "A Study on Factors Affecting the User Experience of Metaverse Service," *International Journal of Information Systems in the Service Sector*, vol. 14, no. 1, pp. 1–17, Oct. 2022, doi: 10.4018/IJISSS.313379.

[21] A. Qolbi, R. Sukmana, R. T. Ratnasari, and N. S. Sari, "The Role of Personal Innovativeness on Behavioral Intention Waqf Online: Extention of Technology Acceptance Model," *Jurnal Ekonomika dan Bisnis Islam*, vol. 7, no. 1, pp. 1–17, 2024.
[22] M. H. Al Khasawneh, M. Al-Rousan, S. Al-Haddad, A.-A. A. Sharabati, and R. Sewan, "Factors affecting consumers' behavioral intentions to use and adopt digital wallets," *International Journal of Data and Network Science*, vol. 8, no. 2, pp. 1197–1212, 2024, doi: 10.5267/j.ijdns.2023.11.014.
[23] S. Kumar and M. Dami, "Integrating Diffusion of Innovation to Technology Acceptance Model: A Survey of Millennials' Intention to Use E-Money Card," in *International Conference on Business and Engineering Management (ICONBEM 2021)*, 2021, pp. 1911–198, doi: 10.2991/aebmr.k.210522.026.
[24] A. S. Alkhalidi, M. Izani, A. R. Aishah, and F. Mustafa, "Exploring the Virtual Space in the Metaverse: A Case Study Analysis," in *2023 Intermountain Engineering, Technology and Computing (IETC)*, 2023, doi: 10.1109/IETC57902.2023.10152097.
[25] E. Anggraeni, K. Normasyhuri, and M. Kurniawan, "Continuity Intention Segment Mobile Payments: Review the Immediate Effects of Performance Expectancy and Effort Expectancy," *KnE Social Sciences*, 2024, doi: 10.18502/kss.v9i16.16266.
[26] D. N. Shatta and F. Shayo, "The influence of performance expectancy on e-procurement adoption model in developing countries: Tanzanians perception," *ITEGAM- Journal of Engineering and Technology for Industrial Applications (ITEGAM-JETIA)*, vol. 7, no. 29, pp. 4–12, 2021, doi: 10.5935/jetia.v7i29.754.
[27] B. L. Handoko, A. S. L. Lindawati, H. Sarjono, and M. Mustapha, "Innovation Diffusion and Technology Acceptance Model in Predicting Auditor Acceptance of Metaverse Technology," *Journal of System and Management Sciences*, vol. 13, no. 5, pp. 443–456, Sep. 2023, doi: 10.33168/JSMS.2023.0528.
[28] A. S. A. Aziz and N. A. Wahid, "Do New Technology Characteristics Influence Intention to Adopt for Manufacturing Companies in Malaysia?" in *First ASEAN Business, Environment, and Technology Symposium (ABEATS 2019)*, 2020, pp. 30–35, doi: 10.2991/aebmr.k.200514.008.
[29] V. Arghashi and C. A. Yuksel, "Interactivity, Inspiration, and Perceived Usefulness! How retailers' AR-apps improve consumer engagement through flow," *Journal of Retailing and Consumer Services*, vol. 64, 2022, doi: 10.1016/j.jretconser.2021.102756.
[30] V. Chamola *et al.*, "Metaverse for Education: Developments, Challenges and Future Direction." Aug. 29, 2023, doi: 10.20944/preprints202308.1872.v1.
[31] S. Richter and A. Richter, "What is novel about the Metaverse?" *International Journal of Information Management*, vol. 73, p. 102684, Dec. 2023, doi: 10.1016/j.ijinfomgt.2023.102684.
[32] C. E. George-Reyes, I. C. Peláez Sánchez, L. D. Glasserman-Morales, and E. O. López-Caudana, "The Metaverse and complex thinking: opportunities, experiences, and future lines of research," *Frontiers in Education*, vol. 8, p. 1166999, May 2023, doi: 10.3389/feduc.2023.1166999.
[33] S. Barta, S. Ibáñez-Sánchez, C. Orús, and C. Flavián, "Avatar creation in the metaverse: A focus on event expectations," *Computers in Human Behavior*, vol. 156, p. 108192, Jul. 2024, doi: 10.1016/j.chb.2024.108192.

BIOGRAPHIES OF AUTHORS

Cadelina Cassandra is Faculty Member of Bina Nusantara University in School of Information Systems since 2014 in Jakarta, Indonesia. Her area of research is in Education Technology, Digital Business, and System Development. She also has interest in UI/UX discipline, Project Management, and Information Systems and Design. She can be contacted at email: ccassandra@binus.edu.

Mohamad Noorman Masrek is a professor in the Faculty of Information Science, Universiti Teknologi MARA. With a wealth of experience and expertise, he has made significant contributions to the fields of information management, library science, knowledge management, and information technology. His research portfolio is extensive, with his work being published in numerous reputable journals and conference proceedings. He has secured multiple research grants from various local and international funding bodies. Beyond his research and academic endeavors, he has also made significant contributions to the scholarly community by serving as an editor and reviewer for several esteemed journals. He can be contacted at email: mnoorman@uitm.edu.my.

Fadhilah Aman is a senior lecturer in the field of Information Systems at Universiti Teknologi MARA (UiTM), Shah Alam, Malaysia. She holds a bachelor's degree in Electrical Engineering from Case Western Reserve University, United States, a master's degree in Information Technology from UUM, Malaysia, and a Ph.D. in Information Systems from Curtin University of Technology, Australia. To date, she has produced a number of scientific articles and academic works in local and international seminars and journals, focusing primarily on technology adoption, collaboration, and IoT. In addition to teaching duties, she has also been appointed as an international relations officer at the Centre of Information Science, UiTM. She can be contacted at email: fadhilahaman@uitm.edu.my.