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**Research Article**

# Factors Effecting on the Adoption of Metaverse in Higher Education: A Systematic Literature Review

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**ABSTRACT**

**Objectives**: Understanding the adoption and acceptance of metaverse systems is crucial and has been extensively studied by numerous academics.

**Methods**: This systematic review aimed to provide a comprehensive view of metaverse adoption in education by identifying forty-three research papers on the subject. This research covers various factors, models, methodologies, and countries where the metaverse is being used in education, making it an essential resource for educators and researchers aiming to embrace this innovative trend. This systematic review thoroughly examined 43 research papers published between 2019 and 2024.

**Results**: The study's main findings underscore the Technology Acceptance Model (TAM) as the predominant model for predicting people's acceptance of the metaverse system. Additionally, SmartPLS (PLS-SEM) has emerged as a crucial tool for verifying metaverse models. Notably, the reviewed research primarily focuses on investigating the factors affecting the adoption of the metaverse in higher education. In addition, most research was conducted in the UAE, China, Jordan, and India, highlighting the global relevance of the findings.

**Conclusions**: Metaverse is an exciting and interactive learning environment that offers vast digital spaces, enabling synchronous communication and shared experience among users.

**Keywords:** Metaverse, Factor, technology adoption and acceptance, higher Education, systematic review.

## INTRODUCTION

In the last few years, the world has witnessed rapid and remarkable developments in information and communications technology, especially in education, and one of these technologies is metaverse technology. (Maghaydah et al., 2024; Shi et al ., 2023; Lin et al., 2022). Perhaps the simplest definition of the metaverse is that it represents a three-dimensional (3D) virtual world in which people interact with each other as (Avatar) using digital technologies (Maghaydah et al., 2024; Shi et al. ., 2023; Lin et al., 2022; Rawat & Alami., 2023; Zhang et al., 2022). Definitions of the metaverse are not limited to the virtual world. Still, they are much broader and refer to the Internet as a whole, including the full scope of Augmented Reality (AR), Virtual Reality (VR), Mixed Reality, Avatars, blockchain technology, and immersive technology.(Maghaydah et al., 2024; Shi et al ., 2023; Chen et al., 2024; Rawat & Alami., 2023) The metaverse is not restricted to a single platform or technology. Still, it represents an emergence of different technologies, including VR, AR, artificial intelligence (AI), blockchain, and the Internet of Things (IoT).(Rawat & Alami., 2023; shi et al., 2023)It is a fully immersive and interactive digital environment that blurs the line between the real and virtual worlds.(Shi et al., 2023; Lee et al., 2021)

Facebook launched its virtual world in 2019, Horizon World. Mark Rosenberg, the company's owner, announced the company's name change to the Meta Platform and officially announced a commitment to developing this platform, on which many virtual world technologies were developed.(Maghaydah et al., 2024; Shi et al ., 2023; Cheng et al., 2022)

Higher education institutions have shown growing interest in the notion of the metaverse, which has emerged as a crucial and increasingly prominent area of focus in the last few years. (Shi et al ., 2023; Lin et al., 2022; Rawat & Alami., 2023) The virtual realm, the metaverse, provides an interactive educational space and a fresh perspective on real-time engagement.(Lin et al., 2022; Lee et al., 2021; Dwivedi et al., 2022 ;Jagatheesaperumal et al., 2024).

Metaverse offers a highly immersive learning environment that can boost student motivation by providing virtual platforms for participation in classes and communication with educators and peers through avatars. (Lin et al., 2022; Kabilan, 2023; Roy et al., 2023).The metaverse presents an enhanced, multifaceted educational experience, offering a three-dimensional representation of numerous subjects.(Barráez-Herrera, 2022; Kaddoura & Husseiny, 2023; Kabilan, 2023).It facilitates exploration and advancement in scientific fields, particularly in mathematics, medicine, and engineering. This enabled a more accurate understanding of these subjects and enhanced their comprehension. (Lin et al., 2022; Kaddoura and Husseiny, 2023; Kabilan, 2023).The process of adopting the metaverse in education remains a difficult and complex matter because there are not sufficient studies that include all the aspects that lead to the acceptance of the metaverse in education in terms of the factors, different theories, and methodologies used.(Sarıtaş & Topraklikoğlu, 2022; Lin et al., 2022; Chua & Yu, 2023) This results in a dearth of holistic comprehension of these studies and the failure to establish a systematic structure for integrating the metaverse into educational contexts.(Chua & Yu, 2023; Roy et al., 2023; ALFaisal et al., 2022).This literature review aims to analyze the adoption of metaverses in education, focusing on key fields and factors influencing its acceptance. It evaluates 43 research articles published between 2019 and mid-2024, identifying key research methods, models, and four research questions. The review emphasizes the need for further comprehensive investigation to address limitations and identify factors affecting metaverse adoption in education. The review aims to address the limitations of existing studies and provide a comprehensive understanding of the metaverse's potential in education.

**RQ1: What are the major factors influencing the adoption of metaverses in the education sector in the articles collected?**

**RQ2: Which countries were involved in the collected articles?**

**RQ3: What are the main models/general frameworks used in accumulated articles?**

**RQ4: What was the primary methodology used in the articles gathered?**

## 2. Literature Review

### 2.1 Metaverse in Education

The goal of education is to exchange the process of transferring information and data between learners, whether they are students, teachers, or lecturers, either inside the classroom or through e-learning. (Jagatheesaperumal et al., 2024; Zhang et al., 2022; Kabilan, 2023) Using an immersive three-dimensional digital environment such as AR, VR, and Mixed Reality enhances interaction between users, communicating through avatars or pseudonyms. (Maghaydah et al., 2024; Al-Emran et al., 2024). This leads to increased interaction and enthusiasm, as using an avatar gives the person an exact digital image in virtual reality. In other words, the presence of a character on the Internet has a counterpart in real life through which he can exchange information, experiences, and knowledge. (Keegan et al., 2023; Maghaydah et al., 2024). One of the most remarkable aspects of Metaverse's educational systems is the incorporation of artificial intelligence programs. (Lin et al., 2022; Shi et al., 2023; Kaddoura & Husseiny,2023). These programs were designed to provide everyone with an educational environment tailored to their specific skills and inclinations. (Kabilan, 2023; Kaddoura and Husseiny, 2023). This approach aims to enhance students' motivation to study and learn, allowing educators to focus on addressing their students' diverse needs. (Al-Emran et al., 2024; Lin et al., 2022) Accordingly, students will be immersed in an entire educational ecosystem, the Internet of Things, enhanced by artificial intelligence that uses big data analytics, and teachers will be able to monitor students' abilities through various lessons, increase their practical capabilities, innovation, and creativity, know where problems exist early, and determine appropriate treatment methods for these problems.(Kamalov & Gurrib, 2023; Maghaydah et al., 2024).The metaverse has the potential to improve accessibility and inclusivity in higher education by enabling students with physical disabilities or geographical limitations to participate in virtual classes and learning activities.( Zhang et al., 2022; Kaddoura & Husseiny, 2023) It expands educational opportunities for individuals who may have been excluded from traditional higher education. (Yenduri et al., 2023)

### 2.2Theories/ model used in the adoption

The rapid growth of technology has prompted a focus on understanding the human perspective and how customers desire and interact with future technologies. This involves exploring the acceptance of new technologies, developing IT systems, and examining theories related to the adoption of IT systems. The primary objective is to understand the factors influencing consumers' decisions to accept and embrace new technologies. Several theories have been used for the adoption of information technology:

| Theory name | Description |
|---|---|
| 1. The Diffusion of Innovations Theory (DOI) | Rogers categorized the general population into five groups based on their propensity to accept new technologies rapidly. (ALshammari & Rosli, 2020; Sharma et al., 2020). |
| 2. Information Systems Success Model(IS) | Is a theory of information systems (IS) that seeks to offer a thorough understanding of IS success by recognizing, examining, and illuminating the connections between six of the most significant success components typically used to evaluate information systems. (Aldammagh et al., 2021). |
| 3. The Theory of Reasoned Action (TRA or ToRA) | It is mostly used to foresee people's conduct. The TRA's main goal is to understand a person's voluntary conduct by examining their fundamental motivations. The Transtheoretical Model of Attitudes and Behaviors (TRA) states that the primary predictor of whether someone would perform a behavior is that person's motivation to do so (Alshammari & Rosli, 2020; Sharma et al., 2020). |
| 4. The theory of planned behavior (TPB) | That behavioral intention is the best predictor of human social behavior is the core tenet of the TPB. (ALshammari & Rosli, 2020; Sharma et al., 2020). |
| 5. Technology Readiness (TR) | is the probability that an individual will adopt and use new technologies to fulfill personal and professional goals (Parasuraman & Colby, 2001). |
| 6. The Technology Acceptance Model (TAM) | TAM tries to describe the broad factors influencing computer acceptance to better comprehend User behavior across a broad variety of endpoints and user communities. The primary TAM model includes and assesses two beliefs: perceived usefulness (PU) and perceived ease of use (PEU). Other factors, or external variables, as they are referred to in TAM, may influence an individual's belief in a system. The TAM2 is an enhancement of the original Technology Acceptance Model (ALshammari & Rosli,2020; PC Lai, 2017; Sharma et al., 2020). |
| 7. The Unified Theory of Acceptance and Use of Technology (UTAUT) | The UTAUT model attempts to explain the user's basic intentions and subsequent behavior when using an information system. Enabling variables, effort expectations, social influence, and performance expectations are the theory's four main constructs. (ALshammari & Rosli, 2020; PC Lai, 2017; Sharma et al., 2020). |

**Table 1: The model used in technology acceptance**

### 2.3 AR, VR technology

VR and AR technology is considered a basic feature of the metaverse, as it enables users to fully immerse themselves in interactive virtual environments and integrate them with the real world using special devices such as glasses, gloves, cellular devices, and tablets, as they work to transport the user to completely different worlds, as if they were real, helping him to immerse himself, be present, and participate. (Dong & Liu, 2022; Jagatheesaperumal et al., 2024, Maghaydah et al., 2024).

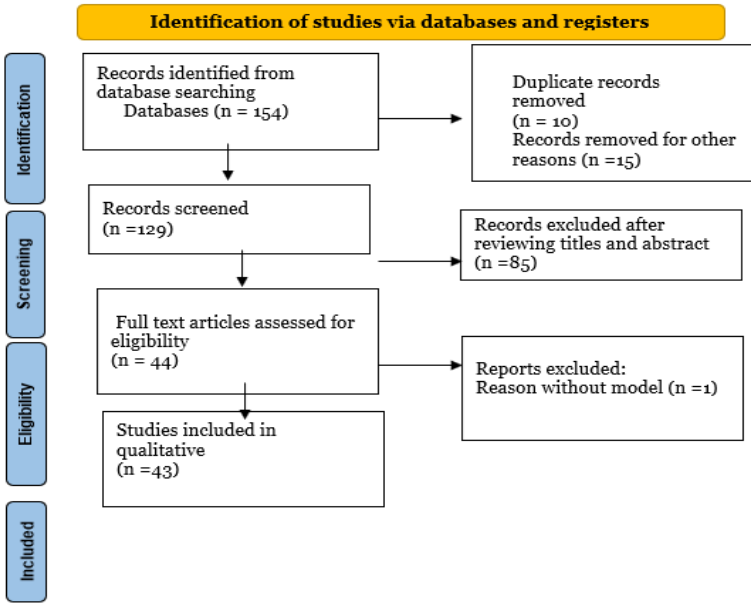


Fig1: PRISMA flowchart

## METHODS

We are conducting innovative research to determine the critical factors that drive acceptance of the metaverse in education. We use a thorough literature review method that is systematic, transparent, and replicable to gather, evaluate, and synthesize insights from previous research. Our study followed the PRISMA 2020 guidelines to provide an organized and structured analysis of global literature. (Yang et al., 2022) The formulation of research objectives is fundamental in guiding our systematic review process and shaping the focus of our study. Figure 1 illustrates the sequential phases of the research methodology used in this study.

Studies included in the systematic review

### 3.1 Eligibility

were required to meet specific criteria. They had to be written in English and had to have a framework or model that addressed at least one of the research objectives. Additionally, papers discussing the adoption of Metaverse in education, published between 2019 and 2024, were considered. Priority was given to empirical studies that examine relevant factors. Papers that were unrelated to the research objectives were inaccessible for verification. By applying these criteria, the review was based on high-quality, pertinent, and dependable studies. For a detailed overview of the evaluation criteria, please refer to the table.

### 3.2 Data sources and search strategies

The literature review conducted in this study gathered empirical and exploratory studies on the adoption of metaverse. The search process involves utilizing specific keywords and combining them with Boolean operators. These included terms such as "Metaverse “AND ("Adoption" OR "Acceptance" OR "Factor" OR "Intention" ) AND ("Education" OR "Learning"). The studies were gathered from different databases renowned for their extensive academic literature collection. These databases were selected based on three criteria: high impact, extensive disciplinary coverage, and an established track record of supporting meticulous systems reviews of the literature. We offer a wide range of quality articles from leading sources, including ACM Digital Library, Emerald, IEEE, ScienceDirect, Springer, Google Scholar, Taylor & Francis, and Wiley Online Library. This broad selection ensured a wide and varied collection of papers related to our research area. Our rigorous selection process minimized possible selection bias and omissions by adhering to specific inclusion and exclusion criteria. Relying on these databases is crucial in assessing journal performance and publication impact. This method enables us to incorporate a diverse array of studies crucial for understanding metaverse adoption in education while minimizing potential biases and omissions.

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### 3.3 Inclusion and exclusion criteria

| Inclusion Criteria | Exclusion Criteria |
|---|---|
| 1. Need to include the adoption of metaverse technology in Education. | 1. Articles on metaverse systems but not in the area of education |
| 2. Need to have a research Model /Framework | 2 . Articles not framed or modeled |
| 3. Should be published in English | 3. Articles published in non-English languages |
| 4. Must be published between 2019 and in the middle of 2024 | 4. paper published before 2019 |

Table 2:Inclusion and exclusion criteria

The search process is outlined in a figure detailing the number of studies at each stage. Initially, 154 studies were identified from the database. After removing 10 duplicates and excluding 15 for other reasons, 129 papers were screened. Summaries, introductions, and conclusions were reviewed at this stage, eliminating 85 articles. This left 44 papers for eligibility assessment, of which one was rejected. Ultimately, 43 articles were selected for data abstraction and summarization.

### 3.4 Collection and assessment of information

We gathered and organized data from the reviewed studies using a Microsoft Excel spreadsheet. For each study, we collected information such as the research aim, objective, problem, gap, year of publication, sample size, research type, data gathering methods, country, and research approach. Furthermore, we gathered information on the model types as well as independent, dependent, and moderating variables to enhance the reliability and validity of our data extraction and analytical procedures.

## 4. Results and discussion

**RQ1: What are the main determinants of acceptance of metaverses in learning? Used in articles collected**

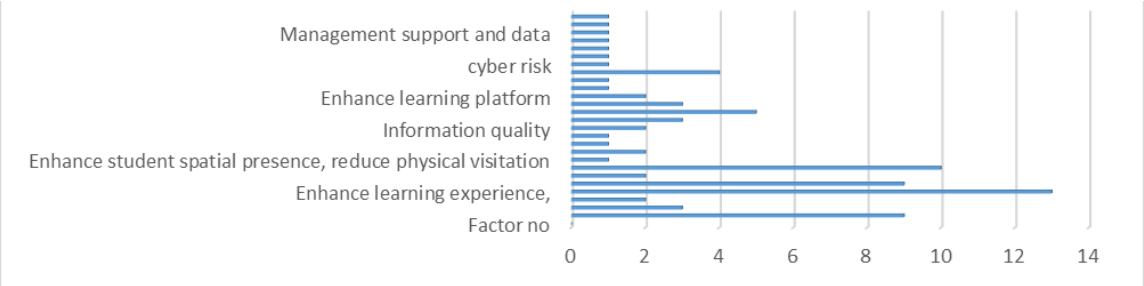
### 4.1 Key determinants of metaverse acceptance in learning environments

This section synthesizes the key research findings on the determinants of metaverse acceptance in education. Based on a comprehensive review of the existing literature, these findings provide a basis for developing a metaverse adoption framework.

Table 3: explain the factor

| Factors | Paper no | Count |
|---|---|---|
| enhancing student Engagement | 1,3,4,5,6,13,30,34,37,39,44 | 11 |
| Motivation and efficiency, | 1,6,27 | 3 |

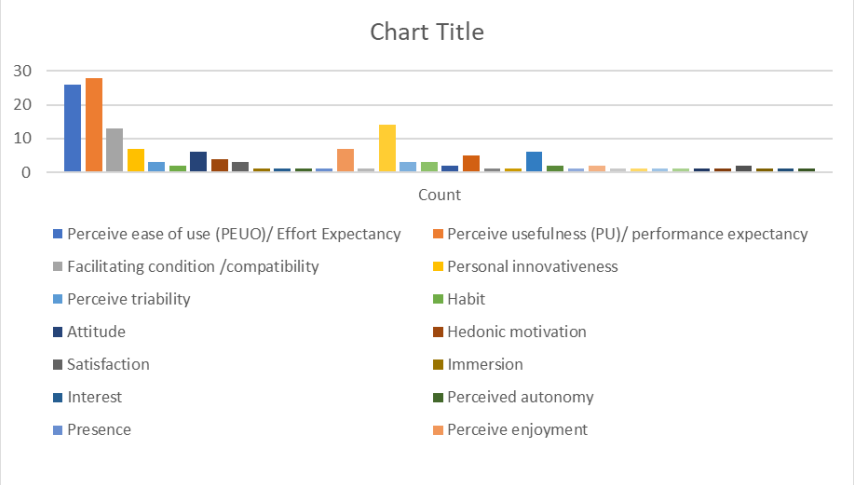
| | | |
|---|---|---|
| learning outcomes | 1,24,44 | 3 |
| Enhance learning experience, | 1,3,4,6,8,15,17,25,26, 29,30,39, 40,43 | 14 |
| Practical implication (educational practice) | 4,13,17,19,31,35,36,38,41 | 9 |
| Deep learning | 5,37 | 2 |
| Integrate innovative technologies and personality innovative | 7,8,13,14,18,19,20,21,25,40,44 | 11 |
| Enhance student spatial presence, reduce physical visitation | 5 | 1 |
| Privacy, accessibility, security, | 25,42 | 2 |
| System quality | 12 | 1 |
| Service quality | 12 | 1 |
| Information quality | 12,29 | 2 |
| Enhance user satisfaction, | 12,19,21, | 3 |
| Enjoyment, | 13,14,17,20,29 | 5 |
| Social sustainable, competitive, environment awareness and readiness | 31,34,41 | 3 |
| Enhance learning platform | 26,28 | 2 |
| Enhance supply chain resilience | 32 | 1 |
| critical thinking, and knowledge transfer & improving teaching effectiveness | 1 | 1 |
| immersive(interactive) education | 35,38,42 | 4 |
| cyber risk | 14 | 1 |
| usability | 12 | 1 |
| easy to use, | 29 | 1 |
| collaboratives' | 43 | 1 |
| Financial readiness | 2 | 1 |
| Management support and data | 2 | 1 |
| Positive staff culture | 2 | 1 |
| Versatility, adaptability | 30 | 1 |




| Variable | Paper-No | Count |
|---|---|---|
| Perceive ease of use (PEUO)/ Effort Expectancy | 1,3,4,5,7,12,14,15,18,19,20,21,23,25,26,27,28,29,30,33,38,39,40,41,4243, | 26 |
| Perceive usefulness (PU)/ performance expectancy | 1,3,3,4,5,7,8,12,14,14,15,15,18,19,20,21,23,25,26,27,28,29,30,32,33, 38,39,40,41,42,43 | 28 |
| Facilitating condition /compatibility | 3,4,5,7,12 ,18,21,25,28,32,33,41,42 | 13 |
| Personal innovativeness | 7,13,14,17,17,20,33 | 7 |
| Perceive liability | 7,40,33 | 3 |
| Habit | 7,41 | 2 |

| | | |
|---|---|---|
| Attitude | 4,5,28,37,38,39 | 6 |
| Hedonic motivation | 3,7,29,41 | 4 |
| Satisfaction | 21,33,36 | 3 |
| Immersion | 5 | 1 |
| Interest | 6 | 1 |
| Perceived autonomy | 13 | 1 |
| Presence | 32 | 1 |
| Perceive enjoyment | 14,17,19,20,26,27,40 | 7 |
| Entertainment | 15 | 1 |
| Social influence | 4,5,7,12,13,15,18,25,26,28,32,34,41,42 | 14 |
| Perceived observability | 7,33,20 | 3 |
| Perceive complexity | 7,17,33 | 3 |
| Perceive behavioral control | 4,13 | 2 |
| Self-efficacy (SE) /computer SE | 5,14,26,37,38 | 5 |
| Subjective nom | 5 | 1 |
| Infrastructure availability | 1,2 | 2 |
| Price Value | 19,29,30,38,40,41 | 6 |
| Perceive playfulness | 36,38 | 2 |
| Perceive efficiency | 36 | 1 |
| Computer anxiety | 26,28 | 2 |
| Technical support | 26,2 | 2 |
| System interactive | 26 | 1 |
| Green self-image | 34 | 1 |
| Perceive curiosity/extravasation | 18 | 1 |
| Perceive Organization benefit | 21 | 1 |
| Perceive technical resource | 21 | 1 |
| Perceive ubiquity | 30,40 | 2 |
| Trust supply chain partner | 32 | 1 |
| Biospheric value | 34 | 1 |
| Future perception | 5 | 1 |
| Context awareness | 17 | 1 |
| Digital divide | 44 | 1 |
| Technology adaptability | 44 | 1 |
| Policy & regulation | 44 | 1 |

Table 4: explain the variable

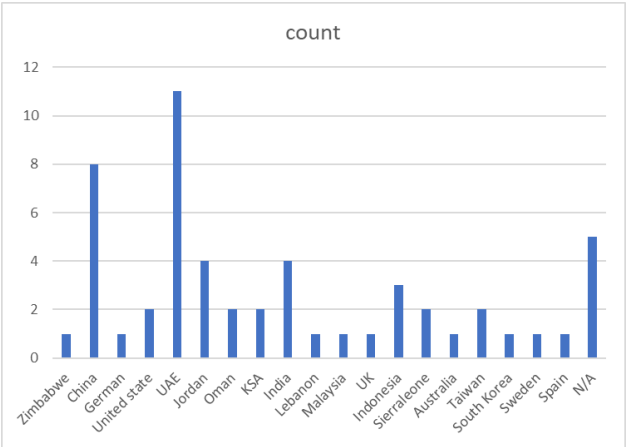


### 4.2 RQ2: Which countries were involved in the collected articles?

The research participants were mainly students and learners, concentrating on the individual level in various countries, including the United Arab Emirates (UAE), China, Jordan, India, Taiwan, Saudi Arabia (KSA), Oman, Indonesia, USA, and other countries.

| Country | Paper no | count |
|---|---|---|
| Zimbabwe | 1 | 1 |
| China | 4,5,11,29,32,37,38,39 | 8 |
| German | 3 | 1 |
| United state | 3,5 | 2 |
| UAE | 2,5,8,19,20,21,22,26,30,40,44 | 11 |
| Jordan | 8,13,14,18 | 4 |
| Oman | 5,17 | 2 |
| KSA | 5,8 | 2 |
| India | 7,9,10,28 | 4 |
| Lebanon | 6 | 1 |
| Malaysia | 8 | 1 |
| UK | 8 | 1 |
| Indonesia | 11,12,23 | 3 |
| Sierra leone | 15 | 2 |
| Australia | 24 | 1 |
| Taiwan | 27,37 | 2 |
| South Korea | 34 | 1 |
| Sweden | 35 | 1 |
| Spain | 36 | 1 |
| N/A | 41,42,25,43,16,31 | 6 |

Table 5: explain the countries




### RQ3: What are the main models/general frameworks used in accumulated articles?

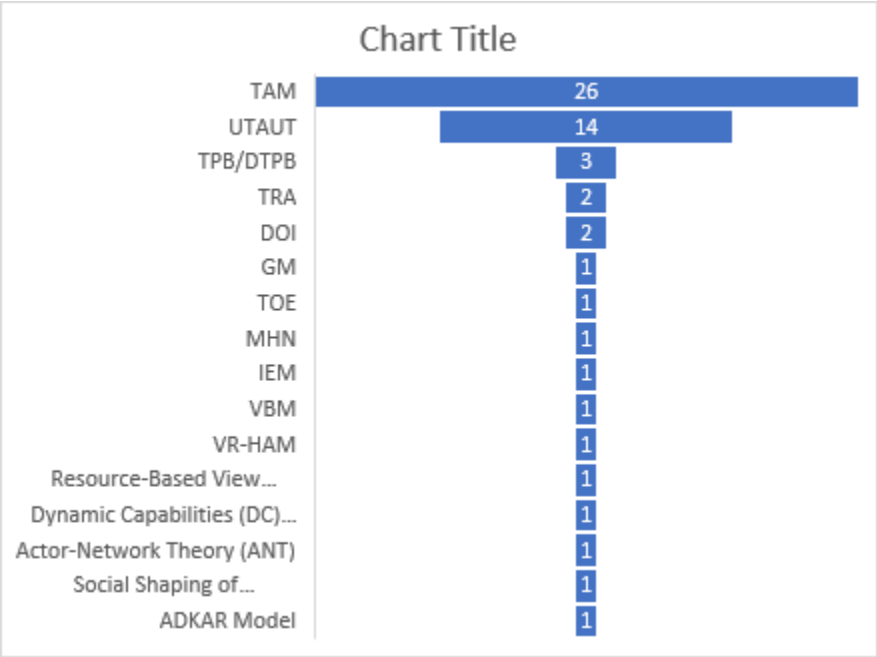
### 4.3. Features of the inclusive studies

The key features of the articles included in the final synthesis of the systematic review are presented in this section. The analysis encompassed 36 studies examining the implementation of metaverse, VR, and AR technologies in educational settings. These studies were conducted between 2019 and 2024 and mainly involved students and learners from different countries. Notably, 34 studies used either technology (TAM) or (UTAUT/UTAUT2). Additionally, other theories include the (TRA), (TPB), General Model (GM), Technology Organization Model (TOE), Virtual Reality Hardware Acceptance Model (VR-HAM), Innovative Ecosystem Model (IEM), Value-Based Model (VBM), diffusion innovation theory (DOI), and Maslow's Hierarchy of Needs (MHN). Furthermore, 31 studies used questionnaires as their primary data-gathering technique. Four studies employed the PRISMA Systematic Literature Review and one employed bibliometrics.

| Paper no | Methodology | model |
|---|---|---|
| 1 | qualitative research | (TAM) |
| 2 | Quantitative | TAM, DOI, Resource-Based View (RBV) Theory, Dynamic Capabilities (DC) Theory, Actor-Network Theory (ANT), Social Shaping of Technology (SST), ADKAR Model |
| 3 | utilized a systematic literature review (SLR) | including (TRA), (TAM), and (UTAUT) |
| 4 | a quantitative methodology | (UTAUT) and (TPB) |
| 5 | (SLR) | (TAM), (UTAUT) |
| 6 | a quantitative | (TAM) |
| 7 | The methodology involves conducting a SLR using (PRISMA) | the Virtual Reality Hardware Acceptance Model (VR-HAM) as an extension o(TAM |
| 8 | Quantitative | (TAM) |
| 9 | involves an SLR t | a theoretical framework |
| 10 | The methodology employed in the case study | The research paper utilizes the Pattern matching theory |
| 11 | case studies, quantitative, qualitative, mixed-method approaches, . | The Analytic Hierarchy Process (AHP) |
| 12 | quantitative research | (UTAUT),(TAM), (TRA), (TPB) |
| 13 | quantitative research method. | the Decomposed Theory of Planned Behavior (DTPB),. The DTPB extends the (TPB) |
| 14 | quantitative research | (TAM), |
| 15 | quantitative | (TAM), (UTAUT) model |
| 16 | qualitative | N/A |
| 17 | a quantitative research methodology | UTAUT |
| 18 | quantitative | UTAUT |
| 19 | quantitative | (TAM) |
| 20 | quantitative method | (TAM) |
| 21 | quantitative | (TAM) |
| 22 | quantitative | a theoretical framework based on (PLS-SEM) and Artificial Neural Network (ANN) algorithms |
| 23 | quantitative | TAM |
| 24 | quantitative | ( DOI) |
| 25 | Quantitative Research | (UTAUT),General Model (GM) |
| 26 | Quantitative method, | (TAM) |
| 27 | quantitative | the Extended (TAM) |
| 28 | Quantitative | The UTAUT model |
| 29 | quantitative research method | (TAM) |
| 30 | Quantitative | tam |
| 31 | a bibliometric analysis | TAM, UTAUT, and TOE |
| 32 | quantitative research | (UTAUT) |
| 33 | the study involves an integrated SEM-ANN method, quantitative | combining (PLS-SEM) and (ANN) approaches |
| 34 | quantitative | Maslow's hierarchy of needs, and the (TAM) |

| | | |
|---|---|---|
| 35 | quantitative | Innovation Ecosystems Model, Value-Based Model |
| 36 | quantitative | extends (TAM) |
| 37 | a mixed-methods approach | extended (UTAUT) |
| 38 | quantitative | (TAM) |
| 39 | quantitative | (TAM) |
| 40 | quantitative | (TAM) |
| 41 | A Systematic Literature Review | (UTAUT) |
| 42 | a quantitative methodology | (UTAUT) |
| 43 | quantitative | (TAM) |
| 44 | Quantitative | Tam |

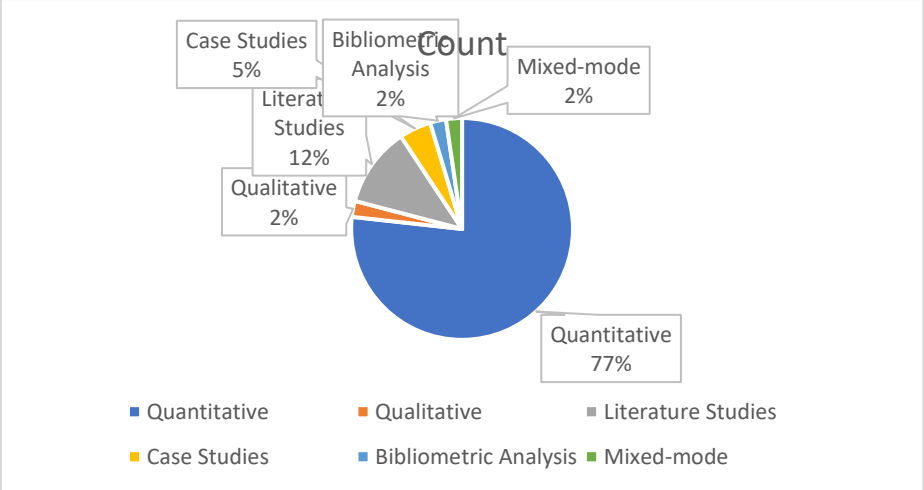
**Table 6:** explain the methodology and model




RQ4: What was the primary methodology used in the articles gathered?

The table shows that the methodology used is quantitative: 33 articles, 4 systematic literature reviews, 2 case studies, 1 qualitative study, 1 mixed methods study, and 1 bibliometric study, as well as 1 paper.

| Methodology | Count |
|---|---|
| Quantitative | 33 |
| Qualitative | 1 |
| Literature Studies | 5 |
| Case Studies | 2 |
| Bibliometric Analysis | 1 |
| Mixed mode | 1 |




## Key Findings

A comprehensive systematic literature review of 43 research papers published between 2019 and 2024 has yielded several critical insights into the adoption of the metaverse in higher education. The Technology Acceptance Model (TAM) is the most widely used framework for predicting metaverse acceptance, emphasizing perceived usefulness (PU) and perceived ease of use (PEOU) as key determinants (28 and 26 counts, respectively).
**Influential factors**: Key factors driving adoption include enhancing student engagement (11 studies), improving the learning experience (14 studies), integrating innovative technologies (11 studies), and social influence (14 studies). Other notable variables include facilitating conditions (13 studies), personal innovativeness (7 studies), and perceived enjoyment (7 studies).
**Geographical focus**: Research is predominantly conducted in the UAE (11 studies), China (8 studies), Jordan (4 studies), and India (4 studies), reflecting a global interest with a concentration in specific regions.
**Methodological Preference**: Quantitative methodologies dominate (33 studies), with SmartPLS and PLS-SEM emerging as critical tools for verifying metaverse adoption models.

## Conclusion

This comprehensive systematic review carefully examines the present landscape of metaverse implementation in educational settings. Through a comprehensive analysis of the existing literature, we unequivocally identified influential factors, such as psychological and technological readiness, motivational factors, user experience, quality factors, social and cultural factors, and inhibiting factors that significantly impact stakeholder attitudes toward the metaverse. We emphasize the importance of practical learning exercises in enhancing student knowledge acquisition and motivation. Educational organizations must thoroughly grasp the interconnectedness of these elements within learning environments. They must consider not only the technical aspects, but also the social, psychological, and motivational dimensions of the metaverse. A comprehensive understanding of how these factors interact is essential for their effective implementation in educational contexts. This understanding can enable stakeholders to develop steady strategies for effective integration, ensuring that the possible advantages of the metaverse are fully realized in the academic environment.

## Appendix

**Acknowledgments** This work is part of a thesis submitted in fulfillment of a PhD in the College of Computing and Informatics CCI, Universiti Tenaga Nasional, Malaysia

**Ethical statements** I hereby declare that this manuscript is the result of my independent creation under the reviewers' comments. Except for the quoted contents, this manuscript contains no research achievements published or written by other individuals or groups. I am the only author of this manuscript. I bear the legal responsibility for this statement shell.

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