Scientific Publications

World Journal of Nursing Research, 2024, 3, 905
www.scipublications.org/journal/index.php/wjnr
DOI: 10.31586/wjnr.2024.905

Article

Metaverse in Nursing: A Concept Analysis

Romelson Barut [1], Jessa Joy Dairo [1], Suzanne Dawis [1], Liza Galias [1], Uno Mischelle Mamburao [1], Roison Andro Narvaez [1,*]

[1] St. Paul University Philippines, Philippines

* Correspondence: Roison Andro Narvaez (rnarvaez@spup.edu.ph)

Abstract: Background: Over the past decade, there has been a rapid advancement in technology and virtual reality applications, leading to the emergence of the metaverse - a virtual universe where users interact with each other and their surroundings through immersive experiences. In the nursing profession, the metaverse presents unique opportunities to enhance patient care, education, and collaboration. **Aim:** To analyze and identify the attributes of metaverse in nursing, exploring its dimensions, benefits, challenges, and implications. By examining relevant literature and theories, this study will contribute to a better understanding of the metaverse in nursing for future research and practice. **Method/Design:** Concept analysis by Walker and Avant (2019). **Results:** Metaverse in nursing involves three defining attributes: use of advanced technologies, better access to education and healthcare and community building. Antecedents of metaverse in nursing require technological advancements, increased digital literacy, demand for innovative education, globalization of healthcare education **Conclusion:** Metaverse in Nursing suggests that it is a promising technology that has the potential to enhance nursing practice and improve patient outcomes, but further research is needed to fully explore the impact of its integration.

Keywords: Metaverse, Nursing, Metaverse in Nursing, Concept Analysis

How to cite this paper:
Barut, R., Dairo, J. J., Dawis, S., Galias, L., Mamburao, U. M., & Narvaez, R. A. (2024). Metaverse in Nursing: A Concept Analysis. *World Journal of Nursing Research, 3*(1), 36–49. Retrieved from https://www.scipublications.com/journal/index.php/wjnr/article/view/905

Received: January 15, 2024
Revised: February 22, 2024
Accepted: March 15, 2024
Published: March 16, 2024

1. Highlights

What is already known about this topic:

1. Metaverse refers to a collective virtual shared space, typically created by the convergence of virtual reality (VR), augmented reality (AR), the internet, and other digital technologies.
2. The concept of leveraging digital technologies to enhance healthcare delivery, education, and collaboration has been an ongoing process.

What this paper adds

1. Metaverse, with the help of nurses, has the potential to transform the way healthcare is given, making it more accessible, efficient, and personalized while also encouraging collaboration and innovation
2. Metaverse poses a fundamental question about privacy, security, and equal access to technology, all of which must be addressed in order for it to be used responsibly and ethically, especially in the nursing profession.

2. Introduction

Metaverse refers to a three-dimensional (3D), immersive, virtual world in which social and economic interaction occurs between the users, irrespective of their location. Computational-based interaction takes place between the users [1, 2, 3]. A metaverse platform is configured to enable its users, represented by avatars, to engage in social

interactions and emotional exchanges, and communicate with one another in a virtual world [4]. Metaverse as a virtual world where our virtual selves and those of people in our local and global communities come together to participate in work, shopping, social events, education, leisure, and other activities [5]. The metaverse incorporates cutting-edge artificial intelligence technologies via an emergent amalgamation of augmented reality, virtual reality, and mixed reality, cloud computing techniques, blockchain, and 5G/6G wireless communication networks [6,7].

Others believe that the metaverse is a ternary digital world established on the basis of digital technology integrating the virtual and real worlds, which people enter with digital identities [8]. Overall, the metaverse is considered to be the next-generation mobile computing platform [9]. On the contrary, metaverse poses some challenges which include worries about user privacy, exorbitant costs associated with technology, conflicts between healthcare organizations and institutions regarding the implementation of new technologies, and moral dilemmas pertaining to possible risks to human health, depression, violence, and self-harm, as well as possible detrimental effects on cultural security or health status as well as possible harm to developing nations' intellectual property rights and improper usage [10].

Metaverse has a dictionary definition of virtual three-dimensional space that can be used by people and artificial intelligence to communicate, interact, and exchange information to ultimately imitate realistic scenarios [11]. [12] defined metaverse in healthcare as the use of the internet for meaningful purposes relevant to the services they aim to provide for the public. In addition, it provides an alternative option for obtaining a network of information and data for educational purposes. Medical training can also be conducted through the use of the platform. The system of healthcare has been drastically changed as its implementation offered a patient-centric approach and accessibility for both ends [13].

In this age of medical breakthroughs and technology, the metaverse has attracted global interest as a groundbreaking digital environment with the potential to offer a diverse array of healthcare. One of the major technology-driven disruptions that may occur soon is the metaverse, often known as the "immersive internet" [14]. This might have an impact on patient experience, physician-patient interactions, innovation, research and development procedures. On the other hand, [15] mentioned that all of the challenges involving the relationship between humans and computers and the seamless merging of the virtual and physical worlds are addressed by the notion of the metaverse. Within the world of virtual environments, the metaverse is a growing network of virtual spaces that are becoming more and more popular [16]. Metaverse offers tremendous promise for individualized, immersive learning environments, improving the efficacy and efficiency of nursing education for remote patient monitoring, and providing a secure, supervised setting for nurses to refine their abilities [17].

The metaverse is an integrated space in which the real and virtual worlds are connected and it can be applied as part of the teaching-learning methodology of higher education [2]. Users act through avatars that represent themselves and as educational uses for the metaverse emerge, efforts must be made to explore and apply its potential to educate next-generation nurses who are familiar with digital devices [18] which can boost learners' engagement and immersion and enable collaboration and real-time interaction; moreover, metaverse provides a realistic 3D sense of reality, which is the main reason why users find it so immersive [19]. On the other hand, supported the use of the metaverse in nurse education that enables learners to indirectly experience high-risk environments in 3D, which can also be useful for nursing safety education. Teaching methods used for nursing safety education include lectures, group discussions, simulations, videos, web-based learning, and flipped learning [20].

The study aims to create an impact on metaverse technology as a part of a comprehensive approach to nursing skills, knowledge, and educational opportunities.

Furthermore, it will deepen a better understanding of the concepts in an attempt to provide defining attributes and the importance of metaverse in the healthcare setting as an integral part of nursing practice. Researchers are keen to seek insights into the promising use of what we call cutting-edge technology which is the metaverse in nursing.

2. Materials and Methods

2.1. Design

A concept analysis of Walker and Avant (2019) was conducted through specific phases which starts with the thorough selection of concepts relevant to the target topic, providing clear purpose of the analysis, identifying the evident applications of the well-defined concept, classifying the significant attributes of the concept, identifying the suitable model case and the related cases along with those that serves conflicting information, and recognizing the antecedents and consequences as well as empirical referents [21]. Table 1 shows the step guide of Walker and Avant's Method of Concept Analysis.

Table 1. Eight (8) Steps of Concept Analysis, Walker and Avant (2019)

Eight (8) Steps of Concept Analysis by Walker and Avant (2019)	
1	Select a concept
2	Determine the aims or purposes of analysis
3	Identify all uses of the concept that you can discover
4	Determine the defining attributes
5	Identify a model case
6	Identify borderline, related, and contrary cases
7	Identify antecedents and consequences
8	Define empirical referents

2.2. Data Collection

The search was conducted between December 2023 to January 2024 using online resources such as PubMed, Springer, MDPI, CINAHL, Google Scholar, Elsevier, and EBSCOHOST. Keywords used are the following: "metaverse", "nursing", "immersive internet", "virtual reality" (VR), "3D technology", "augmented reality" (AR), "virtual world". After filtering through databases, a total of 3,450 studies were identified based on titles alone. Following the application of eligibility criteria, only 21 articles were deemed suitable for inclusion. From this subset, a final selection was made, resulting in 17 articles. The PRISMA diagram guided the selection of the studies on metaverse in nursing (Figure 1).

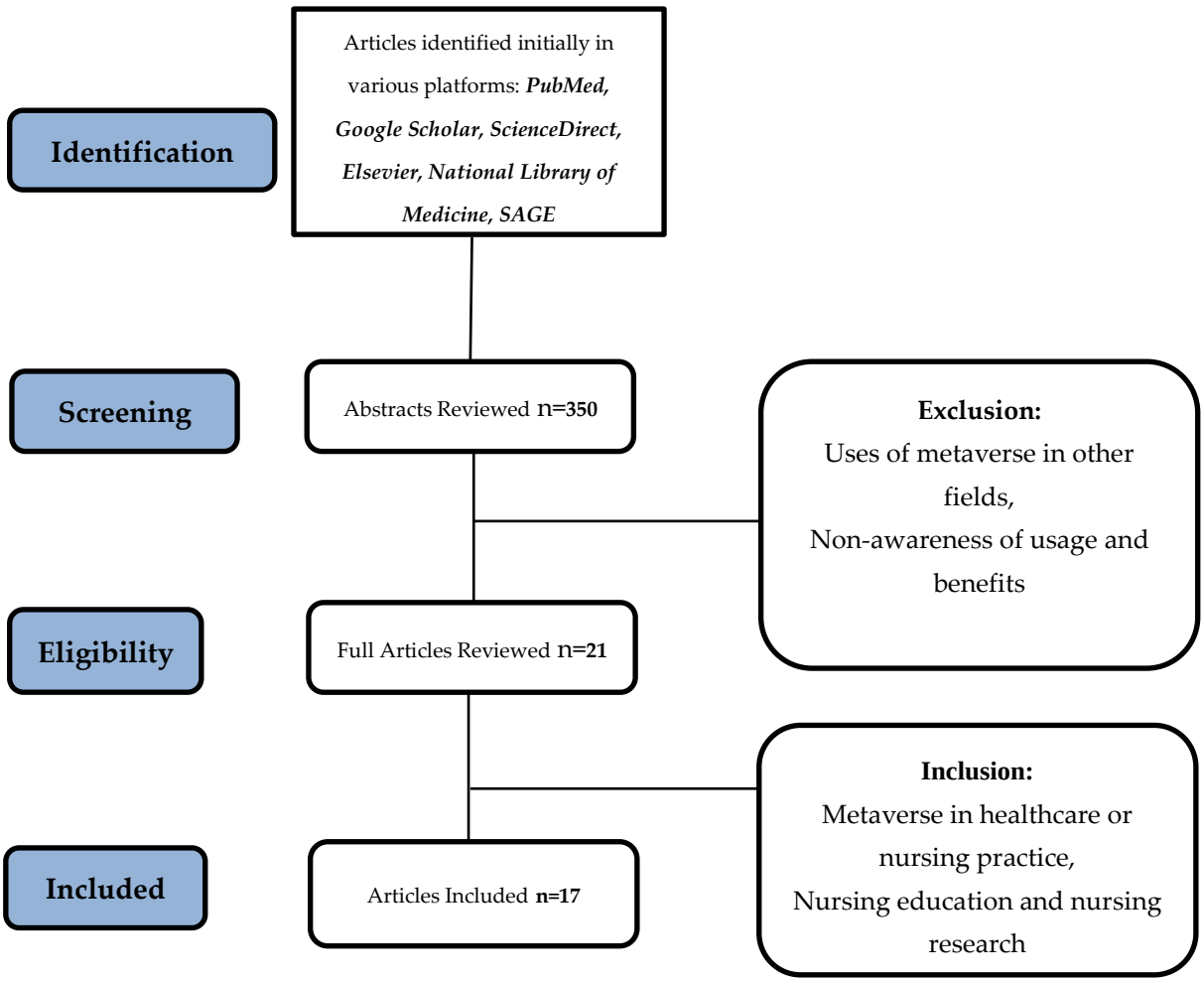

Figure 1. PRISMA Flow Diagram of Metaverse in Nursing

2.3. Inclusion and Exclusion criteria

The Inclusion criteria include peer-reviewed evidence-based articles in support the premises of Metaverse in Nursing. The exclusion criteria are those use of metaverse of other fields or those beyond these attributes despite its relatedness to the topic of interest.

2.4. Quality Appraisal

A matrix table was used to categorize the findings that have been taken out of the database using the Sparbel and Anderson (2020) tool with the information of the author, year of publication, design, method, level of evidence, definition of metaverse aim and the study findings [22] (Appendix A). The Level of Evidence (LOE) was evaluated in utilizing the methodology made by Melnyk and Fineout-Overholt (2023) [23] to assess the quality and the significance of the studies during the initial process by using the levels of evidence assigned to each study. Nursing experts were also invited to further review. Consensus was made for any disagreements in selecting the included articles.

3. Results

3.1. Defining Attributes

Based on the reviewed literatures, the attributes collectively define the metaverse in nursing and highlight its unique features and capabilities in enhancing nursing education,

patient care, collaboration, telehealth, and research: 1) Use of advanced technologies, 2) Better access to education and healthcare, 3) Community building.

3.1.1. Use of Advanced Technologies

Virtual reality (VR) or Augmented Reality (AR) simulations allow nurses to immerse themselves in realistic and interactive virtual environments. Through the use of virtual reality, augmented reality and other immersive technologies, students and professionals in the nursing field could potentially get a more hands-on and authentic experience of certain procedures or treatments as well as the opportunity to practice in a risk-free and controlled environment. Telehealth refers to the use of technology to provide healthcare services remotely. This enables nurses to provide care to patients who are unable to physically visit as a healthcare facility. Remote patient monitoring involves using technology to gather and transmit patient data from a distance. In the metaverse, nurses can utilize devices like wearable sensors or mobile apps to monitor patients' vital signs, track their medication adherence, or monitor specific health conditions. [8, 15, 17, 20, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36].

3.1.2. Better Access to Education and Healthcare

The Metaverse potentially enables nurses and health care professionals to receive training or complete courses online, without the boundaries of physical locations. This could offer better access to education and training for those unable to attend brick and mortar institutions due to distance cost or other factors [8, 15, 17, 20, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36].

3.1.3. Community Building

The metaverse could also provide a platform for online communities of nurse and healthcare professionals to build connections, share knowledge and resources, and collaborate on projects. This could foster a sense of community and help professionals feel connected and supported even when working in isolated settings [15, 17, 26, 29, 31, 32, 33, 35, 36]**.**

3.2. Case Studies

3.2.1. Model Case

A model case is a concept application that exemplifies every one of the concept's distinguishing characteristics [21].

Case: Nurse Sarah, a dedicated healthcare professional, with a passion for leveraging technology to improve patient outcomes, Sarah integrates the use of advanced technologies like virtual reality (VR) simulations, telehealth services, remote patient monitoring, and virtual training environments into her daily routine.

Sarah begins her day by immersing herself in a VR Simulation, practicing critical patient care scenarios. She then seamlessly transitions to a telehealth platform, connecting with patients remotely to provide consultations and monitor chronic conditions. Through telehealth, she maintains regular communication with patients, ensuring a continuous care relationship. In the afternoon, Sarah engages in a virtual training environment, participating in a collaborative learning session with fellow nurses from different geographical locations which provides a sense of community building. The Virtual Training Environment adapts to Sarah's learning pace, providing personalized content and assessments.

Analysis: In this case, the use of Advanced Technology like VR simulations, contributes significantly to Sarah's clinical skill development, providing a risk-free space to refine her abilities and promote better health to patients. Telehealth enhances Sarah's reach, allowing her to provide healthcare services to patients in remote or underserved areas. Remote monitoring enables Sarah to intervene proactively, addressing health issues

before they escalate. This practice also helps Sarah to provide a platform for online communities of nurses and healthcare professionals to build connections, share knowledge and resources, and collaborate with each other. This case covers all the defining attributes of Metaverse in Nursing.

3.2.2. Borderline Case

Examples or situations that include most but not all of the distinguishing characteristics of the idea under study are known as borderline cases. They might have most or even all of the distinguishing traits, but they might differ significantly in one of them, like the frequency or severity of the occurrence [21].

Case: Nurse Jessica works in a busy urban emergency department, and she is curious about the potential of Metaverse in nursing. She hears about a new program that involves virtual reality simulations of emergency room situations, where nurses can practice responding to a variety of different emergencies and learn from the outcomes and involves remote patient monitoring. Jessica signed up for the program and practiced in a Virtual Training Environment to improve her skills to promote better health and education. However, she noticed that the virtual reality simulations are not as engaging or realistic as she had hoped. She doesn't feel connected and supported by other VR students. Despite this, Jessica perseveres with the program, and she does see some improvement in her emergency room skills. However, she acknowledges that the virtual reality simulations were not as effective for her as they might be for other nurses.

Analysis: In this case, Jessica is the population of interest, the Metaverse program is the intervention, and the comparison is traditional emergency room training. The outcomes are improved nursing knowledge and skills, improved patient outcomes in the emergency room and better access to health and education. However, Jessica's experience with the virtual reality simulations is a borderline case as it only covers 2 out of 3 of the defining attributes, because she finds the simulations less engaging and realistic than she had hoped, and lacks of community building which might affect her ability to learn effectively.

3.2.3. Related Case

Related cases are examples of concepts that share some characteristics with the concept under study but do not fully embody it [21].

Case: Nurse Emily works in an intensive care unit of a hospital. She has heard about the potential of using virtual reality simulations to train nurses to improve their skills, especially in managing critically ill patients. Emily is curious about how Metaverse can be used for medical education and training and decides to look into it further. Emily finds a virtual training environment that offers a program that uses virtual reality simulations to train nurses. Emily signed up for the program but due to unexpected circumstances, she was not able to attend the training. Emily also finds out from other colleagues that the program doesn't cover every aspect of intensive care nursing, and there are still some aspects of the job that she needs to learn through traditional methods, such as classroom-based education and on-the-job training.

Analysis: In this case, Emily's interest in using virtual reality for medical education and training to promote better health is a related case to the concept of Metaverse in Nursing, as no defining attributes happened at all.

3.2.4. Contrary Case

Cases in contrast provide obvious illustrations of "not the concept [21]".

Case: A nurse named Meliza has always been very technology-averse and has not used any technology to help her with her job. She is very attached to traditional methods of learning and cares for her patients using her own methods and techniques. Despite the advances in technology and the potential of Metaverse in nursing, Meliza is not interested

in using virtual reality simulations or any other technology to help her with her job. Meliza sees technology as a distraction from her job, and she believes that it would not benefit her or her patients in any way. She is satisfied with the way she does her job and does not see a need for any change.

Analysis: In this case, Meliza's resistance to using technology to help with nursing care is contrary as the outcomes of its use are negative or something that is clearly contrary to the idea of using technology to improve nursing care. The case doesn't define any of the attributes of the concept.

3.3. Antecedents

Events or situations known as antecedents are those that need to happen or be in place before a concept manifest [21].

The adoption and integration of metaverse technologies in the nursing field have been influenced by several occurrences. Technological advancements in virtual reality, augmented reality, and artificial intelligence have provided the necessary foundation for the development of the metaverse.

Additionally, the increasing digital literacy among nursing professionals has contributed to their familiarity and comfort with virtual platforms. The COVID-19 pandemic has further catalyzed the adoption of remote and virtual methods in healthcare, driving the need for innovative education tools and efficient resource management. The globalization of healthcare education and the demand for improved access to healthcare services have also fueled interest in the metaverse [34].

Furthermore, cost and resource constraints, collaborative care models, patient engagement, regulatory changes, and ethical considerations are all factors that have set the stage for the integration of the metaverse in nursing.

Together, these incidents create a conducive environment for the utilization of metaverse technologies in various aspects of nursing, promising enhanced education, research, and healthcare delivery.

3.4. Consequences

Events or episodes that follow the occurrence of concepts are known as consequences, or alternatively, the results of the concepts [21].

The use of metaverse technologies in nursing can have positive consequences such as enhanced patient outcomes, increased access to care, enhanced learning opportunities, and improved collaboration and communication [29, 31, 32]. However, there are also negative outcomes to consider, including technological challenges, ethical concerns, the risk of dependency on technology, and the financial burden of implementation. Nurses and healthcare organizations should carefully evaluate and develop strategies to address these consequences and ensure the effective and responsible use of metaverse technologies in nursing practice [17, 33, 34]. It is crucial for nurses and healthcare organizations to carefully think about these consequences, weigh the advantages against the possible risks, and come up with strategies to minimize any negative effects that might come with using metaverse technologies in nursing practice.

3.5. Empirical References

Empirical referents are groups or classifications of real-world occurrences that show the concept's occurrence by their existence or presence [21].

The evolution of Metaverse in nursing can be traced back to the introduction of virtual reality technology and its use in healthcare. Virtual reality provides an immersive and interactive environment that can be used for a variety of purposes, including training and education, research, and therapy. In the nursing field, virtual reality has been used for patient education, such as explaining medical procedures or demonstrating how to administer medications, as well as for training and simulation, allowing nurses to practice

various skills in a safe and controlled environment. Metaverse in nursing could be in virtual reality in patient education. For example, patients who are unable to attend in-person appointments or classes due to mobility issues could receive virtual education through virtual reality technology, providing them with the same knowledge and skills as if they had attended the in-person class. Another example could be the use of virtual reality in training and simulation, where nurses can practice various skills in a virtual environment before performing them on a patient. This can improve their skills and confidence and lead to better patient outcomes [36].

4. Discussion

The concept of the metaverse in nursing presents both intriguing opportunities and significant challenges. At its core, the metaverse refers to a virtual shared space created by the convergence of virtually enhanced physical reality and physically persistent virtual reality. In the context of nursing, the metaverse holds promise for revolutionizing various aspects of healthcare delivery and education. Based on the findings, the researchers proposed a conceptual diagram of metaverse in nursing as shown on Figure 2. Defining attributes of Metaverse in nursing involves identifying the essential qualities or characteristics that make Metaverse relevant and applicable to nursing. These are the Use of Advanced Technology such as (VR/AR simulations, Telehealth and Remote Monitoring), Better Access to Education and Healthcare and lastly, Community Building. As technology continues to evolve, opportunities for nurses to leverage Metaverse in nursing will only continue to grow.

Figure 2. Conceptual Diagram of Metaverse in Nursing

The findings imply that there isn't much literature on this subject outside of a few editorials and evaluations of the literature. The studies that are featured are recent, and because the metaverse was embraced in various contexts, more research is necessary soon. Notwithstanding these drawbacks, the metaverse can be used in clinical condition prevention and treatment; it can also be used in educational and training environments, and researchers can use it to expedite study processes and use larger, global sample sizes [36].

Challenges that nurses may face when implementing Metaverse in nursing include Technical proficiency, Cost, Ethics and legality, Access and availability. Metaverse technology is relatively new and requires specific skills and expertise to be effective. It may be challenging for nurses to acquire the necessary technical skills and understanding to implement and use Metaverse in nursing effectively. The implementation of Metaverse in nursing may require significant investments in equipment, software, and training. This could be a potential challenge for healthcare systems and institutions that may be limited in terms of resources. Additionally, there are several ethical and legal concerns related to the use of Metaverse in nursing, such as privacy, data security, and patient consent. It may be challenging for nurses to navigate these issues and ensure that patients' rights and interests are protected.

Furthermore, Metaverse technology may not be available or accessible to all nursing professionals, especially those working in rural or remote areas. This could be a challenge for nurses who may not be able to access or use Metaverse technology [37].

These challenges will require collaborative efforts among healthcare professionals, policymakers, and technology providers to overcome and ensure that patients' rights and interests are protected while maximizing the benefits of Metaverse in nursing.

5. Implications for Practice

The world is evolving and so with nursing practices and procedures. Metaverse in Nursing has promising uses that can help give quality care to patients. It helps enhance nurses' training and simulations, encourages patients' engagement to health teachings and enables nurses to work even with geographical barriers. Nurses who use Metaverse for training and education can improve their skills and knowledge, which can translate into better care for patients. Better patient outcomes can lead to increased patient satisfaction, better patient outcomes, and better nursing practice in general. Metaverse can be used for collaboration and collaboration in nursing care, such as virtual case conferences, continuing education, and simulations of complex patient scenarios. Metaverse can help improve interprofessional collaboration, leading to more effective and efficient communication and care delivery. The effect of the use of metaverse in the healthcare service industry is positive due to the current and applied use of its technology to the current services of a few healthcare providers worldwide. The training that is incorporated with metaverse is also seen as effective as it offers a realistic simulated environment to its learners which gives them a chance to expose themselves in more accurate learning space.

6. Limitations and Recommendations

There are challenges and barriers in investigating and exploring the concept of Metaverse in nursing. These may include, but are not limited to, the following: Lack of understanding and awareness: The concept of Metaverse in nursing is still relatively new, and many nurses and healthcare professionals may not be familiar with it or its potential applications. This may lead to a lack of interest and understanding of the concept. Technical limitations: Some nurses and healthcare professionals may not have access to the necessary technology or equipment to fully experience and utilize the benefits of Metaverse in nursing. This may limit the applicability and feasibility of the concept. Ethical considerations: The use of Metaverse in nursing raises ethical considerations related to issues such as privacy, confidentiality, and data security. These concerns may impact the adoption and use of Metaverse in nursing. Complexity and cost: The implementation and use of Metaverse in nursing may be complex and costly, which may limit its applicability in certain healthcare settings. This may impact the feasibility and cost-effectiveness of the concept. These limitations highlight the need for further research and exploration of Metaverse in nursing, as well as the development of strategies to

address these challenges to ensure the safe and effective integration of this technology into nursing practice.

Future research on Metaverse in Nursing may include exploring further the impact on patient outcomes, such as improved patient satisfaction, reduced anxiety levels, and better adherence to treatment. The development of standardized tools and metrics for measuring the effectiveness and impact of Metaverse in nursing can also be an important area of focus for future research. Another area that may be worth exploring further is the ethical considerations related to the use of Metaverse in nursing, such as issues related to privacy, confidentiality, and patient consent. Developing guidelines and best practices for the use of Metaverse in nursing can also be an important focus for future research. Overall, the future of Metaverse in nursing is exciting, and there is a lot of potential for its application in various clinical scenarios. Future research can help to further develop and refine the use of Metaverse in nursing to improve patient care and outcomes.

7. Conclusion

Metaverse is a virtual reality technology that has the potential to enhance nursing practice in several ways, including providing a simulation environment for nurses to learn and improve their skills. This improves the efficiency of nurse training by reducing the need for physical training spaces. It also enhances interprofessional collaboration among nurses and other healthcare professionals. Additionally, it improves patient outcomes by providing better care and better understanding of patient needs. And finally, the metaverse is emerging as an immersive technology with enormous potential for optimizing patient care across the entire healthcare continuum. In conclusion, the concept analysis of Metaverse in Nursing suggests that it is a promising technology that has the potential to enhance nursing practice and improve patient outcomes, but further research is needed to fully explore the impact of its integration into current nursing practice.

Acknowledgments: The researchers would like to thank St. Paul University Philippines – Graduate School for their support and guidance as part of the Methods of Research course requirements.

Conflicts of Interest: The authors declare no conflict of interest

Author Contributions: RB, JJD, SD, LG, UMM: Conceptualization, Methodology, Formal analysis, Investigation, Data curation, Writing – original draft, Project administration. RAN: Conceptualization, Formal analysis, Investigation, Supervision, Validation, Visualization, Writing – review & editing,

Appendix A

Author/Year/ Country	Design	Aim	Results	Level of Evidence	Concept Definition
De Gagne et al. (2022) USA	Umbrella Review	To analyze the acquired support on the effectiveness of metaverse pedagogy in nursing education.	Reflects the effectiveness of the application of metaverse in nursing education	Level 5	Incorporated metaverse into nursing education, which promotes knowledge acquisition, self-assurance, active learning, and improved academic achievement.
Ryu et al. (2023) Korea	Prototype to design and create metaverse classroom setting	To establish a metaverse classroom to effectively evaluate its effectiveness.	Metaverse can be used to effective teaching in nursing	Level 3	Metaverse in education creates a learner-centered educational environment.

Lee et al. (2023) Korea	Qualitative Study	To evaluate the experiences of the nursing students regarding the use of VRChat for learning	The students were able to reflect their learning through the application of metaverse which offers experiential learning	Level 6	Metaverse offers 3D experiences to the nursing students which may offer a higher level of learning.
Kim & Kim (2023) South Korea	Mixed method design	To evaluate the effectiveness usage of metaverse in career mentoring among nursing students.	Utilizing metaverse in career mentoring for nursing students positively affected their decision making and self-efficacy.	Level 7	Metaverse can also be applied in career mentoring sessions for students.
Chen et al. (2020) China	Meta-analysis	To report the effectiveness of the use of VR in necessary aspects such as knowledge, skills, satisfaction, confidence, and performance time.	Use of VR to improve skills, and knowledge is effective and beneficial.	Level 5	Metaverse offers virtual reality to users which enables realistic providence to learning.
Mendez et al. (2020) Maryland, USA	Qualitative Study	To better understand the perspective of the nursing teachers regarding the use of VR and AR technologies in nursing education.	The use of VR and AR is effective in facilitating the learning process in nursing education as it offers accessibility and novelty in delivering educational concepts and contents.	Level 6	Metaverse includes the use of VR and AR to provide virtual experience in the learning process.
Yang & Kang (2022) Republic of Korea	A Quasi-Experimental Study	To evaluate the effectiveness of the technological application involved in the therapy for the children diagnosed with early onset of schizophrenia, in terms of the students' knowledge, critical thinking ability, and capability to communicate.	Through the use of metaverse, the nursing students' knowledge, critical thinking ability, and communication skills are improved through this method of training.	Level 3	Metaverse is a simulation program designed to teach the nursing students how to properly handle children diagnosed with early onset of schizophrenia.
Ali et al. (2023) Republic of Korea	Pilot Study	To evaluate the trust that people will put on the technological advances that will gather their personal information and medical history to further assist them with their medical needs.	Blockchain technology promises data security among its users and transparency to build a stronger background of metaverse in the medical field.	Level 3	Metaverse is applied in blockchain technology that gathers and analyzes each patient's personal and medical background to provide clear and fast medical assistance

Ryu et al. (2023) Korea	Pilot Study	To evaluate the usability of the developed metaverse-based learning system.	The students who were able to experience the system provided positive feedback regarding its usability.	Level 3	Metaverse was used to provide a virtual space for learning wherein nursing students were able to accomplish various tasks that are designed with varying difficulty level.
Ergin et al. (2023) Turkiye	Cross-sectional Study	To determine the perception of the nurse regarding the metaverse across time	Most of the nurse involved in the study believed that they can use metaverse for patient education and virtual nursing.	Level 4	Metaverse provides new platforms for nurses to accurately and consistently provide their medical services to the people in need of their assistance
Sharma & Sharma (2023) India	Systematic Review	To evaluate the use of ChatGPT and Metaverse technology in remote patient monitoring	The use of these advantages revolutionizes the nursing education that both benefit the medical staff and nursing students as it boosts their skills, confidence, and decision- making skills	Level 5	Metaverse can be used to remotely monitor patients through online medical consultation platforms
Damar (2022) Turkiye	Content Analysis	To identifying how metaverse is applied in various health-related fields such as Medicine, Nursing, Public health, midwifery, and dentistry	The use of metaverse in health-related fields in health is viewed as effective; however, the exploration should be done through exploration which often raises fear and doubt.	Level 5	Metaverse is a technological advantage applied in various health-related fields primarily to enhance patient-doctor communication, faster medical transaction, and patient-friendly experiences.
Suh et al. (2023) Nebraska, USA	Perspective Analysis	To evaluate the current state of the use of metaverse in health-related fields.	Metaverse indeed enhances the quality of education, service, and overall health care system in most parts of the word that adapted this technology.	Level 5	Metaverse widens virtual worlds that actually creates a beneficial environment for people who are indeed of medical assistance.
Li et al. (2023) Singapore	Pragmatic Research	To provide a clear definition of the use and application of metaverse in health-related fields.	Suggested the metaverse has a huge potential in creating a shifting environment and system when it comes to healthcare.	Level 5	Metaverse offered AI generated customer service, simulated medical training and remote consultations.

Prasetyo & Masruroh (2022) Indonesia	Scoping Review	To further analyze the available literature on the use of metaverse in health care.	Mainly, metaverse is used for educational purposes, communication and interventions.	Level 5	Metaverse provides a space for people where they can effectively communicate and obtain necessary information.
Baskar (2022) India	Systematic Review	To evaluate the use of metaverse in medical education and training.	Using the advantages that the metaverse offers, it offers benefits for medical aspects and training of healthcare providers.	Level 5	Metaverse is a virtual space wherein healthcare providers utilize their skills to reach more people in providing healthcare remotely.
Petrigna & Musumeci (2022) Italy	Scoping review	To examine the current usage of metaverse with prevention and treatment, education and training, and research setting.	Suggested that metaverse can be used for proper health promotion programs to reach more people in the public.	Level 4	Metaverse is widely considered in different fields such as education, science, and medicine as it carries a wide range of benefits to the public and professionals.

References

[1] Arcila, JBP. (2014). Metaversos Para el máster iberoamericano en educación en entornos virtuales. Etic@ Net. *Revista Científica Electrónica De Educación y Comunicación En La Sociedad Del Conocimiento*. 2014;14(2):227–248. https://doi.org/10.30827/eticanet.v14i2.11977

[2] Díaz, J., Saldaña, C., Avila, C. (2020). Virtual world as a resource for hybrid education. *International Journal of Emerging Technologies in Learning (IJET)* 2020;15(15):94–109. https://www.learntechlib.org/p/217986/

[3] Mystakidis, S. (2022). Metaverse. Encyclopedia, 2(1), 486-497. https://doi.org/10.3390/encyclopedia2010031

[4] Lowenthal, P.R., & Dunlap, J.C. (2020). Social presence and online discussions: A mixed method investigation. Distance Education, 41(4), 490-514. https://doi.org/10.1080/ 01587919.2020.1821603

[5] Wiederhold, B. K., Riva, G. (2022). Metaverse Creates New Opportunities in Healthcare:Annual Review of Cybertherapy and Telemedicine 2022. Volume 20, Year 2022 ISSN:1554-8716. https://psycnet.apa.org/record/2023-49082-001

[6] Kim, J. (2021). Advertising in the metaverse: Research agenda. Journal of Interactive Advertising, 21(3), 141-144. https://doi.org/10.1080/15252019.2021.2001273

[7] Murtha, J. (2022). Is the metaverse the new frontier in medicine? | MDLinx https://www.mdlinx.com/article/is-the-metaverse-the-new-frontier-in-medicine/4lN14X9eyCaeoOFEXWbQVo.

[8] Yang, S., & Kang, M. (2022). Efficacy Testing of a Multi-Access Metaverse-Based Early Onset Schizophrenia Nursing Simulation Program: A Quasi-Experimental Study. International Journal of Environmental Research and Public Health, 20(1), 449. https://doi.org/10.3390/ijerph20010449

[9] Javaid M., Haleem A. (2020). Virtual reality applications toward medical field. Clin Epidemiol Global Health. 2020;8(2):600–605. https://doi.org/10.1016/j.cegh.2019.12.010.

[10] Nguyen, H. S., Danh, H. C., Ma, Q. P., Mesicek, J., Hajnys, J., Pagac, M., & Petru, J. (2023). A Bibliometrics Analysis of Medical Internet of Things for Modern Healthcare. MDPI Journals. https://doi.org/10.3390/electronics12224586

[11] Cambridge Dictionary (n.d.) Cambridge Advanced Learner's Dictionary & Thesaurus © Cambridge University Press https://dictionary.cambridge.org/dictionary/english/metaverse

[12] McGonigle, C. & McGonigle, D. (2023). Metaverse: Healthcare's next frontier. Online Journal of Nursing Informatics (OJNI), 26(3). https://www.himss.org/resources/online-journal-nursing-

[13] Bhatt, T. (2023). Metaverse in healthcare industry: applications, advantages, challenges, and more. Intelivita. https://www.intelivita.com/blog/metaverse-in-healthcare/

[14] Kataria S., Kedia., A. K. & Ravindran V., (2023). Metaverse: Evolving role in healthcare delivery implications. Journal of the Royal College of Physicians of Edinburgh, 53(3), 186-191. Volume 53, Issue 3. https://doi.org/10.1177/14782715231189900

[15] Suh, I., McKinney, T. & Siu, K.-C. (2023). Current Perspective of Metaverse Application in Medical Education, Research and Patient Care.Virtual Worlds 2023, 115-128. https://doi.org/10.3390/virtualworlds2020007

[16] Uddin M., Manickam S., Ullah H. & Obaidat, M. (2023). Unveiling the Metaverse: Exploring Emerging Trends, Multifaceted Perspectives, and Future Challenges.IEEE Access. https://doi.org/10.1109/ACCESS.2023.3281303

[17] Sharma, M., & Sharma, S. (2023). A holistic approach to remote patient monitoring, fueled by ChatGPT and Metaverse Technology: The Future of Nursing Education: Nurse Education Today. Volume 131. https://doi.org/10.1016/j.nedt.2023.105972

[18] Kye, B., Han, N., Kim, E., Park, Y., & Jo, S. (2021). Educational applications of metaverse: possibilities and limitations. Journal of educational evaluation for health professions, 18. http://doi.org/10.3352/jeehp.2021.18.32

[19] Jeong, Y., Lim, T., & Ryu, J. (2021). The effects of spatial mobility on metaverse based online class on learning presence and interest development in higher education. Korean Association for Educational Information and Media, 27(3), 1167-1188. http://doi.org/10.15833/KAFEIAM.27.3.1167

[20] De Gagné, J. C., Randall, P. S., Rushton, S., Park, H. K., Cho, E., Yamane, S. S., & KJung, D. (2022). The use of metaverse in nursing education. *Nurse Educator*, 48(3), E73–E78. https://doi.org/10.1097/nne.0000000000001327

[21] Walker, L.O. & Avant, K. C.(2019). *Strategies for Theory Construction in Nursing (6th ed.).* New York City, NY: Pearson.

[22] Sparbel, K., & Anderson, M.A. (2020) Integrated Literature Review of Continuity of Care: Part 1, Conceptual Issues. Journal of Nursing Scholarship 32(1):17-2. https://doi.org/10.1111/j.1547-5069.2000.00017.x

[23] Melnyk, & Fineout-Overholt, E. (2023). Evidence-based practice in nursing & healthcare: A guide tobest practice (Fifth edition.). Wolters Kluwer.

[24] Ryu, H., Lee, H., & Yoo, H. J. (2023). Development of a metaverse online learning system for undergraduate nursing students. Nurse Educator. https://doi.org/10.1097/nne.0000000000001509

[25] Lee, H., Yi, Y. J., Moon, W., & Yeo, J. (2023). Exploring the Potential Use of the Metaverse in Nurse Education through Mock Trial. Nurse Education Today https://doi.org/10.1016/j.nedt.2023.105974

[26] Kim, Y., & Kim, M. Y. (2023). Effects of metaverse-based career mentoring for nursing students: a mixed methods study. BMC Nursing, 22(1). https://doi.org/10.1186/s12912-023-01323-8

[27] Chen, F. Q., Leng, Y., Ge, J., Wang, D., Cheng, L., Chen, B., & Sun, Z. (2020). Effectiveness of Virtual Reality in Nursing Education: Meta-Analysis. Journal of Medical Internet Research, 22(9), e18290. https://doi.org/10.2196/18290

[28] Mendez, K. J. W., Piasecki, R. J., Hudson, K. W., Renda, S., Mollenkopf, N. L., Nettles, B., & Han, H. R. (2020). Virtual and augmented reality: Implications for the future of nursing education. Nurse Education Today, 93, 104531. https://doi.org/10.1016/j.nedt.2020.104531

[29] Ali, S., Abdullah, Armand, T. P. T., Athar, A., Hussain, A., Ali, M., Muhammad, Y., Joo, M., & Kim, H. C. (2023). Metaverse in Healthcare Integrated with Explainable AI and Blockchain: Enabling Immersiveness, Ensuring Trust, and Providing Patient Data Security. Sensors, 23(2), 565. https://doi.org/10.3390/s23020565

[30] Ryu, H., Lee, H., & Yoo, H. J. (2023). Development of a metaverse online learning system for undergraduate nursing students. Nurse Educator. https://doi.org/10.1097/nne.0000000000001509

[31] Ergın, E., Yalçınkaya, T., & Yücel, Ş. Ç. (2023). Nurses' thoughts on the metaverse and future time perspectives: a cross-sectional study. Research Square (Research Square). https://doi.org/10.21203/rs.3.rs-3573001/v1

[32] Damar, M. (2022). What the literature on medicine, nursing, public health, midwifery, and dentistry reveals: An overview of the rapidly approaching metaverse. Journal of Metaverse, 2(2), 62–70. https://doi.org/10.57019/jmv.1132962

[33] Li, Y., Gunasekeran, D. V., RaviChandran, N., Tan, T. F., Ong, J. C. L., Thirunavukarasu, A. J., Polascik, B. W., Habash, R., Khaderi, K., & Ting, D. S. (2023). The next generation of healthcare ecosystem in the metaverse. Biomedical Journal, 100679. https://doi.org/10.1016/j.bj.2023.100679

[34] Prasetyo, J., & Masruroh, M. (2022). The Future of Post-Covid-19 Health Services using Metaverse Technology. Journal of Nursing Practice, 6(1), 93–99. https://doi.org/10.30994/jnp.v6i1.295

[35] Baskar, K. (2022). Revolutionizing Medical Education with Metaverse. International Journal of Scientific Research in Computer Science, Engineering and Information Technology, 8(4), 2456–3307. https://doi.org/10.32628/CSEIT22844

[36] Petrigna, L., & Musumeci, G. (2022). The Metaverse. A New Challenge for the Health Care System: A Scoping Review. Journal of Functional Morphology and Kinesiology. https://doi.org/10.3390/jfmk7030063

[37] Bhatt, T. (2023). Metaverse in healthcare industry: applications, advantages, challenges, and more. Intelivita. https://www.intelivita.com/blog/metaverse-in-healthcare/