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Review Paper

Nigeria Technical and Vocational Education in the Metaverse Technology: A Systematic Review

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Abstract— Nowadays, education is seen as the most significant activity in our lives, most especially technical and vocational education for self-reliance. Even if there are various ways to learn, not all of them are interesting. But, because of technology advancement, education is now more appealing and fascinating. Virtual reality and augmented reality, which merge the actual world with the virtual world, are some of the most promising technologies in the educational industry. "METAVERSE" is the name of this virtual environment. We can communicate with individuals in a virtual setting using avatars that are lifelike. The usage of metaverse technology in some literary works has made learning more alluring than watching people on a screen. In this study, the researcher employed systematic literature reviews using the PRISMA flowchartr. PRISMA is an acronym for systematic reviews and meta-analyses, and it is a flowchart to learn more about the potential, efficacy, and benefits and drawbacks of learning technical and vocational education in the metaverse. The research leads us to the conclusion that the metaverse is a successful teaching tool. Because learning technical and vocational education in the metaverse has several benefits, including aiding in the visualization of materials and making learning more participatory, simple, and enjoyable for students of technical and vocational education, it is also helpful for teachers of vocational and technical education. There are significant restrictions, though, such the price of the hardware required to host the metaverse. Consequently, there are greater benefits to adopting the metaverse as a learning tool in technical and vocational education. Future work is required to make the most of the metaverse's benefits and address its drawbacks as a learning platform.

Keywords— Technical and vocational education, metaverse, virtual reality, augmented reality, virtual learning

1. Introduction

Technical and vocational education (TVE) refers to all forms and levels of education and training that provide knowledge and skills related to occupations in various sectors of the economy. It comprises formal, non-formal, and informal learning and enables people to develop skills and knowledge from basic to advanced levels. TVE serves multiple purposes, including preparation of youth for work, learning and developing work-related skills, and mastery of underlying knowledge and scientific principles. Work is broadly defined and therefore refers to both formal employment and self-employment. To support self-employment, TVE curricula often include entrepreneurship training. TVE can take place at secondary, post-secondary, and tertiary levels and includes work-based learning and continuing training and professional development, which may lead to qualifications. TVE also includes a wide range of skills development opportunities attuned to national and local contexts. Learning to learn, the development of literacy and numeracy skills, transversal skills, and citizenship skills are integral components of TVE. There are numerous approaches to support learning of trade courses or subjects at all school levels. Some of them make learning pleasurable, while others make it look dull, especially where practical facilities are not available. Formal vocational education is one such approach that provides skill-based learning and focuses on teaching practical skills. It was designed to prepare individuals for work-related reasons and can be completed online or traditionally. It's because much of what we learn comes from books, which are primarily made up of text with little drawings or photographs. This gives our understanding of learning the appearance that it can be more appealing. Technology has been developing quickly lately. Almost every industry, particularly education, has undergone a technological revolution [1]. There are numerous technologies employed in technical and vocational education nowadays. For instance, teachers might use a projector to go over lesson plans with students before to the COVID-19 Pandemic [2]. Today, however, schooling is conducted via video conference. However, there are drawbacks to studying technical and vocational education via video conferencing, such as limited interaction with lecturers, practical facilities

or other students. We are constantly looking for the best ways to employ technology to enhance the technical and vocational educational process because of this issue. Virtual reality (VR) and augmented reality (AR) are two of the education industries' most promising technological advancements [3],[4]. Through the use of a computer-simulated virtual world, virtual reality technology enables users to interact with their surroundings. For instance, the use of VR has been made possible through initiatives like Google Earth, which lets users explore the world in virtual reality. Then there is the technology known as augmented reality, which combines digital objects with the actual world. Additionally, you can see some augmented reality (AR) applications in the real world via social media filters and gaming apps like Pokémon Go. The actual world and the virtual world can be combined using technologies like VR and AR. "METAVERSE" is the name of this virtual environment. The metaverse is a real-world-like virtual universe that exists [5], [6]. Interaction or communication with other people, people represented by avatars and continual evolution regardless of whether users are connected or not make up the three fundamental features of the metaverse. A computer-simulated environment of the real world is referred to as a virtual world, but this definition differs since an avatar serves as its foundation [7], [8]. Because we can readily engage with others without going from place to place in the physical world, the metaverse has solved our communication and interaction problems [9]. All educational and learning activities are conducted online in this epidemic era. Online education, however, has restrictions that prevent us from directly connecting with others and practical facilities, which can make learning of technical and vocational course, feel dull. These restrictions can be overcome in the digital age thanks to the metaverse. As opposed to viewing people on a screen, the metaverse enables us to connect with individuals and practical facilities in a virtual setting through the use of lifelike participant avatars [3]. The recent publicity that the metaverse has received has piqued people's interest. Even large institutions made significant investments in this technology, and many people eager to try utilizing it. With all of these questions, metaverse becomes an interesting and crucial area for investigation.

2. Related Work

The world is currently significantly impacted by technological advancements, and the education industry is no exception. The COVID-19 pandemic has compelled us to engage in online learning activities, and remote techniques such as voicemail, email, and video conferencing are used for this purpose [4]. Online learning activities have a lot of benefits, but we must equally acknowledge that there are drawbacks, especially when it comes to the learning of trade courses. The metaverse is one of the technologies that can be used in the teaching and learning of technical and vocational education [5]. The metaverse is the next evolution of the internet, and it spans a range of technologies, including virtual reality (VR) headsets that transport you to whole new environments; augmented reality (AR) glasses that will one day project computer-generated images onto the world around you; and mixed reality (MR) experiences that blend physical and virtual environments. The metaverse can positively improve comprehension, knowledge retention, student engagement, attention span, and motivation [1]. Since the COVID-19 pandemic involved non-face-to-face (NFF) learning, employing the VR Class Format provided by the metaverse platform can assist in resolving any interactions or educational issues that may arise [6]. It might be assumed that the metaverse will be the future of our internet because it enables us to virtualize and travel from our displays [3]. The term "metaverse" refers to fusing the physical and digital worlds. Interactivity, corporeity, and persistence are the three main features of the metaverse. Being interactive means interacting with others. Corporeity refers to being represented by avatars, while persistence refers to continuing to grow both when you are connected to the virtual world and when you are not [7]. A virtual world is a computer-simulated environment that can be populated by many users who can create a personal avatar, and simultaneously and independently explore the virtual world, participate in its activities and communicate with others. Virtual worlds are closely related to mirror worlds. Although virtual worlds are used as an alternative method of communicating and interacting with students and teachers, a sense of isolation can occur such as losing certain body language cues and other more personal aspects that one would achieve if they were face to face. The metaverse is a 3D digital space that includes various simulated or mirrored scenes, avatars, NPCs, etc. [8], [9]. Through diverse social interactions, we can replicate real life in this virtual environment, which undoubtedly creates new opportunities for teaching and learning strategies, . Utilizing Virtual Reality (VR), Augmented Reality (AR), and Mixed Reality (MR) technologies, Meta verse utilizes Extended Reality (XR). Virtual Reality, augmented reality, mirror worlds, and life logging are the four subtypes of the metaverse [10], Virtual reality is the metaverse subtype that is used in education the most. Utilizing volumetric 2D/3D projection, VR technology creates 360-degree and 3D films. VR will have a bigger impact on education in the future. Immersive virtual reality technologies are used in a wide range of fields such as training, education, health, and research [11]. Utilizing Virtual Reality (VR), Augmented Reality (AR), and Mixed Reality (MR) technologies, Meta verse utilizes Extended Reality (XR) [12]. Virtual Reality, augmented reality, mirror worlds, and life logging are the four subtypes of the metaverse. Virtual reality is the metaverse of the four that is used in education the most [13]. Utilizing volumetric 2D/3D projection, VR technology creates 360-degree and 3D films [14].VR will have a bigger impact on education in the future [15]. The use of VR technologies in a wide range of fields and the use of VHs in many of these applications were discussed in the previous section. A crucial factor for the effectiveness of many of these applications is that the user perceives and responds to the events and situations taking place in the virtual environment as if they were real [12]. Many of these applications include virtual humans that are classified into avatars and agents. VR refers to the creation of simulated environments (i.e., IVEs) with the use of computer technology, software, and hardware. In contrast to traditional interfaces, VR not only displays the created environments to

the users but also gives them the feeling that they are “inside” the environment [10]. As an illustration, it employs gamified learning techniques with virtual reality. It demonstrates how gamifying virtual reality can improve communication among players and help students better visualize their learning materials [16]. Students' emotions and physiology are also impacted by VR-based learning. Some VR instruction might be emotionally taxing for pupils and interfere with their ability to learn [16]. Only a select few academic disciplines can be taught using VR technology. For the time being, declarative and procedural practical knowledge benefit from VR-based learning [17]. The education industry has benefited from a number of AR-related factors as well [18]. Digital things can be incorporated into the physical environment with AR technology [19]. Students or professors can employ augmented reality in the classroom. Teachers who are interested in implementing augmented reality applications in the classroom have ideas to do so [20]. It is simpler for teachers to construct the appropriate AR with the aid of an AR authoring tool application because they don't need to learn programming [21]. Students can learn specific courses, including geometry, with the aid of augmented reality. Their ability to solve materials, envision things, become more motivated or interested, develop creative thinking skills and practical skills are all benefits. The fact that this AR is not free and the restricted language it offers are two drawbacks to using it as a learning tool [22]. Another illustration demonstrates the benefits AR-based learning has for both teachers and students of technical and vocational education. However, there are certain difficulties for pupils who have trouble using computers or cellphones [23]. However, because AR may foster creativity and increase learning and teaching in the classroom, it is more effective than traditional learning [24]. The metaverse is becoming the educational environment of the future thanks to the growing use of AR and VR in the classroom. In order to make teaching more participatory, Wang Yu Yang et al.'s research led to the development of a new metaverse classroom platform. A more engaging, interactive, and student-centered learning environment can be created with metaverse. To avoid the negative effects, it also requires close attention [25]. Suh Woong et al. also claimed that students find learning in the virtual environment (Metaverse) to be enjoyable, and that this can boost students' interest in learning if teachers employ it effectively [26]. The metaverse can support clinical and medical education. This platform provides a solution for a multiuser, online clinical case study that calls for a lot of visualization scenes and characteristics. By using it, students can learn medical education in a virtual setting that mimics actual hospital settings, complete with all the necessary virtual resources for medical learning [27]. Due to its current state of development, the metaverse hasn't been utilized all that frequently [28], [29]. This approach should be able to get beyond limitations in time and geography and give those with physical and environmental issues equal opportunity [30].

3. Design

A systematic literature review was employed as a study methodology in this research. The PRISMA flowchart was used to assess the paper. PRISMA stands for Preferred Reporting Items for Systematic Reviews and Meta-Analyses, and it is a flowchart. The PRISMA flowchart visually summarizes the screening process and records the number of articles found and the selection process transparently by reporting on decisions made at various stages of the systematic review. The PRISMA flowchart makes it simple for readers to comprehend how records utilized as references in the systematic literature review were gathered, processed, and analyzed. Figure 1 displays the PRISMA Flowchart phase. The PRISMA flowchart consists of a 27-item checklist and a four-phase flow diagram. It is intended to help authors improve the reporting of systematic reviews and meta-analyses.

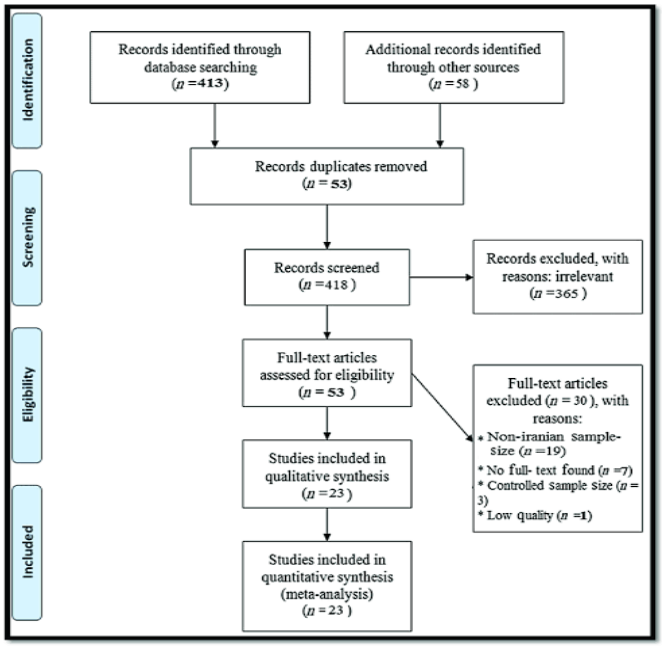

Fig 1: PRISMA Flowchart

The identification stage comes first in the process. The researcher conducted a database search using Google Scholar, Research Gate, and other journal databases, including Elsevier, Science Direct, MDPI, and others. Metaverse, technical and vocational education system, virtual reality, augmented reality, and virtual world are the search terms the researcher employ to browse the database. Moreover, the researcher gathered 420 papers from the database. The screening process is the next stage. In this stage, "Mendeley" was used to manage all of the gathered references. The researcher starts by eliminating any duplicates and selecting a work that has at least been published within the previous five years. Then discard any publications that lack full-text articles. Finally, screening was completed by manually identifying and deleting non-English research publications. The number of papers obtained was trimmed down to 111 in this step. After that, the author studied each title and abstract individually and weed out any that don't pertain to the topics. References were down to just 60 papers. The eligibility phase is the third step. To assess whether the paper is about using VR, AR, and Metaverse in technical and vocational education, the final screening in this stage was conducted by

reading all the full-text articles from the preceding step. Full-text articles about VR, AR, the metaverse, and technology in education that had nothing to do with research subjects were excluded. In this step, 40 papers are excluded. Included in the steps is the last one. In this step, the researcher selects the essay that best fits the topics from the eligibility criteria. The 30 final articles were utilized as references at the conclusion. The goal of these systematic reviews is to learn more about the potential, viability, benefits, and drawbacks of learning in the metaverse. Research articles written in English are the primary filter criteria in the analysis. In this approach, full-text articles, duplicate articles, and the publication dates and locations of the papers are also used as filtering criteria.

4. Result and Discussion

According to the author's research, the Google Scholar search engine returned 420 pages when the term "Education System in Metaverse" was entered. Twenty nine papers were chosen for our systematic literature analysis because they are relevant to the subjects after screening 60 eligible papers. By contrasting the points of view of the author, the researcher first assessed those works. Then, the author determines whether the perspective in that publication is comparable to the ones needed to address this research issues. Is the metaverse the educational technology of the future? The metaverse has been used in many spheres of life, including technical and vocational education. Metaverse will be the internet of the future because it enables us to virtualize and venture beyond screens [3]. Additionally, VR has been used in the classroom for several courses, including computer science and engineering that call both declarative and procedural practical knowledge [18]. Additionally, AR, a component of the metaverse, has been used in education and has the potential to fundamentally alter how people learn and support future learning activities [19]. In order to study anytime, anywhere, and to provide equal possibilities for persons with physical challenges and settings, the metaverse can be used in technical and vocational education [8], [30]. This means that the learning process will take place in a virtual world (a simulated environment). Language learning has been done in the virtual world. One of those studies was using the metaverse platform "Second Life" to teach participants technical and vocational subjects with virtual workshops for practical works. This platform is ideal and appropriate for people who have a strong desire to learn technical and vocational skills, but it might be challenging for people who lack technological expertise and experience. Although "Second Life" as a learning platform is not yet well-known, it has a lot of potential [9]. By overcoming the limitations of 2D learning platforms, metaverse can provide both formal and casual active learning experiences [12]. Additionally, it enables students to collaborate with others in a virtual environment where they can communicate face-to-face via avatars and construct three-dimensional objects that symbolize concepts, ideals, or emotions [29]. Students can view the Pashedu III Tomb thanks to an example of employing metaverse for learning architectural heritage documentation [28]. Learning in the metaverse promotes collaborative, interactive, and learner-centered teaching and learning. There are a few prerequisites to use Metaverse, a new platform for education, including having a good internet connection, a midrange to high-end computer, and a suitable server [7], [25]. The rapid advancement of technology has made all of those prerequisites unnecessary, suggesting that the metaverse may be the medium of instruction in the future. Does the fact that students are using the metaverse as a technical and vocational learning tool demonstrate its efficacy? There is evidence that learning technical and vocational skills in the metaverse is more efficient than learning in the traditional sense after gathering data from references. Some of the texts we include below mention VR and AR as elements of the metaverse. Table I lists the benefits of using the metaverse for learning technical and vocational skills. It is clear that studying in the metaverse has a number of benefits, including raising creativity levels and making technical and vocational education more interactive [1], [2], [4], [6], [11], [13], [27]. Additionally, by employing the metaverse as a learning platform, we are no longer constrained by time and place and can learn anywhere and at any time [1], [6], [13], or [27]. In order to construct a virtual environment and virtual items, Metaverse uses a virtual world [6], [13], [14], [20], [22], [23], [27]. These might aid us in visualizing our course materials and learning tools. Learning materials and tools should be visualized to make learning easier and to pique students' attention and make learning of technical and vocational skills more fun [1], [10], [14], and [22]. Additionally, a fun and engaging learning environment has been developed. Students' emotional well-being can improve when learning in this setting [17], [23]. Teachers can benefit from Metaverse as a learning platform since it can aid in the technical and vocational learning process by letting them illustrate or depict materials and tools [21], [22].

Table 1. Advantages Learning Technical and Vocational Education Using Metaverse

Advantages	Study Identifiers
Improve creativity, and enhance learning and teaching in education by making it more interactive	[1], [2], [4], [6], [11], [13], [27]
No geographical, time limitations and more interactive	[1], [6], [13], [27]
It makes students more excited to learn and easier.	[1], [10], [14], [22]
Can create virtual environment or virtual objects to help visualization	[6], [13], [14], [20], [22], [23], [27]
Help teacher in the learning process	[21], [22]
The metaverse provides a sense of presence that sets it apart from 2D technologies, making it easier to remember doing something than being told.	[1], [2], [3], [6]
The metaverse spans a range of technologies, including VR,AR, and MR, which can positively improve comprehension, nowledge retention, student engagement, attention span, and motivation.	[1], [2], [3], [6]
The metaverse can be used to teach technical and vocational education	[1], [2], [3], [6]
The VR Class Format provided by the metaverse platform can assist in resolving any interactions or educational issues that may arise in NFF learning	[1], [2], [3], [6]

The benefits of Study Identifiers By making education more interactive, you can increase creativity and better the learning and teaching of technical and vocational processes. [1], [2], [4], [6], [11], [13], [27] No geographical, time, and more interaction restrictions [1], [6], [13], [27] Students of technical and vocational education learn more eagerly and more quickly as a result. [1], [10], [14], [22] able to produce virtual environments or things to aid in visualizing learning materials and practical facilities [6], [13], [14], [20], [22], [23], [27] Assist the teacher in the technical and vocational education process [21, [22] fostering the emotional well-being of of technical and vocational education students [17], [23]Table II lists the drawbacks of using the metaverse for learning technical and vocational education courses. It is clear that there are drawbacks or restrictions to learning technical and vocational education in the metaverse. Because Metaverse is a brand-new and cutting-edge technology, not everyone can utilize it yet due to limitations of that technology [2]. Additionally, because the metaverse is still in its infancy, appropriate hardware is expensive [2, [6], [22], [24]. We must complete all technical and vocational education learning tasks in the virtual world when we are learning in the metaverse. Our writing abilities may gradually deteriorate as a result, increasing our temptation to cheat. Additionally, the virtual world is full with diversions, so our attention is not solely focused on studying [1], [6], or [10]. It is challenging to keep track of every student's activities while using the metaverse as a learning platform because we are not required to be in the same physical space as our instructors [10]. The following are some of the benefits of using the metaverse in education [1], [2], [3], [6].

- The metaverse provides a sense of presence that sets it apart from 2D technologies, making it easier to remember doing something than being told something.
- The metaverse spans a range of technologies, including VR,AR, and MR, which can positively improve comprehension, knowledge retention, student engagement, attention span, and motivation.
- The metaverse can be used to teach technical and vocational education.
- The VR Class Format provided by the metaverse platform can assist in resolving any interactions or educational issues that may arise in NFF learning.

Table 2. Disadvantages Learning Technical and Vocational Education Using Metaverse

Disadvantages	Study Identifiers
Lack of technology experience	[2], [5], [6]
Cost of device	[2], [6], [22], [24]
Declining writing skills, increasing cheating, and lack of focus	[1], [6], [10]
Hard to monitor student's activity	[10]
The metaverse technology can cause potential problems such as academic freedom (damage to stock prices through	[4]
The metaverse has limitations in its educational applications	[2]

Inexperience with technology can be a significant disadvantage when using intrusion detection systems (IDS) for studies. IDS are complex systems that require a certain level of technical expertise to set up, configure, and maintain. Without the necessary knowledge and experience, researchers may struggle to effectively use IDS in their studies, leading to inaccurate or incomplete results [2], [5], [6], device cost: the cost of developing a metaverse can be expensive due to various factors, including 3D asset development, programming, server infrastructure, and ongoing maintenance. The cost of building a metaverse can be broken down into several categories, including development costs, data and infrastructure costs, hardware for AR/VR headsets, manpower, and content. The physical components underlying a functioning metaverse and their cost structures include consumer devices, network capacity, and enterprise hardware to design virtual environments. The required investments represent large fixed costs for establishing the metaverse [2], [6], [22], [24], deteriorating writing abilities, rising cheating, and lack of concentration are all drawback of technology metaverse in education. Deteriorating writing abilities is a lack of emphasis on writing skills. In some educational systems, there may be a reduced focus on developing strong writing skills, leading to a decline in students' abilities leading to efficiency gain were students may resort to plagiarism and other forms of cheating to save time and effort, prioritizing grades over actual learning. Rising cheating increases pressure, peer influence were students may be more likely to cheat when they see their peers doing so, leading to a "cheating culture" in some educational settings. Lack of concentration caused by technological distractions due to prevalence of smartphones and other digital devices can be a significant source of distraction for students, making it harder for them to concentrate on their studies, competition for attention in this case students may feel overwhelmed by the various demands on their time and attention, leading to difficulties in focusing on a single task [1], [6,] [10]. Other potential problems that can be caused by metaverse technology such as academic freedom also lead to the metaverse's potential to blur the lines between the physical and digital worlds could raise questions about academic freedom. For example, if educational institutions and content creators are heavily influenced by corporate interests or government regulations in the metaverse, it could impact the free exchange of ideas and knowledge [4]. The metaverse has limitations in its educational applications such as weaker social connections even lthough, the metaverse provides new social communication spaces, the connections formed within these spaces may not be as strong or meaningful as those in the real world. Privacy impingement is a virtual nature of the metaverse and the potential for anonymity can lead to privacy concerns, as personal information and interactions may be more easily accessed or manipulate and possibility of various crimes in which metaverse's virtual space and anonymity can also facilitate the commission of crimes, such as harassment, fraud, or theft, which may pose risks to users, especially students, others include challenges in designing effective educational experiences were metaverse offers new possibilities for learning, designing and implementing effective educational experiences within this environment can be challenging for teachers and educational institutions and also Misuse of student data were educational metaverse platforms need to be developed with safeguards to prevent the

misuse of student data, as the virtual nature of the metaverse may make it easier for personal information to be accessed or shared without consent [2]. Monitoring student behavior is challenging to the implementation of metaverse in technical and vocational education were a metaverse learning environment can be difficult for educators to effectively monitor and assess student behavior, engagement, and progress. [10].

Despite the drawbacks of applying metaverse technology in technical and vocational education, there are still benefits to using the metaverse for learning technology in technical and vocational education. For example, by integrating augmented reality to visualize content, such as learning two-dimensional plane geometry, the metaverse can increase accessibility, interaction, and enjoyment in learning and education. However, it is important to note that the implementation of the metaverse as a learning platform will require time and addressing the challenges and limitations it presents.

5. Conclusion and Future Scope

In conclusion, a PRISMA flowchart has been used to successfully conduct a systematic literature review. Based on the PRISMA processes, it was concluded that literature can be used as a source of analysis to determine the viability, efficacy, and benefits and drawbacks of learning technical and vocational skills in the metaverse. The metaverse is a useful tool for technical and vocational education. It has several benefits, particularly for students. The cost of the hardware required to host metaverse is one of the drawbacks to adopting metaverse as a technical and vocational learning tool or platform. The use of the metaverse in education as a teaching tool, however, has additional benefits. It facilitates content visualization and enhances learning of technical and vocational education by making it more engaging, simple, and exciting. According to various researches, the metaverse can aid both teachers and students of technical and vocational education in their educational endeavors. This study has shown that learning in the metaverse has many benefits, but that not everyone can use it due to current technology. The metaverse is a novel technology, despite the fact that it has been integrated into many aspects of our daily lives. The metaverse is currently being developed right now. It will require extensive research before being completely integrated into the educational system especially technical and vocational education because it is a new educational platform. The metaverse is currently only utilized in a few academic topics, necessitating a decent computer, a strong server, and sufficient bandwidth. Given the rate of technology advancement, the metaverse might be the way that technical and vocational education develops in the future. However, we advise conducting further research on the use of metaverse in the future, particularly in technical and vocational education.

Data Availability
The author's email address can be used to seek access to the data that supports the study's conclusion. Due to their size and the fact that some of them needed the data source's consent before being made public, the data were not available.

Conflict of Interest
There is no disagreement of interest.

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Authors' Contributions
The author produces the first draft of this manuscript by searching all the articles needed to conduct this study. The data collected were analyzed and interpreted by the author to come up with camera ready copy of the manuscript with findings and conclusion.

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