# The use of Metaverse platforms in public service provision: Implications on citizen satisfaction with special reference to the education sector
# (An exploratory empirical analysis of the Egyptian case)
# استخدام منصات الميتافيرس في تقديم الخدمات العامة: الآثار المترتبة على رضاء المواطنين
# مع إشارة خاصة إلى قطاع التعليم (تحليل ميداني استكشافي للحالة المصرية)

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## Abstract

Nowadays, tech companies are all jumping on the bandwagon, hoping to take the lead in forming Metaverse and capitalizing on its significant potential for generating revenue. Governments are likewise intrigued by the prospects that Metaverse presents for providing higher value and delivering better public services to communities. As one commentator says; "we might soon be able to interact with governments in Metaverse directly or through our avatars to take part in policymaking, receiving information and services from AI-enabled virtual public representatives that will give citizens a human-like experience". Furthermore, Metaverse can offer numerous opportunities for educational improvement through its distinctive capabilities which promote immersion, interaction, and presence. Nonetheless, since this technology is still in its early stages of development, the current literature lacks adequate empirical evidence concerning the effectiveness of educational Metaverse and its pros & cons as a technology-enhanced learning system.

*Purpose:* The aim of the present research is to understand the evolution of Metaverse since origin, describing its characteristics and applications, as well as exploring the intention to use Metaverse platforms in public service provision and how state-owned enterprises can leverage it for boosting citizen satisfaction, especially in education, in order to develop an advanced teaching model based on this fresh technology.

*Methodology:* This work is exploratory explanatory in nature, with a predictive futuristic orientation. Both qualitative and quantitative viewpoints were employed in the study. For theoretical intents, the paper adopted a descriptive analytical method, whereas empirically it used a field study approach. First, systematic review of previous literature was conducted, then online questionnaire-based survey was utilized to collect data from a 400-respondent sample. Deductive and inductive tools were both applied as well.

*Findings:* The research demonstrated how Metaverse facilitates novel forms of social engagement, remote collaboration, and immersive education. It also assessed its potential impact on citizen satisfaction within the public sector. Technical challenges, social concerns, and regulatory frameworks were addressed, highlighting the need for privacy, data security, and ethical considerations. The empirical analysis reached that there is a significant direct positive impact of educational Metaverse on citizen satisfaction with government educational services in Egypt. Finally, the study concluded that Metaverse remains an area of endless possibilities. Alongside, it is not a one-size-fits-all educational solution; is that it offers a customized learning mechanism designed to meet the unique needs and preferences of each student. Therefore, the continuous evolution of Metaverse requires ongoing research to ensure its responsible integration into the educational process.

*Originality:* The paper adds to the accumulated results in the field of study, as it could help academics, practitioners, and public executives to obtain a comprehensive – theoretical and practical – overview of how to achieve citizen satisfaction through adopting Metaverse technology in public education. Moreover, the study provides fruitful recommendations that would help chart the path in future. Also, it might assist draw implications for further research opportunities in the area of educational Metaverse.

*Practical implications:* The results provide managerial and policy implications for the Egyptian government on how to use digital communication tools, particularly Metaverse, to foster engagement with citizens and to offer better public educational services.

***Keywords**:* Digital Government, Educational Metaverse, Public Service Delivery, Citizen Engagement, User Satisfaction, Technological Education in Egypt.

**المستخلص:**

*الهدف:* تهدف الدراسة الحالية إلى فهم تطور الميتافيرس منذ نشأته، مع توضيح خصائصه وتطبيقاته، واستكشاف إمكانية الاستعانة به في تقديم الخدمات العامة وخاصةً التعليمية، إلى جانب تناول كيفية توظيفه من قبل مؤسسات التعليم الحكومي بغرض تعزيز رضاء المواطنين، وصولًا إلى بلورة نموذج تعليمي متطور يعتمد على تلك التقنيات الحديثة.

*المنهاجية:* تعد الدراسة الحالية ذات طبيعة استكشافية وتفسيرية وتوجه تنبؤي مستقبلي، وقد استخدمت أساليب التحليلين النوعي والكمي للبيانات، مع توظيفها لأدوات الاستنباط والاستقراء معًا. فعلى المستوى النظري تبنت الدراسة المنهج الوصفي التحليلي، حيث بدأت باستعراض الأدبيات السابقة، ثم تلاها دراسة ميدانية تضمنت استبيان إلكتروني شمل ٤٠٠ مشاركًا على المستوى التطبيقي.

*النتائج:* أثبتت الدراسة أن الميتافيرس يتيح أشكالًا جديدة من التفاعل الاجتماعي والتعلم عن بُعد. وقد تم بحث تأثير الاستعانة به على رضاء المواطن عن الخدمات العامة المقدمة. كما تم مناقشة التحديات التقنية والمجتمعية والتنظيمية التي تواجه تطبيقه، مع التركيز على قضايا الأمن والخصوصية والاعتبارات الأخلاقية. وقد أظهرت النتائج أن استخدام الميتافيرس في التعليم سيكون له أثرًا إيجابيًا مباشرًا وملحوظًا على رضاء المواطنين عن الخدمات التعليمية الحكومية في مصر بصفة عامة. وقد خلصت الدراسة إلى أن الميتافيرس يمثل مجالًا واعدًا يتمتع بإمكانات غير محدودة، مما يستلزم استمرار البحث فيه لضمان دمجه بشكل أكبر في العملية التعليمية.

*الأصالة:* تسهم الدراسة في إثراء الأدبيات العلمية حول هذا الموضوع، من خلال تقديم إطار نظري وتطبيقي يمكن الباحثين والممارسين وصناع القرار من فهم آليات تحقيق رضاء المواطن عن طريق توظيف الميتافيرس في تقديم الخدمات التعليمية الحكومية. كما تقدم الدراسة كذلك جملة من المقترحات العملية المفيدة، فضلًا عن كونها تفتح آفاقًا بحثية مستقبلية في مجال التعليم الافتراضي.

*الدلالات التطبيقية:* تقترح الدراسة بعض التوصيات التي من شأنها تشجيع الحكومة المصرية على استخدام تقنيات الميتافيرس، بهدف تفعيل مشاركة المواطنين وتحسين مستوى جودة الخدمات التعليمية المقدمة.

***الكلمات المفتاحية:*** الحكومة الرقمية، الميتافيرس التعليمي، تقديم الخدمات العامة، مشاركة المواطنين، رضاء المستخدمين، التعليم التكنولوجي في مصر.

## 1. Introduction: Research aim and purposes

Indeed, in this era of the 4th Industrial Revolution, computer-mediated instruments that improve social presence and connectedness are substantial. At first, Internet of data was initially introduced in the 1990s. Whereas, we embraced Internet of people in the 2000s. Next, Internet of Things (IoT) was introduced in the 2010s. Nowadays, we are approaching Web 3.0 in the 2020s, which includes Internet of place and Internet of ownership. Internet is actually undergoing a revolution thanks to Metaverse; a continuum that represents a range of technologically-upgraded worlds and realities. It is the new virtual universe that combines real and digital worlds to create an immersive dimension that surpasses pure three-dimensional (3D) technology (De Felice *et al.*, 2023: 1744). Metaverse is essentially an online virtual space that replicates our 3D world, allowing us to engage and carry out actions much like we can in the real world (Sear, 2022). Hence, we can now engage in and/or inhabit a persistent shared experience instead of just surfing through Metaverse (Accenture, 2022). According to Suzuki *et al.* (2020); avatars handle everything on behalf of users, and mutual contact is possible in Metaverse just like it is in the actual world.

Notably, Metaverse—which was hitherto only an abstract idea—is gaining prominence and drawing interest from customers, investors, companies, and significant international players. Although not the only industry impacted by this digital revolution, e-commerce is undoubtedly the first to adjust to this new immersive reality (De Felice *et al.*, 2023: 1744). According to Anderson and Rainie (2022); proponents of extended reality and the creation of increasingly-sophisticated and immersive online worlds claimed that the society as a whole stands to gain from the technology's quick development in a number of areas, including civic and social life, education, healthcare, and arts. Furthermore, Fountain (2001) emphasized the adoption of digital government as a way to show how public officials, like other actors, should comprehend and use technology (Cho, 2023: 30).

In contemporary times, state and local government agencies are beginning to recognize the potential advantages that Metaverse can offer for their operations and service provision. The onset of Covid-19 pandemic accelerated the transition to remote work, during which various technologies associated with Metaverse—e.g., Virtual Reality (VR), Augmented Reality (AR), Artificial Intelligence (AI), blockchain, natural language processing, computer vision, and edge computing—facilitated this shift. Organizations rapidly adapted, leading to the widespread dissemination of practices, like virtual meetings and document sharing. It is imperative for leaders of large public organizations to evaluate the implications of Metaverse on their daily-work activities and long-term strategies. While technologies that form the foundation of Metaverse are still in their nascent stages, they promise to ultimately enhance the ability of governments to deliver services, provide information, and engage with citizens in a quick, efficient, and secure manner, gaining their satisfaction (Armbrust, 2022).

In effect, the discourse surrounding Metaverse is increasingly contentious, with two recent opinion articles suggesting that it may become obsolete as major tech companies pivot towards generative AI. Conversely, some experts contend that Metaverse is going to last, asserting that booming technologies, such as generative AI, can also be effectively integrated within Metaverse. Thence, it is emphatic to explore the future of Metaverse and draw insights from various case studies. Despite regulations are indeed important, it is essential to recognize that big tech companies cannot bear the entire responsibility for self-regulating the Metaverse. Consequently, it is crucial to examine how governmental bodies and public sectors can harmonize their efforts with the potential of this technology in promoting public service delivery and reaching citizen satisfaction. Besides, governments should play a pivotal role in ensuring that Metaverse experience is valuable for all users, while leveraging technology to support sustainable development and mitigate the risks of a "Metacurse". It is substantial for governments to be present in the place where their constituents are or anticipated to be, with Metaverse being a prominent example here (Distor *et al.*, 2023: 6).

On the other hand, digital technologies have significantly altered the landscape of education worldwide over the past twenty years. Technology-enhanced learning is becoming now more common as many students are trying to use advanced applications within their learning activities. This fact can assist in meeting their new educational needs and requirements (Lopez-Belmonte *et al.*, 2022: 1). In general, Metaverse platforms possess the capability to revolutionize classroom instructions, facilitate remote collaboration between educators and learners, enhance vocational training programs, and open up new avenues for lifelong learning. Research has demonstrated that VR/AR can effectively enhance various educational outcomes, including comprehension, knowledge retention, student engagement, attention span, motivation, and satisfaction (Clegg, 2023).

As for Egypt, it is obvious that the country has been undergoing notable economic growth and development recently. This progress has resulted in heightened investment in the education service, particularly through the integration of new technologies. The government's commitment to upholding the quality of education and equipping students for the digital era has increased the demand for Metaverse educational solutions. Additionally, the Covid-19 pandemic has expedited the shift towards online and remote learning, further propelling the expansion of the educational Metaverse market in Egypt. Thus, the Egyptian educational Metaverse market is now experiencing considerable growth and advancement, driven by customer preferences for immersive and interactive learning experiences, the implementation of VR/AR technologies, the emergence of educational Metaverse platforms, a youthful demographic, government backing, and favorable macroeconomic circumstances (Statista Market Insights, 2024).

This research, therefore, seeks to investigate the future of state-owned enterprises within the modern digital technological landscape. In this respect, the present paper displays the concept of Metaverse and the responsibilities of governments in harnessing the potential of this innovative trend for public service delivery. Initially, the focus will be on the regulatory role that must tackle both existing and emerging challenges associated with the suit of technologies enabling Metaverse. Subsequently, the discussion will address the role of public organizations as prospective users of Metaverse, with a special reference to the educational field in Egypt. Lastly, various policy and program implications will underscore the Metaverse's opportunity for innovation and transformation in public sector decision-making, service production and delivery, while highlighting the necessity of carefully assessing whether Metaverse is the most appropriate technology to meet certain public needs and satisfy customers. Hopefully, the study could serve as starting point for further research into how the application of Metaverse platforms can boost educational service provision, elevate perceived city brand value, and strengthen relationships with citizens, specifically in the Egyptian scenario.

## 2. Research problem and conceptual model

Actually, the notion of Metaverse has been capturing headlines for a couple of years lately, sparking a wide range of discussions and debate that vary from genuine enthusiasm to profound skepticism. In 2021, Facebook took a remarkable step by rebranding itself as "Meta", prompting many commentators across Internet to perceive the development of Metaverse as the recent technological gold rush. Indeed, the trends contributing to the rise of Metaverse have been evolving over the past two decades. For instance, online gaming has provided highly-immersive and engaging digital entertainment experiences, oftentimes set within expansive "Sandbox" virtual environments that grant players much freedom (Horton, 2022).

Although Metaverse originated in the 1990s, but the first scientific research on this subject did not appear until 2000. The volume of publications surged considerably in 2020, likely as a result of Covid-19 which hastened the switch to digital worlds. Over 50% of articles were produced in four countries, with USA leading with 20% (51 publications), followed by China and South Korea, each contributing 15% (36 publications). UK and Japan followed with 12% (30 publications) and 8% (21 publications), respectively. The findings indicated that the primary field of study concerning Metaverse is Computer Science (CS), accounting for 31.6% of total research (De Felice *et al.*, 2023: 1750).

Simply, Metaverse is conceptualized as a collective virtual space enabled by advanced technologies, including VR, AR, AI, IoT, 5G connectivity, big data analytics, spatial computing, alongside digital twins. While it remains a nascent idea, Metaverse holds the promise of revolutionizing the physical realm and facilitating the transition or expansion of real-world activities into a virtual domain (Wiles, 2022). In this regard, Dwivedi *et al.* (2022) stated that Metaverse represents a world that surpasses national boundaries, borders, and gender distinctions, necessitating a novel perspective that goes beyond traditional humanistic frameworks. Moreover, they posited that Metaverse market is poised for growth, which will contribute to the establishment of a sustainable Metaverse universe (Cho, 2023: 36). In fact, the technologies associated with Metaverse can provide numerous benefits to the public sector, including enhanced information sharing, improved communication with citizens, greater accessibility to public services, and the chance to engage in a new virtual economy. Various implementations are currently being explored in many cities and countries across the globe (Sultanow *et al.*, 2022: 1).

In the foreseeable future, government services can be accessible within virtual worlds, such as Metaverse, enabling individuals to undertake activities, like tax payments and voting through VR/AR platforms. This advancement presents fresh occasions for governments to deliver their services in an entirely-different manner, potentially transforming their interactions with citizens and the provision of public services. It may enhance transparency, efficiency, satisfaction, and citizen engagement in the policymaking process, while simultaneously reducing costs and complexities, eventually offering a more human-like experience for users. However, this transition requires governments to take critical decisions regarding their integration into Metaverse and the roles they should hold within this increasingly-immersive digital landscape (Sear, 2022).

Whereas Metaverse presents great opportunities, historical instances of technological hype and IT failures need governments to approach this domain with a healthy degree of caution. As with any emerging technology, it is important to evaluate the Metaverse's effectiveness in meeting business requirements, addressing socio-economic issues, and fostering innovative changes in public sector decision-making and in service production and delivery (Distor *et al.*, 2023: 2). At the very least, the transition to a more virtual and interactive environment will compel regulators to revise their current regulations across various sectors. Furthermore, the unique attributes of Metaverse are likely to introduce new inquiries and challenges for regulators, such as the protection of intellectual property generated within Metaverse, taxation of virtual property transactions, monitoring antisocial behavior (e.g., bullying), establishing identities, authenticating certifications, and managing healthcare and personal data in virtual environments. Actually, numerous questions are still unconsidered (Caserta, 2023).

Hence, the practical applications of Metaverse are still constrained, and its adoption by public sector organizations remains a matter of senior discussion. Whilst some governments have ambitious plans, many have yet to encounter a compelling rationale for embracing that technology. This raises critical questions like; should public authorities be investigating this realm of immersive technology, which holds the potential for enhanced citizen service delivery, and thus increasing public satisfaction?

Additionally, how can governments maximize the value derived from Metaverse, and what obstacles exist that may hinder their ability to reap its benefits (Aldane, 2023)?

Otherwise, the educational system in Egypt is confronted with a variety of issues that call for coordinated efforts in the areas of policy, infrastructure, finance, pedagogy, and community involvement. Indeed, Egypt's Sustainable Development Strategy (Vision 2030) includes education as one of its ten interconnected pillars. This strategy aims to create citizens who are capable of realizing their full potential and who are empowered, skilled, and technologically literate. Egypt's strategy highlights the magnitude of working on the professional development of educators and adopting better teaching instruments and methodologies, improving education infrastructure to support learning and innovation, upholding the operational structure of relevant ministries to enhance service delivery, and revising curricula and evaluation tools to reflect changes in the labor market and technological advancements worldwide in order to contribute to maximizing the quality of the education system, and supporting the formation of strong, competent, and socially-conscious citizens (Global Evidence…Series, 2024: 3).

In practice, the impact of modern technology on educational outcomes differs greatly, which may cover the application of Metaverse platforms. The success of programs is frequently heavily context-dependent, making it challenging to identify the precise underlying factors influencing a program's effect. Therefore, technology in general may disrupt or affect traditional classroom education in an inconsistent way. Beg *et al.* (2022), for example, noted the benefits of an in-class technology program for teachers, but de Barros (2023) emphasized the null and negative results connected to a similar intervention in India. The inconsistent results of research highlighted the significance of carrying out further work to determine the causes of these kinds of programs' success or failure, and to pinpoint factors that reinforce program efficacy (Global Evidence…Series, 2024: 4).

Obviously, the analysis of previous literature indicates that Metaverse as an educational setting remains in a developmental phase (Crisol-Moya *et al.*, 2020; Diaz, 2020). This situation arises from the fact that investigations into Metaverse are still in their exploratory phases, revealing a notable gap in academic literature regarding this topic, particularly within the realm of education (Park *et al.*, 2021; Baynat & Lopez, 2020; Nurhidayah *et al.*, 2020). While the assessment of learning is a prevalent subject in scientific discourse, significant challenges have been encountered in acquiring instruments that certainly evaluate educational practices within Metaverse (Lopez-Belmonte *et al.*, 2022: 9). This paper has sought to address the necessity for valid and reliable means to appraise educational practices within Metaverse.

Alongside, in the research conducted by Tlili *et al.* (2022), which involved a bibliometric analysis of studies related to Metaverse in education, it was observed that the predominant areas of focus were natural sciences, mathematics, and engineering at 53%. This was followed by general education at 15%, and arts & humanities at 11% (Gurkan & Bayer, 2023: 67). Consequently, it is essential to consider managerial research concerning Metaverse and its applications in education, like the current one.

Furthermore, a large portion of the existing research on educational Metaverse has primarily been theoretical, lacking a robust number of empirical analyses. Tlili *et al.* (2022) reported also that merely 18.8% of studies employed quantitative methodologies, while 39.6% utilized qualitative or mixed methods. Importantly, the remaining 41.7% concentrated on literature reviews and theoretical discussions, without the inclusion of empirical data. However, the practicality and efficacy of educational Metaverse require additional validation through a greater volume of empirical evidence (Liang *et al.*, 2023: 72). Hence, this is the focus of the present study.

To sum up, despite the body of research concerning Metaverse is still limited in nature, and research agendas are just beginning to take shape (Dwivedi *et al.*, 2022), this work serves as a foundational building block for the future reconnaissance and thorough analysis of Metaverse application, especially within public enterprises. The findings from this exploratory study can guide public sector organizations in recognizing the emerging scope within Metaverse, and assist them in formulating actionable strategies as more Metaverse platforms come to fruition. In essence, while numerous articles have delved into the technical dimensions of Metaverse, a wide gap persists regarding the implications of this technology for government operations and citizen satisfaction (Distor *et al.*, 2023: 1), specifically in the educational domain—with special reference to Egypt. Thereby, the current paper approaches this discourse through a review of related literature with an empirical perspective, addressing a fundamental research question which is:

*"What is the role of governments in the adoption of Metaverse technology for the sake of providing public services? & how can this contribute to citizen/ user satisfaction, particularly in the Egyptian educational sector?"*

Consequently, the study examines its central variables as illustrated in figure (1) below:




*Figure (1)*
***Research conceptual model***
Source: Prepared by the researcher.

## 3. Literature review

### *3.1The concept of Metaverse – meaning & origins:*

The concept of Metaverse, while a relatively new term in the discussions of technology experts and scholars, was originally introduced by Neal Stephenson in his

1992 science fiction novel "Snow Crash" (Dwivedi *et al.*, 2022: 2). In this context, Metaverse refers to "a 3D space that serves as a parallel universe to our own, allowing individuals to navigate, share, and engage in personalized experiences". It typically depicts humans enjoying unrestricted access to a digital realm, where they interact through avatars that mirror their real-world identities. The notion itself is derived from a Macedonian word inspired by the English "Metaverse" combining the prefix "meta" (meant as beyond) with the noun "verse" (derived from "universe"). It is noteworthy that early ideas of Metaverse began to emerge in the late 1960s, especially via precocious literary works exploring parallel and digital universes, such as Philip K. Dick's "The Game-Players of Titan" and the short story "We Can Remember It for You Wholesale". Thence, Metaverse is not a completely new concept. Since October 2021, the term has surged in popularity following Facebook's announcement to rebrand its parent company as "Meta", which oversees platforms like Facebook, WhatsApp, Instagram, & Oculus, and initiating a project under this name. Shortly thereafter, Microsoft revealed plans to incorporate Metaverse into its Teams platform in 2022, introducing a feature called "Mash" that lets users create avatars for participation in business meetings (De Felice *et al.*, 2023: 1745).

In this regard, Zuckerberg (2021) defined Metaverse as "a post-Internet experience that allows us not only to observe, but also physically interact with objects within our surroundings" (Gurkan & Bayer, 2023: 59). Allam *et al.* (2022) noticed that the conception of Metaverse has existed for several decades, however it has recently garnered significant global interest following the rebranding of "Meta". Bibri and Allam (2022) asserted that recent advancements in computing and immersive technologies have enabled "Meta" to accelerate its vision and develop a global computing platform referred to as "Metaverse" (Cho, 2023: 31). Generally, the evolution of Metaverse has been facilitated by technologies, such as AI, IoT, VR, AR, 3D modeling, space and edge computers. Users of these technologies can fully engage in this virtual environment, allowing them to interact, conduct business, learn, and enjoy various activities. In fact, Metaverse represents a virtual world that leverages Web 3.0 technologies (also termed the Decentralized Web), which signifies an advancement of Internet that promotes more secure and private interactions among users. This is achieved through blockchain technology, which establishes a peer-to-peer network enabling transactions without the need for intermediaries. Likewise, Web 3.0 is supported by 5G Internet technology that is not yet universally accessible (Schroeder, 2022). Notably, the most appealing and widely-utilized interfaces for engaging with Metaverse include mobile and wearable devices, such as AR glasses, headsets, and smartphones. While access to Metaverse is facilitated through various platforms that allow individuals to immerse themselves in parallel worlds, "Second Life" has developed as a particularly popular platform in the global market. Currently, numerous platforms with diverse features and functionalities are ready (De Felice *et al.*, 2023: 1747-1749).

Since 2020, the term Metaverse has become a buzzword, primarily driven by huge tech companies. The interest surrounding Metaverse is experiencing rapid growth, with Gartner recognizing it as one of the top ten strategic technology trends for 2023. As a relatively new concept, the definition of Metaverse remains ambiguous, leading to confusion among those wrestling with finding the most effective approaches. While Metaverse is still in its infancy and continues to evolve, one widely-referenced definition described it as "a continuous and immersive simulated world experienced in the first place by large groups of simultaneous users who share a profound sense of mutual presence". This environment can either be fully virtual or consists of layers of virtual content superimposed on the real physical world (Distor *et al.*, 2023: 1). Moreover, Zhang *et al.* (2022) posited that the term Metaverse is a combination of "meta" (means inside/ transcending) and "verse" (indicates the whole world), suggesting the creation of a new virtual universe that extends beyond the tangible world. Davis *et al.* (2008) characterized Metaverse as "immersive 3D virtual environments, where individuals interact as avatars with each others and with software agents, utilizing the real world as a metaphor but free from its physical constraints". Hennig-Thurau *et al.* (2022) viewed Metaverse as "a novel computer-mediated environment, where individuals engage and communicate in real time through avatars in virtual realms, garnering substantial attention", and they explored the importance of real-time multisensory social interactions within the Metaverse's virtual-reality. Additionally, Hennig-Thurau and Ognibeni (2022) emphasized that the fundamental worth of Metaverse lies in its social aspect, which involves collaborative activities with avatars in immersive 360-degree environments. They categorized the ways in which organizations can harvest this potential to generate social value across different settings, such as in workplace (i.e., interactions among employees), during consumption (i.e., interactions among customers), and at service interface/ frontline (i.e., interactions between employees and customers) (Cho, 2023: 30-31).

Otherwise, the definition of Metaverse is subject to varying interpretations based on different perspectives. Dwivedi *et al.* (2022: 4) classified its various definitions into four distinct types; environment, interface, interaction, and social value, each highlighting specific attributes of Metaverse. A weighty classification criterion is the degree of similarity to real world, which differentiates the types of Metaverse. This includes realistic environments that faithfully mirror real-world limitations, and unrealistic ones that provide significant freedom without such constraints. Metaverse can be also classified based on the level of immersion offered by the interface, such as 3D and VR. While a 3D realm utilizing VR technology provides substantial immersion, it encompasses more than merely the functionality of VR devices within that space. Beyond environments and interfaces, definitions of Metaverse focus on interactions that extend beyond basic conversations between users and non-player characters as well. Recently, there has been a shift towards redefining the social implications of Metaverse itself, moving away from the notion of it being solely a replica of real-world society.

Of course, there are several fundamental components that frequently form the basis of a definition of Metaverse. Ultimately, Metaverse may represent a convergence of digital, physical, and interpersonal realms. These worlds likely possess pre-existing connections, for instance the digital and social spheres intersect within social media platforms and online multiplayer games. Conventional social interactions occur at the intersection of physical and interpersonal settings. Technologies such as AR, bridge the digital world with the physical, while VR immerses users in a hybrid environment that combines both digital and physical elements. Consequently, it is not surprising that Metaverse is often reinforced by VR, AR, and wearable technologies. In additiona, other critical enabling technologies encompass Machine Learning (ML), AI, IoT, 5G, blockchain, cloud, scalable and edge computing. These technologies furnish the efficiency, intelligence, connectivity, and interactive functionalities needed for the operation of Metaverse. As these technologies continue to evolve and mature, they have the potential to facilitate new experiences that promote workflows, bolster safety, and assist organizations in attaining their objectives more effectively (Tross *et al.*, 2023).

In this respect, Metaverse Capabilities (MetCap) are identified as "the capacity of an organization to establish a Metaverse environment that facilitates goal-oriented users in experiencing immersion through the seamless integration of physical and virtual realms". This integration empowers users to engage in value creation transactions and activities beneficial to business. MetCap can be compounded by a variety of resources. Existing literature determines three primary components essential for developing Metaverse; hardware, software, and content (Park & Kim, 2022). Besides, Dwivedi *et al.* (2022: 40) introduced the human element as a critical resource type within MetCap. Given the significance of technology in Metaverse, these capabilities are further categorized into four key areas; communication, rendering, interaction, along with team processes (Davis *et al.*, 2009). As a result, the successful execution of these capabilities requires a combination of human skills and effective management leadership. Other resources associated with Metaverse include avatars, non-fungible tokens, and 3D spaces, among others (Zhang, 2022).

In fact, the distinction between Metaverse and digital transformation lies in their fundamental objectives and implications. Digital transformation encompasses a variety of interpretations according to different people, primarily focusing on the digitization of business operations. This involves converting paper-based information into digital formats, enhancing speed and efficiency through streamlining and process automation, as well as improving data accuracy to facilitate advanced analytics. Essentially, it aims to optimize same existing practices by implementing several improved methodologies. Conversely, Metaverse presents an opportunity to completely rethink collaboration in both personal and professional contexts. It transcends merely adapting traditional methods to a new digital landscape; instead, it seeks to integrate various technologies to forge entirely-novel collaborative frameworks and new ways of working together. This could cover utilizing data within a virtual setting to address real-life challenges. In the public sector, applications may range from unifying multiple social service agencies in order to enhance service delivery for citizens, to crafting tailored recruitment experiences for youth interested in careers as military or law enforcement. Furthermore, it is likely to comprise innovative strategies that have yet to be conceived (Accenture, 2022).

Noteworthy, as long as the development of Metaverse applications involves the utilization of big data for designing virtual environments, alongside the generation of big data through user interactions within these settings, thereby it is imperative to address challenges related to data availability, quality, storage, processing capabilities, interoperability, dissemination, privacy, and security in those nascent Metaverse applications. Furthermore, it is crucial to examine the potential for power disparities, including wealth inequality, algorithmic bias, and digital exclusion, which may arise from technologies such as VR, harmful surveillance practices, and adverse user behaviors or psychological effects (Sultanow *et al.*, 2022: 2).

Herein, the perspectives of experts regarding mental health implications of Metaverse are strikingly assorted. For adolescents, it has the potential to exacerbate negative self-perceptions and bullying behaviors that have been prevalent on social media over the past twenty years. On the contrary, some experts view Metaverse as a useful platform for conducting therapeutic sessions for patients suffering from post-traumatic stress, and those with autism spectrum disorder. Else, there is an ongoing discourse concerning the environmental impact of Metaverse. Key concerns revolve around carbon emissions associated with AI model operations, resource depletion linked to constant upgrading of devices, and issues posed by electronic waste disposal. However, others argue that Metaverse could reduce pollution by minimizing activities, such as travel and in-office work. While the comprehensive analysis of both positive and negative environmental consequences of Metaverse remains limited, existing research on Distributed Ledger Technology (DLT) and cryptocurrency mining provides insights into the magnitude of challenges at hand, as do previous studies on remote work, online service provision, and e-commerce (Distor *et al.*, 2023: 3). Moreover, Metaverse encounters additional governance challenges, including the relevance of national laws, issues surrounding consent and accountability, and implications of private rule-making (de Zwart & Lindsay, 2010). A substantial question arises regarding whether the regulations governing online world will apply similarly in digital domains, and how the diverse legal frameworks of various countries will resonate within Metaverse (Dwivedi *et al.*, 2022: 13).

In conclusion, the implication of employing meta-vertical technologies stays a topic of contention. Relevant risks can be divided into two master areas. The first pertains to mental well-being, which includes aspects such as physical activity, active participation in social relationships, and time spent in natural worlds. The second concerns the pursuit of personal identity, specifically the tendency to idealize oneself and one's surroundings. Likewise, Metaverse technology raises several ethical concerns that must be addressed to ensure user safety, including issues related to biometric data, privacy, cyberbullying, hate speech, identity protection, and safeguarding vulnerable populations. Given these considerations, it is emphatic that a thorough legislative and regulatory framework is urgently required. On an international scale, the World Economic Forum has initiated a project entitled "Defining and Building the Metaverse", which seeks to establish a fair, interoperable, and secure Metaverse through the collaboration among both public and private sectors, encompassing businesses, civil society, academics, and regulatory bodies (De Felice *et al.*, 2023: 1746).

### *3.2Applying Metaverse in public enterprises:*

Undoubtedly, the convergence of technologies has significantly blurred the lines between physical, digital, and biological spaces, heralding the onset of the 4th Industrial Revolution. This anticipated transformation is poised to simultaneously alter the production, management, and governance of both private and public enterprises in the post-pandemic era. The evolution of Internet from Web 1.0 characterized by a read-only format, to Web 2.0 which emphasizes user-generated content, sets the stage for the forthcoming Web 3.0. This next iteration is expected to be defined by predominantly-decentralized protocols, aiming to establish an online network, where users possess ownership and control over the resources they generate. As a result, this evolution gives rise to Metaverse; a virtual domain that integrates persistently-existing virtual environments with digitally-enhanced physical realities (Buhalis *et al.*, 2022; Tlili *et al.*, 2022). It is clear that all organizations, including those in the public sector, will be greatly influenced by these massive technological advancements. The potential ramifications of those innovations on public sector governance, product development, citizen satisfaction, social welfare, and safeguarding of public interests could be quite enormous, if not properly acknowledged or underestimated (Anane-Simon & Atiku, 2023: 168).

Whilst Metaverse is still in its budding phase of development, its conceptual and technical aspects have garnered interest of governments around the globe for a while. In this age of digital transformation, it is imperative for governments to embrace modern technologies as a foundation for new era of public services and citizen-focused relationships (Gayatri, 2023). Thus, Metaverse could be envisioned as a preferred medium for providing online services and applications to citizens, facilitating communication and engagement between individuals and public entities (Cho, 2023: 30). In the contemporary world, increasing numbers of citizens anticipate an online presence from their governments. Merely having a Facebook page or website is insufficient, as many people desire the ability to interact with their governments on a daily-basis manner through virtual platforms. This growing expectation has led governments to adopt VR as a means of delivering public services. VR is poised to revolutionize organizations, impacting areas such as payment processing, identity verification, recruitment, advertising, content creation, and security. Sectors including education, healthcare, tourism, and culture will undergo major transformations. Actually, the possibilities are vast, ranging from hosting town hall meetings and live speeches by public officials, to offering digital services for citizens, such as voting, registration, and access to information regarding domestic laws and regulations (Sear, 2022).

In the coming years, a transition from traditional physical public offices to virtual counterparts may occur, allowing citizens to access services at their convenience, regardless of location. This evolution could also boost democratic engagement, as virtual platforms would empower citizens to express their opinions and impact policy-making processes. Furthermore, Metaverse has the potential to promote transparency within governmental functions. For example, by utilizing blockchain technology, governments could document and authenticate transactions in Metaverse, hence ensuring accountability and mitigating corruption. Additionally, AI could be leveraged to analyze the data produced in Metaverse, resulting in more informed decisions and improved public services (Takeleap, 2023). Consequently, the expected rise in Metaverse utilization suggests a transformative effect on public operations, upholding citizen involvement and satisfaction, offering cost-effective training solutions, and fostering collaboration and information exchange among agencies, which ultimately benefiting the public sector as a whole. Nevertheless, there are numerous considerations that governments should address prior to committing and investing in these new technologies, as expressed by Corridore (2023):

- Regulations play a crucial role in maintaining balance among competition, innovation, security, and privacy.
- The issuance and authentication of government-issued digital identities within Metaverse are essential for eliminating fraud.
- The need for great transformations in methods and channels through which government services are delivered, alongside the establishment of robust 5G infrastructures that incorporate edge computing.
- It is important for government operations to adapt across various departments and levels.
- It is necessary to collaborate with tech companies to upskill workforce and stay up-to-date.
- Lastly, ensuring that all citizens have reliable access to low-latency, high-capacity Internet in a cost-effective way is of utmost magnitude.

Metaverse, like other new technologies and concepts, encounters a variety of existing and developing challenges, primarily due to the individual technologies upon which it is built. A particular study stressed "3Ms" associated with Metaverse, emphasizing the risks linked to monitoring, manipulating, and monetizing users. Whereas Metaverse is perceived as an immersive VR environment, it is vital to remember that users are real individuals connected to actual institutions that require protection concerning these 3Ms. Therefore, the role of government here is paramount in two main aspects. Firstly, regulating Metaverse to reduce and prevent potential risks related to privacy, ownership, and data protection. Secondly, establishing open and shared criteria to facilitate competition between major big tech companies, and to avoid monopolistic practices and technology lock-in. In short, Metaverse does not necessitate a complete overhaul of current regulations and standards, but rather an optimization aimed at enhancing technological potential, while reducing negative impacts (Distor *et al.*, 2023: 2-3).

Sultanow *et al.* (2022: 2) developed a capability map outlining potential business capabilities within Metaverse for numerous domains of public sector, drawing from an analysis of academic literature and practical case studies. The identified areas include education (digital campus experiences, virtual training and simulation, etc.), healthcare (virtual simulations for patient care, employee training for emergency situations, etc.), tourism (virtual travel to distant locations, participation in virtual festivals, etc.), military (virtual training to simulate operational scenarios, acquiring technical skills for equipment operation and repair, etc.), judiciary (virtual court proceedings, AI decision-making support, etc.), administrative services (covering document processing, virtual citizen consultations, etc.), emergency management (virtual training for natural disaster scenarios, etc.), public safety (virtual training for procedural challenges and special operations, etc.), and city planning (traffic management, interactive feedback, visualization of future development projects, etc.), among other areas.

Accordingly, it is evident that the integration of Metaverse into public services transcends mere theoretical exploration, as various governmental authorities worldwide are actively investigating its applications. For instance, USA Army is utilizing Metaverse to develop immersive training simulations. This initiative illustrates the capacity of Metaverse to improve not only civilian government functions, but also critical sectors such as national defense and security. Moreover, European Union has launched the project of "Digital Twin Earth", which creates a virtual model of the planet to track climate change and environmental deterioration. This endeavor underscores the Metaverse's potential in promoting sustainability and informing environmental policy formulation (Takeleap, 2023).

Besides, components of Metaverse can be leveraged for community consultations, urban planning, and preservation of cultural heritage. This approach may also serve as a foundation for promoting tourism. For example, Seoul (in South Korea)—one of the first remarkable cities to embrace Metaverse—is developing a digital platform for public services that includes virtual city hall; a venue for public events and digital community services. In a similar vein, Barbados aims to become the first country in history to establish an embassy on the widely-used Metaverse platform called "Decentraland". This small island nation has been at the forefront of digital currency adoption and intends to maintain progress by extending its physical embassies' network into various virtual worlds. Notably, several governments including Estonia, Kazakhstan, Serbia, Sweden, and Maldives have experimented with the concept of virtual embassies in the early 2000s through the platform "Second Life". Meanwhile, Dubai has established a new governmental agency to oversee digital assets, with its headquarters located in "Sandbox"; one of the biggest virtual worlds currently available. Furthermore, Dubai has announced a collaboration and partnership with private enterprises and investors to develop a forward-thinking, human-centered city in Metaverse named "One Human Reality". Otherwise, Saudi Arabia celebrated their national day within Metaverse on "Decentraland" in September 2022 (Distor *et al.*, 2023: 4; Horton, 2022; Sear, 2022).

For the public sector, exploring methods to support internal government operations within Metaverse might be a prudent initial step, and could prove a wise way to start. This presents an opportunity to walk with the workforce prior to running with the public. Whether aimed at internal or external collaboration, it is crucial to avoid merely replicating existing public service delivery in a virtual setting. Instead, it is important to seek innovative approaches to work and prioritize leveraging Metaverse to provide greater value to communities. Similar to their private sector counterparts, public service organizations must contemplate several aspects of responsibility within

Metaverse. In terms of trust, government agencies must tackle issues related to resilience, privacy, security, and preserving intellectual property rights. Alongside, there are human factors to consider, such as sustainability, safety, and well-being. For any organization, especially governmental entities, experiences within Metaverse must also be inclusive, accessible, and equitable (Accenture, 2022).

Indeed, implementing Metaverse in public services, while promising, poses significant challenges. Key issues include regulatory frameworks, governance, equitable access, user safety, data protection, and building necessary skills and competences across the public sector (Aldane, 2023). An obvious obstacle here is the digital divide, as not all people have access to high-speed Internet or advanced technology needed for the full participation in Metaverse. As well as, concerns regarding data privacy and security arise, as user interactions within Metaverse generate vast amounts of data, leading to questions about their usage, storage, and preservation. Moreover, the immersive and potentially-addictive characteristics of Metaverse may introduce societal risks. Governments, then, should consider the implications for societal norms, social relationships, and mental health (Takeleap, 2023). So, the evolution of Metaverse will necessitate the establishment of new regulations and legal frameworks designed to safeguard users. Clearly, issues related to privacy, data protection, cybersecurity, and ethics are expected to capture the attention of regulators and lawmakers in the years ahead. For example, UK government's Digital Catapult collaborates with academia, industry stakeholders, and regulatory bodies to examine the effective support for Metaverse innovations, aiming to integrate "safety by design" standards into Metaverse technologies (Horton, 2022).

In summary, if the government chooses to utilize virtual space as a medium for communicating with citizens or providing public services, it has to identify a cost-effective, legally-sound, and technologically-feasible approach. This may involve leveraging applications created by private enterprises, or collaborating with other governmental entities to share expenses. In addition, governments will need to address the energy consumption and computational resources necessary to support Metaverse, besides the financial barriers faced by users. They must also be mindful of the potential health implications for individuals who spend extended periods in this virtual setting. Furthermore, it is fatal for governments to avoid a Metaverse-divide, as not all citizens will possess the purchasing power to acquire the essential needed devices and connectivity packages. Also, regulators are already facing challenges concerning the societal effects of digital platforms. Overall, it is emphatic that as VR becomes increasingly prevalent, public sectors have to make sure that their services remain equally accessible within Metaverse. This accessibility should encompass multilingual support and cross-border services, while also catering to individuals with disabilities or special needs, along with those lacking access to computers or Internet, such as the elderly or residents of remote areas. This means, eventually, that governments must undertake a set of measures to get prepared for disruptions that Metaverse may introduce (Sear, 2022).

### *3.3Achieving citizen satisfaction via the utilization of Metaverse technology in governments:*

Nowadays, customer experience is a fiercely-competitive battleground, and organizations that want to stand out in this crowded market need to place customers at the core of their activities. In the era of big data, companies should find a way to extract understanding from customers' information in order to meet their expectations; is that they expect firms to be as dedicated to their satisfaction and success as they are, if not more (Fahim & Mazen, 2025). Nevertheless, organizations frequently hold assumptions regarding their products and services, often leading to an inflated perception of customer satisfaction. A report by Bain & Company illustrated this discrepancy, revealing that 80% of companies believed they provided "superior" customer experience, while only 8% of customers concurred. Furthermore, the same report indicated that 95% of senior management teams considered themselves "customer-focused", yet merely 30% implemented mechanisms for gathering customer feedback. This gap in satisfaction creates disconnection between perception and reality, steering organizations in an erroneous direction, which may result in customer attrition and misalignment of products and services. A straightforward solution to this issue is the ongoing collection of customer feedback, thereby assessing sentiment and satisfaction levels (Dennis, 2024).

On the other hand, public service organizations are currently experiencing unprecedented pressure, as they strive to address demands of a world characterized by severe crises and rapid technological advancements, where instability has become commonplace. Today, public service leaders have the chance to proactively respond to this shifting digital and societal landscape. By utilizing the Metaverse continuum, they can better fulfill urgent needs of their constituents, such as facilitating easier access to services, while also tackling enduring problems, like climate change. Leaders are now equipped with brand-new tools to rethink service delivery and foster a government that is more resilient, efficient, and focuses on residents' demands. Numerous public organizations have already made clear strides in this path. Although some may not yet recognize how their initiatives align with the broader Metaverse continuum, they are increasingly appreciating its value in contemporary contexts (McElderry, 2023). In fact, technologies associated with Metaverse offer a practical avenue for public enterprises seeking cutting-edge solutions to current issues and occasions to generate value in the short term. Potential near-term opportunities that would enhance enterprise value can be categorized into three distinct areas (Tross *et al.*, 2023):

1. Enterprise simulation; which integrates physical and virtual 3D objects to build immersive or hybrid replicas of real-world contexts, in order to optimize operations and ensure intelligent decision-making.
2. Augmented workforce experience; which creates immersive worlds that use AI/ML, VR/AR, as well as decentralized digital-asset sharing designed to offer customized experience for training, learning, collaboration, and workplace engagement.

3. X-reality experiences; which are hybrid virtual and physical experiences that bring constant worlds, passing experiences, and unprecedented forms of engagement to citizens.

In this respect, Armbrust (2022) asserted that government endeavors within Metaverse are coalescing around three fundamental themes:

1. Innovative training methods: Metaverse provides robust new methods for public employee training. For instance, VR/AR can simulate hazardous situations, allowing safety personnel to experience and prepare for threatening scenarios in a controlled environment.
2. Enhanced connectivity: Metaverse principles expressively improve customer service in public organizations. Automated avatars are capable of responding to inquiries in multiple languages, whilst AI tailors customer experience. Similarly, Metaverse promotes collaboration both within and between agencies, facilitating not only virtual meetings, but also cooperative efforts in simulated environments.
3. Advanced management strategies: Metaverse techniques application empowers governments to address public challenges, including crime and carbon emissions.

Unfortunately, some governments are well-known for their sluggishness in implementing change. Established traditions contribute to the persistence of non-digital practices that consume professionals' time, thereby sustaining a cumbersome and costly system that imposes heavy burdens on citizens and taxpayers. However, this conventional approach to work, income generation, and life perspectives is on the verge of dramatical transformation. Metaverse nowadays is increasingly recognized as a massive step in public services, as it offers more convenient and appropriate means for citizens to access necessary services. Furthermore, it enhances engagement and communication between the government and populace by providing a secure and private framework for governmental transactions with citizens. This makes it particularly suitable for the development of digital public services, including those related to health and education. As well, Metaverse has the potential to revitalize industries adversely affected by Covid-19. It also offers governments a chance to foster their transparency and accountability through the leverage of blockchain technology for transaction tracking (Schroeder, 2022).

Meanwhile, Metaverse represents more than just a technological trend, rather it signifies a paradigm shift that could reshape the delivery of public services. Applying Metaverse for governmental functions is an innovative strategy promising to achieve satisfaction, enhance accessibility, optimize service efficiency, and boost transparent governance. With its inherent capability and unique features of decentralization, interoperability, and real-time interaction, Metaverse presents a novel framework for public service provision. It envisions a government that transcends physical boundaries, where services are not only digitized, but also immersive, interactive, and tailored to individual needs. In this new vision, Metaverse acts as a virtual public forum, providing inclusive space for citizens to engage with governmental entities in a markedly-efficient manner. For instance, one could participate in a virtual town hall meeting, expressing thoughts and concerns directly to local officials from the comfort of home. Besides, the concept of virtual public office could facilitate tasks, such as renewing a driver's license or applying for social services, eliminating inconveniences of long waiting periods. Moreover, Metaverse has the potential to expand governmental offerings beyond conventional services, introducing innovative avenues for civic engagement, like deliberative platforms and virtual public consultations. Hence, Metaverse could transform public sector from a service provider into facilitator of democratic participation and community development, ultimately leading to a more engaged, equitable, efficient, and satisfying public sector (Takeleap, 2023).

In effect, the obvious defining characteristic of Metaverse is its decentralized nature; is that it is not owned by any single organization/ country. The infrastructure, technologies, and data are not subject to the control of any one party/ entity. Instead of permitting large tech companies to centralize, exploit, and profit from customer data for their own purposes, the decentralized environment empowers users to retain ownership of their own information. This principle extends to various types of data, including health, tax, and civic information. In a truly-decentralized world, governments do not possess any citizen data. Yet, this decentralization presents a challenge, as it places citizens in the driver's seat rather than governments, requiring these governments to carefully consider their role in this evolving landscape. Concurrently, a big chance exists for governments to take a more proactive stance in regulating Metaverse. For one, they could facilitate the establishment of standards across Metaverse, encompassing not only technological and infrastructural standardization, but also in the application of regulations. Otherwise, governments could play a proactive role in addressing the requirements for identification and authentication within Metaverse. As virtualization increases, the need for trust among participants becomes paramount; a role that governments are well-positioned to fulfill, given that many governments continue to preserve high levels of public trust (Caserta, 2023).

According to Chatterjee *et al.* (2022); the implementation of AI-enabled services in strategic public service significantly impacts citizen satisfaction. Notably, the findings regarding social value implied that integrating Metaverse within public sector can reinforce communication among citizens and with their cities, thereby allowing people to engage with contemporary societal trends and fostering their satisfaction and involvement in city-related activities and events. Further, the findings related to cultural value indicated that using Metaverse in public sector can bolster the competitiveness of tourism and culture (Cho, 2023: 33,36). Subsequently, the importance of evaluation in this case cannot be overstated. In many instances, evaluations may depend more on qualitative factors than on quantitative metrics. Despite specific evaluation criteria may vary across different applications, a primary focus for public sector organizations should be the effect of technology on citizen satisfaction and mission effectiveness, rather than solely on cost savings. Nevertheless, it is essential not to overlook quantitative efficiencies completely. For example, immersive training solutions are often assessed based on the accelerated pace at which trainees acquire new skills. At same time, measurement maybe constrained by an organization's capacity to anticipate and comprehend how new experiential paradigms will develop, and how best to leverage and take advantage of them (Tross *et al.*, 2023).

Briefly, the government can adopt Metaverse platforms to deliver services directly to the public or to ease their daily activities, for the sake of reaching satisfaction in particular. It may consider offering support to third-party developers creating Metaverse applications, and may also need to interact with third-party applications as a regulator. Several applications will place the government in distinct roles, such as that of a user, developer, and regulator (Digital.NSW, 2023). However, it is imperious to exercise caution when exploring Metaverse for public service delivery, certainly in light of the failures and exaggerated expectations associated with previous emerging technologies. Success and longevity of such implementations rely on the regulation of Metaverse and its suit of technologies. Regulatory measures must tackle issues related to data privacy, protection, and interoperability, while setting standards and protocols during the design phase to promote competition among major tech firms and prevent monopolistic practices. Ensuring affordable access and reliable connectivity is crucial for bridging the digital divide. The relevance of real-world policies in virtual realm and the need for inclusivity as well, are equally-critical considerations for public sectors in order to ensure that no one is excluded from the benefits of utilizing Metaverse for digital transformation (Distor *et al.*, 2023: 5).

Since Metaverse debuted in Egypt, the government has realized how important it is to control what happens there, and how to incorporate it into the national network. In tandem with the opening of METATUT; the first virtual Egyptian city in Metaverse. This virtual city, which was built to provide visitors immersive experience of ancient Egyptian civilization, was launched on November 30, 2022. It was designed to satisfy people and give them access to entertainment, housing, trade, education, and other areas of daily life. Because of the Metaverse's multidimensionality, several laws are necessary to control various elements, yet the novel technology also introduces different uncertainties. The analysis of Egypt's current regulations, such as data protection, telecommunications, and banking laws points ambiguities and potential gaps that may need to be addressed in the context of Metaverse. The prompt advancement of Metaverse and its integration into numerous daily-life aspects indicate critical legal challenges. Existing legislation regarding data preservation, fintech, and cyber-crimes should adapt to safeguard users, virtual transactions, digital assets in this new technological era (El-Hennawy, 2024).

### *3.4The educational Metaverse – a paradigm shift:*

Now that more individuals are becoming aware of Metaverse applications, it is flourishing. In an effort to support Metaverse, nations are racing to deploy 5G, and in order to stay up with emerging technologies, they are making considerable investments in modernizing their digital infrastructure. International reports claim that by 2030, Metaverse might produce up to $5 trillion in value. Herein, the Egyptian government understands that investment in Metaverse can yield larger returns and improve economy and sustainable development. It also has a clear strategy for how to deal with Metaverse and digital world generally. In reality, Egypt with its highly-trained population, has a leading chance of leveraging Metaverse technologies to transform several industries, including tourism, healthcare, and education, especially in light of current global economic woes (Ministry of Communications…Egypt, 2023).

Factually, one of the most promising applications of Metaverse lies within the field of education. Masters *et al.* (2020) stated that the tendency towards distance education had developed significantly during Covid-19 pandemic; is that there has been a presumed orientation to online educational environments (Gurkan & Bayer, 2023: 61). Undoubtedly, Covid-19 has accelerated digital transformation. Whereas, traditional educational frameworks have encountered difficulties in adapting to the requirements of digital era, Metaverse presents innovative solutions to these issues, facilitating immersive and interactive learning experiences that promote student engagement and collaboration. This technology has the potential to eliminate geographical constraints, thereby boosting remote and global learning communities (Lin *et al.*, 2022). In recent years, both researchers and educators have investigated the incorporation of Metaverse technologies into educational contexts. Examples include open schools and universities, interactive simulations, virtual classrooms, emulated training apps, and immersive historical reconstructions. Such settings enable students to engage in experiential hands-on activities, which subsantially elevate comprehension and satisfaction (Nahi *et al.*, 2023: 64).

Notably, the key Metaverse components that are beneficial for education are illustrated in figure (2) as follows (Rahul, 2022):


*Figure (2)*
***Metaverse in education industry***
*Source:* Rahul, 2022.

1. Augmented reality: AR facilitates the development of digital representations of tangible objects, incorporating various attributes. The integration of both physical and digital realms ultimately enriches the educational experience for learners.
2. Mirror worlds: Metaverse enables the replication of physical world in a virtual format.
3. Realistic lifelogging: This approach upholds autonomous learning by empowering students to generate their own educational materials through documentation. Advanced capture, storage, and sharing of daily events contribute to more dynamic learning processes, surpassing the limitations of traditional static textbook information.

4. Interactive virtual reality: Within Metaverse application, digital avatars representing learners and educators, engage with one another in a manner akin to real-life interactions within virtual environments.

Indeed, Metaverse presents numerous advantages for the field of education, contributing to the teaching-learning process, as clarified in figure (3) below. Primarily, it offers immersive educational experiences through VR/AR, engaging students in ways that conventional classrooms are unable to achieve. Another significant benefit is the potential for personalized learning, as Metaverse technologies enhanced by AI can be customized to meet individual needs. Additionally, Metaverse addresses accessibility issues, making education more inclusive. Experiential learning as well reinforces critical thinking skills, while flexibility and convenience of accessing educational contents from any location cater to diverse learning preferences. Alongside, the incorporation of gamified elements within Metaverse stimulates student engagement and motivation, rendering the learning process more enjoyable. Furthermore, it equips students with practical knowledge and skills applicable to real-world scenarios, hence promoting insights relevant to their future careers. Lifelong learning is also facilitated, and innovative teaching strategies are encouraged here. Moreover, there are long-term cost savings associated with the reduced requirements for physical infrastructure. Lastly, Metaverse presents extensive research opportunities, enabling the examination of its effects on learning outcomes and teaching methodologies, thereby enhancing educational theory and practice (Nahi *et al.*, 2023: 69-71; Flores-Castaneda *et al.*, 2024: 72-73).

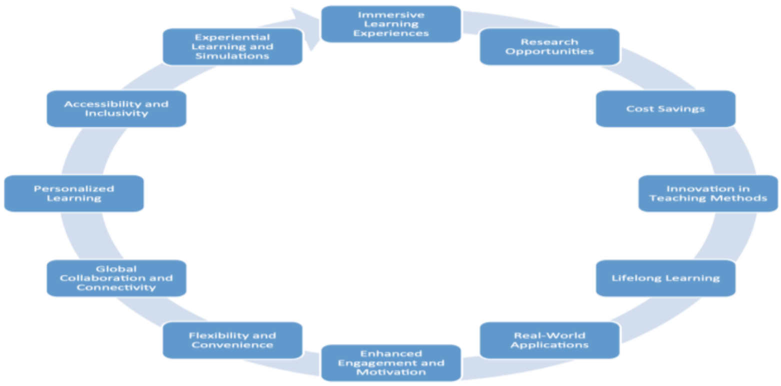


*Figure (3)*
***Benefits of Metaverse in education***
Source: Nahi *et al.*, 2023: 70.

In addition to learning facilitation, Metaverse also encompasses administrative functions. The integration of blockchain technology within Metaverse is regarded as one of the most efficient systems for transactions, enabling secure storage of academic records, transcripts, and marks. This innovation can alleviate the burden of paperwork and streamline the appraisal process. Furthermore, applying Metaverse in education has the potential to bridge the gap in learning quality between developed countries and the developing ones. Overall, technological education is often more cost-effective than conventional approaches; is that educational Metaverse maintains high levels of efficiency, despite conserving time and effort (Rahul, 2022).

Although leveraging Metaverse for educational purposes could provide significant potential advantages, it is accompanied by various challenges. Key issues include privacy considerations, ethical questions, barriers to accessibility, and the existing digital divide. Achieving equity in education enhanced by Metaverse is an urgent matter here (Kaddoura & Al Husseiny, 2023). Shortly, while Metaverse offers considerable pledge, its effective integration into educational settings necessitates meticulous planning and insights grounded in research (Nahi *et al.*, 2023: 65; Zhang *et al.*, 2022).

Recent studies have revealed encouraging outcomes concerning the integration of Metaverse in education. When utilized, Metaverse possesses the potential to offer plentiful merits that positively influence the overall educational experience and learning results. As Metaverse continues to advance technologically and culturally, it can introduce transformative changes to both online and traditional offline learning environments in innovative manners. More specifically, Metaverse can foster immersive, adaptable, scalable, diverse, and interactive learning spaces that boost students' motivation, active participation, and engagement, whilst also facilitating collaborative and hands-on experiences (Diaz, 2020; Vaca Barahona *et al.*, 2016). It is important to acknowledge that although students may encounter some initial technical difficulties, they tend to quickly acclimate to Metaverse and its various functionalities, given their familiarity with digital devices and media (Arcila, 2015). Otherwise, in the realm of education, issues such as privacy, health concerns, student protection, access disparities, certain Metaverse regulations, desensitization, and identity theft remain critical challenges that must be addressed (Pereira, 2022). Furthermore, for Metaverse to achieve broader acceptance and application in educational contexts, there is a pressing need for the development of validation and assessment tools (Lopez-Belmonte *et al.*, 2022: 2).

In this respect, Lopez-Belmonte *et al.* (2022) designed the METAEDU questionnaire, which was grouped into the following eight dimensions; interaction with technology, intrinsic possibilities, accessibility and handling, interaction, interest, motivation, learning, and netiquette. Liang *et al.* (2023: 78) as well investigated the learning experience of students within Metaverse classroom by utilizing three distinct sub-scales; a learning engagement scale, which encompasses cognitive, emotional, and behavioral dimensions, and was adapted from the tool developed by Gunuc and Kuzu (2015); a learning motivation scale, derived from the work of Lin *et al.* (2020); and a perceived sociability scale, which was modified from the instrument created by Kreijns *et al.* (2007). Moreover, Gokce Narin (2021) conducted an analysis of research pertaining to the adoption of Metaverse in the field of education. Findings indicated that the most frequently-employed pedagogical approaches within Metaverse include student-centered learning, blended learning, cooperative learning, inquiry-based learning, and mobile learning (Talan & Kalinkara, 2022: 336).

Likewise, the Community of Inquiry (CoI) framework serves as a valuable theoretical perspective for understanding discriminatory advantages of Metaverse and its potential to enhance learning experiences. This framework comprises three interconnected components deemed essential for upholding meaningful learning; social presence, cognitive presence, and teaching presence (Kozan *et al.*, 2014; Akyol *et al.*, 2008; Garrison *et al.*, 1999). Social presence is characterized by the ability to convey one's personal identity within a community, thereby allowing individuals to present themselves authentically to others. In Metaverse, this is facilitated through the creation of personalized avatars and the interactive engagement with these avatar identities. Cognitive presence denotes the degree of cognitive involvement that facilitates the construction of knowledge and affirmation of meaning. Metaverse with its ability to boost immersive, interactive, and varied learning experiences, has the potential to enhance cognitive presence. Teaching presence relates to the structuring and organization of the instructional process and resources as perceived by students. As a digital learning environment, Metaverse offers a range of instructional capabilities that aid in content delivery, resource allocation, learner personalization, and collaborative group work, thence contributing to improved teaching presence (Liang *et al.*, 2023: 74-75).

Certainly, the successful implementation of emerging technologies in public education systems falls to governments, which must ensure their effective utilization. Visionary education administrators who creatively integrate these technologies within their institutions will set the standard for best practices that others can emulate. Most importantly, it is the proficient teachers who possess the ability to motivate and engage their students. Therefore, comprehensive teacher training is a vital element of any government educational strategy. Without educators equipped to maximize the potential of those tools, initiatives will falter. Governments can initiate foundational efforts through the development of curricula, establishment of digital literacy programs, and by facilitating collaboration among educators to guide the effective use of technology for maximum impact. It is substantial that governments also work to guarantee equitable access to these technologies across all schools and universities, preventing the deepening of disparities, which arise when more affluent institutions can acquire resources that others cannot (Clegg, 2023).

Ultimately, the Egyptian government initiated a reform program in 2018 in response to Egypt's (Vision 2030), which aims to create advanced, inclusive, and worldwide competitive education system that facilitates the achievement of strategic goals, like economic growth, market competitiveness, and enhancement of human capital. The new educational reform program seeks to be learner-centered focusing on students' needs and skills rather than teachers' inputs, and to promote understanding and critical thinking as opposed to memorization and rote learning. Actually, the emphasis on education for students from disadvantaged social and economic backgrounds is at the heart of this change (e.g., students with special needs or from low-income families), as well as increasing the integration of Information & Communication Technologies (ICTs). Nowadays, the Egyptian government is constructing the digital infrastructure required to incorporate educational technology into the process of teaching and learning. Nonetheless, most of the educational institutions in Egypt still lack the digital infrastructure, along with the need to raise teachers' and students' levels of technical competence (Global Evidence…Series, 2024: 3).

Beyond the classroom, modern technologies can be used in many other ways to spur student learning. Whereas, expensive public interventions that rely on intensive technology infrastructure (like the "one laptop per student" program or the installation of smartboards) may not have a clear goal, and hence be ineffective in improving learning outcomes. Alternate approaches for using technology in education encompass programs that augment instruction in the classroom with self-directed software or intensive in-person tutoring. Systems of learning that are adaptable and personalized, and can provide students with customized feedback, pacing, and engagement, are obvious examples. These represent some of the most promising—if challenging to scale—options for developing student learning. One strategy to expand the Teaching at the Right Level (TaRL) approach—which has continuously shown its efficacy by producing some of the most favorable effects that have been thoroughly assessed in education literature—is to use technology for personalized instruction. TaRL's adoption of personalized learning technology makes it possible to execute the program without adding to teachers' workloads, or needing to hire additional staff members (Global Evidence…Series, 2024: 4-5). In this regard, Metaverse can play a prime role as an effective tool of customized learning. In the same context, it is also worth mentioning that understanding the core elements which contribute to student satisfaction can empower schools, colleges, and universities to elevate their educational services and cultivate an enriching learning environment generally.

In essence, measuring customer satisfaction is crucial for developing accurate evaluation of government educational service and quality. Also, monitoring customers' opinions in the education sector (e.g., students, teachers, parents, etc.) is necessary for management decision-making in order to optimize educational processes and policies. Yanova (2015) discussed the measurement of Customer Satisfaction Index (CSI) in educational technology researches. CSI shows the extent to which the existed level of educational quality corresponds to the needs of customers and higher education. Some of the most important indicators for any educational institution here may include:

- Diversity, place, and cost of educational services.
- Quality of the educational process and outcomes.
- Pedagogical, academic, administrative, and support staff.
- Communication, participation, and engagement.
- Safety, security, and privacy.
- Technical equipment and IT level of the educational process.
- Psychological climate and health-preserving environment.
- Upgrade and modernization of educational services and activities.

In this paper, the researcher strived to study the potential impact of educational Metaverse on citizen satisfaction with government educational services in Egypt from a data-driven empirical perspective.

## 4. Empirical study discussion

### *4.1Methodology: research design and procedures:*

This work is exploratory explanatory in nature, with a predictive futuristic orientation. Both qualitative and quantitative viewpoints were employed in its execution. For theoretical purposes, the paper adopted the descriptive analytical method to pinpoint key ideas and clarify the causal relationship between variables, while it used a field study to examine correlations by testing hypotheses in real practice. A systematic review of previous literature was conducted here. In addition, the study implemented an online questionnaire-based survey to gather information and capture perceptions and expectations about the potential impact of applying educational Metaverse on achieving citizen satisfaction in Egypt. Hence, the questionnaire involves a number of statements that determine the opinions of different stakeholders (including learners, educators, parents, etc.) on the educational use of Metaverse and its requirements in Egypt, and others measure the level of overall satisfaction with the quality of government educational services and learning experiences resulting from that. It actually encompasses 37 items other than demographic data, and consists of two broad sections; determinants of educatioal Metaverse (independent variable); 5 items for social presence + 5 items for cognitive presence + 5 items for teaching/ organizing presence, and 2 extra open questions, as well as dimensions of citizen/ user satisfaction (dependent variable); 10 items for satisfaction before/ without considering Metaverse/ now, and 10 more items after considering Metaverse applications.

*before*

*Educational Metaverse* → *Citizen Satisfaction with government educational services* → *before* / → *after*

*after*

Indeed, the questionnaire was designed based on literature review (e.g., Gurkan & Bayer, 2023; Liang *et al.*, 2023; Survey Pluto, 2023; Lopez-Belmonte *et al.*, 2022; Talan & Kalinkara, 2022). It was initially written in English language and next translated into Arabic, as it is the official language in Egypt. The measurement tool used to capture respondents' attitudes here was a 5-point Likert scale ranges from 1–5, where 1 represents "Strongly Disagree", 2 represents "Disagree", 3 represents "Neutral", 4 represents "Agree", and 5 represents "Strongly Agree". Once the questionnaire was validated through the judgment of various experts, it was applied to the research sample. Knowing that the survey was designed into a Google-form, and distributed online across different channels, such as Facebook, WhatsApp, Messenger, Instagram, and e-mail. Data collection and analysis took approximately three months (November 2024 – January 2025).

In a nutshell, it is presumed that both deductive and inductive methodologies were utilized in this investigation. The conceptual framework has been first analyzed and applied to the sample using the deductive approach, later on findings were generalized using the inductive method.

### *4.2Data analysis tools and techniques:*

Data analysis techniques in this study involve several statistical methods used to ensure results' reliability, validity, and accuracy. Cronbach's Alpha was employed to evaluate the reliability of scales, with values near 1 indicating strong internal consistency, while scores above 0.5 are acceptable for questionnaire stability. Composite reliability; a measure of internal consistency similar to Cronbach's Alpha, was also utilized. It assesses the shared variance among observed variables, with a typical threshold of 0.6+ depending on the number of scale items (Tavakol & Dennick, 2011).

Confirmatory Factor Analysis (CFA) was also applied to investigate variables' relationship and questionnaire's internal validity. Kaiser-Meyer-Olkin (KMO) test was applied as well, in which it determines the sampling adequacy for factor analysis, with values between 0.8–1 indicating suitability (Kaiser, 1970). Discriminant validity was established using Fornell-Larcker criterion, which compares the square root of the average variance extracted by a construct to its correlations with other constructs (Fornell & Larcker, 1981).

Besides, correlation analysis was conducted here using Spearman's rank coefficient to determine the strength and direction of variables' relationships. Spearman's is preferred when data do not follow a normal distribution or variables are ordinal in nature. Relationships are categorized as weak, moderate, or strong based on the coefficient's value, and significance is determined by comparing p-value to a 5% significance level (Spearman, 1904). Normality tests, including Kolmogorov-Smirnov and Shapiro-Wilk tests, were also performed in the research to evaluate whether data follows normal distribution. For large samples, nonparametric tests like Spearman's, remain robust and provide reliable results despite normality violations.

Moreover, multiple regression analysis was also utilized here, by which it examines the effect of more than one independent variable on a dependent variable, using a mathematical model based on the dependent variable nature. Analysis was conducted through Ordinary Least Squares (OLS) and considered assumptions, such as normality, absence of multicollinearity (checked via variance inflation factor), and linearity (assessed through scatterplots of residuals and predicted values) to ensure robustness and accuracy of findings (Field, 2013). Additionally, Two sample (T-test) examining the difference between two independent populations, along with ANOVA testing the differences between more than two, were both employed (Cox, 2006).

Actually, all the statistical techniques mentioned above were applied in this study using SPSS-26 and Stata-16. These software tools were selected for their compatibility with the methods used herein.

### *4.3Sample size and description:*

The target population of this research includes all actual (current or previous) and potential users of government educational services in Egypt (different stakeholders like students, teachers, parents, etc.), mainly those who have experience in using smart technology and digital platforms. As it is difficult to reach the whole population, a simple random sample was targeted. The sample size assuming unlimited/ infinite population is usually determined according to the following formula (Keller & Warrack, 1999):

$$n_0 = \frac{z_\alpha^2 * p * (1-p)}{e^2}.$$

Thus, primary data was collected here via a self-completed survey, where total number of participants completed the questionnaire is 400 valid responses.

### 4.3.1 Demographics analysis

This part tackles the socio-demographic and professional features of the selected sample, including gender, age, educational background, work experience, and Metaverse knowledge level. Table (1) below demonstrates the overall demographic characteristics of respondents, in terms of frequency and percentage.

*Table (1)*

***Description of demographic characteristics among survey participants (n=400)***

| Demographics | Frequency | Percentage |
|---|---|---|
| **Gender** | | |
| Male | 116 | 29.0% |
| Female | 284 | 71.0% |
| **Age** | | |
| 18-<25 years | 32 | 8.0% |
| 25-<45 years | 149 | 37.3% |
| 45 years+ | 219 | 54.7% |
| **Educational Level** | | |
| University/ institute student | 27 | 6.8% |
| B.Sc. degree or less | 203 | 50.7% |
| Postgraduate studies | 152 | 38.0% |
| Other | 18 | 4.5% |
| **Work in Education Sector** | | |
| Yes | 133 | 33.3% |
| No | 267 | 66.7% |
| **Metaverse Level of Knowledge** | | |
| Low level | 142 | 35.5% |
| Average level | 225 | 56.2% |
| High level | 33 | 8.3% |

The table above points that the majority of 71% of the sample are females, 54.7% their ages are 45 years+, and only 6.8% are students (very low percentage) whilst 50.7% of respondents have a B.Sc. degree or less. Also, 33.3% of them are working in the education field, and 56.2% have an average level of knowledge about Metaverse whereas 35.5% of the sample do not know a lot about it.

Note that the categories of those under 18 years old and those in high school stage were both removed from the age and educational level groups here, given that the number of respondents in these two categories was zero. This could be due to the lack of interest and difficulty these groups may have in understanding and dealing with the idea of survaying (scientific questionnaires) and realizing its importance in general, despite the fact that the topic is quite related to them.

### 4.3.2 Building indicators of the research variables

Six indicators were created here by combining related statements into a single measure using the equal-weight method. Indicators were used to answer the research hypotheses. These indicators are presented in the row form of table (2) below.

*Table (2)*

***Research variables and indicators***

| Constructs | No. of Statements |
|---|---|
| **Independent Variable** | |
| 1- Educational Metaverse | 15 |
| 2- Social presence | 5 |
| 3- Cognitive presence | 5 |
| 4- Teaching/ organizing presence | 5 |
| **Dependent Variable** | |
| 5- Citizen satisfaction with government educational services “status quo” | 10 |
| 6- Citizen satisfaction with government educational services after considering Metaverse | 10 |

### 4.3.3 Reliability and validity test

The following table (3) shows the reliability and validity of research variables. Cronbach's Alpha reflects a good reliability of the questionnaire items, as values range from 0.817–0.954 for different indicators, which exceeds the threshold of 0.7. Also, composite reliability varies from 0.547–0.674, which is above the preferred value of 0.5, and this proves that the model is internally consistent. Furthermore, CFA investigates the interrelationships between variables to find whether they can be gathered into a smaller set of baseline factors. In this study, CFA is used to test the questionnaire's internal validity. Results of CFA indicate that all items are loaded in their constructs as suggested in the proposed model, as loadings of all items are greater than 0.5. On the other hand, Average Variance Extracted (AVE) values here are above the recommended threshold of 0.5, which points out that constructs could explain more than 50% of statements, and these values reflect high internal validity. Moreover, KMO test is a measure of how data suits factor analysis. This test measures the sampling adequacy for each variable in the model and for the complete model. The statistic is a measure of the proportion of variance among variables that might be caused by underlying factors. KMO values for all variables in the current research are greater than 0.5, and Bartlett's test of sphericity is significant for all variables, which presents adequacy of the sample.

*Table (3)*

***Reliability and validity of the research questionnaire (n=400)***

<table>
<tr><th>Constructs</th><th>No. of Items</th><th>Cronbach's Alpha</th><th>Composite Reliability</th><th>KMO</th><th>Bartlett's Test</th><th>AVE</th><th>Item</th><th>Loading</th></tr>
<tr><td rowspan="14">Educational Metaverse</td><td rowspan="14">15</td><td rowspan="14">0.925</td><td rowspan="14">0.550</td><td rowspan="14">0.845</td><td rowspan="14">4689.080 (0.000)</td><td rowspan="14">0.801</td><td>EM1</td><td>0.764</td></tr>
<tr><td>EM2</td><td>0.816</td></tr>
<tr><td>EM3</td><td>0.763</td></tr>
<tr><td>EM4</td><td>0.687</td></tr>
<tr><td>EM5</td><td>0.652</td></tr>
<tr><td>EM6</td><td>0.750</td></tr>
<tr><td>EM7</td><td>0.788</td></tr>
<tr><td>EM8</td><td>0.802</td></tr>
<tr><td>EM9</td><td>0.805</td></tr>
<tr><td>EM10</td><td>0.708</td></tr>
<tr><td>EM11</td><td>0.789</td></tr>
<tr><td>EM12</td><td>0.684</td></tr>
<tr><td>EM13</td><td>0.719</td></tr>
<tr><td>EM14</td><td>0.707</td></tr>
</table>

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | EM15 | 0.672 |
| Social Presence | 5 | 0.858 | 0.547 | 0.811 | 967.673 (0.000) | 0.808 | SP1 | 0.811 |
| | | | | | | | SP2 | 0.904 |
| | | | | | | | SP3 | 0.800 |
| | | | | | | | SP4 | 0.801 |
| | | | | | | | SP5 | 0.675 |
| Cognitive Presence | 5 | 0.889 | 0.615 | 0.850 | 1106.094 (0.000) | 0.832 | CP1 | 0.847 |
| | | | | | | | CP2 | 0.775 |
| | | | | | | | CP3 | 0.860 |
| | | | | | | | CP4 | 0.857 |
| | | | | | | | CP5 | 0.824 |
| Teaching Presence | 5 | 0.817 | 0.572 | 0.720 | 1084.769 (0.000) | 0.612 | TP1 | 0.811 |
| | | | | | | | TP2 | 0.٧39 |
| | | | | | | | TP3 | 0.898 |
| | | | | | | | TP4 | 0.908 |
| | | | | | | | TP5 | 0.761 |
| Citizen Satisfaction Now | 10 | 0.949 | 0.648 | 0.900 | 4017.558 (0.000) | 0.690 | SN1 | 0.902 |
| | | | | | | | SN2 | 0.839 |
| | | | | | | | SN3 | 0.834 |
| | | | | | | | SN4 | 0.884 |
| | | | | | | | SN5 | 0.918 |
| | | | | | | | SN6 | 0.866 |
| | | | | | | | SN7 | 0.770 |
| | | | | | | | SN8 | 0.805 |
| | | | | | | | SN9 | 0.670 |
| | | | | | | | SN10 | 0.792 |
| Citizen Satisfaction considering Metaverse | 10 | 0.954 | 0.674 | 0.901 | 4183.397 (0.000) | 0.714 | SM1 | 0.773 |
| | | | | | | | SM2 | 0.851 |
| | | | | | | | SM3 | 0.897 |
| | | | | | | | SM4 | 0.848 |
| | | | | | | | SM5 | 0.939 |
| | | | | | | | SM6 | 0.838 |
| | | | | | | | SM7 | 0.860 |
| | | | | | | | SM8 | 0.875 |
| | | | | | | | SM9 | 0.772 |
| | | | | | | | SM10 | 0.778 |

However, table (4) clarifies that correlations of each construct with other constructs are less than the square root of its AVE, so the discriminant validity here is established successfully.

*Table (4)*
***Fornell-Larcker criterion***

| **Constucts** | Educational Metaverse | Social Presence | Cognitive Presence | Teaching Presence | Citizen Satisfaction Now | Citizen Satisfaction considering Metaverse |
|---|---|---|---|---|---|---|
| Educational Metaverse | 0.895 | | | | | |
| Social Presence | .916** | 0.899 | | | | |
| Cognitive Presence | .904** | .798** | 0.912 | | | |
| Teaching Presence | .795** | .589** | .536** | 0.782 | | |
| Citizen Satisfaction Now | 0.026 | 0.022 | .105* | -0.074 | 0.831 | |
| Citizen Satisfaction considering Metaverse | .771** | .706** | .736** | .568** | .177** | 0.845 |

### 4.3.4 Descriptive statistics of variables and statement items

This section provides detailed descriptive statistics and analysis for each item of the questionnaire. Accordingly, table (5) below displays the minimum, maximum, mean, standard deviation, along with the median and InterQuartile Range (IQR) for research variables.

*Table (5)*

***Descriptive statistics of research constructs (n=400)***

| Constructs | Minimum | Maximum | Mean | Standard Deviation | Median | IQR |
|---|---|---|---|---|---|---|
| **Educational Metaverse** | 1 | 5 | 3.838 | 0.657 | 4.000 | 0.730 |
| **Social Presence** | 1 | 5 | 3.752 | 0.750 | 3.800 | 1.000 |
| You frequently use digital platforms, such as social media, video-conferences, or virtual learning environments to interact with others or to learn. | 1 | 5 | 3.920 | 0.949 | 4.000 | 2.000 |
| You are interested in integrating Metaverse into your learning/ teaching experience. | 1 | 5 | 3.630 | 0.908 | 4.000 | 1.000 |
| You see that Metaverse supports building social connections and networks with other students/ teachers. | 1 | 5 | 3.580 | 0.934 | 4.000 | 1.000 |
| You are aware of online netiquette standards for respectful and effective communication in virtual learning environments. | 1 | 5 | 4.070 | 1.011 | 4.000 | 2.000 |
| You believe that Metaverse will become a regular tool in distance learning within the educational settings in Egypt. | 1 | 5 | 3.570 | 0.893 | 4.000 | 1.000 |
| **Cognitive Presence** | 1 | 5 | 3.656 | 0.815 | 3.800 | 1.000 |
| You feel comfortable to use virtual instruments for learning/ teaching purposes, like immersive simulations or digital classrooms. | 1 | 5 | 3.650 | 1.003 | 4.000 | 1.000 |
| You think Metaverse can foster meaningful learning experiences and develop students' practical skills and digital competences. | 1 | 5 | 3.740 | 0.826 | 4.000 | 1.000 |
| You see that engaging in Metaverse may increase students' interest in learning and exploring new subjects, as well as expressing ideas and retaining knowledge. | 1 | 5 | 3.650 | 1.037 | 4.000 | 1.000 |
| You are motivated to participate in Metaverse-based academic activities, such as problem-solving or interactive discussions. | 1 | 5 | 3.750 | 0.983 | 4.000 | 1.000 |
| You believe that Metaverse has the potential to transform the educational practices and outcomes in Egypt. | 1 | 5 | 3.500 | 1.031 | 4.000 | 1.000 |
| **Teaching Presence** | 1 | 5 | 4.108 | 0.690 | 4.200 | 0.600 |
| You think Metaverse platforms for educational purposes should be inclusive, flexible, user-friendly, and pedagogically-sound. | 1 | 5 | 4.080 | 0.847 | 4.000 | 1.000 |
| You perceive the potential drawbacks to using Metaverse in education, like discipline challenges, health issues (physical & mental well-being), and technology dependency. | 1 | 5 | 3.700 | 1.025 | 4.000 | 2.000 |
| You believe that regulatory oversight is necessary for Metaverse technologies to ensure security, equity, and accessibility in education. | 1 | 5 | 4.360 | 0.928 | 5.000 | 1.000 |
| You see that having governance structures in place to protect users' privacy and prevent unethical or misuse of Metaverse in education is essential. | 1 | 5 | 4.460 | 0.863 | 5.000 | 1.000 |
| You are willing to continue learning about Metaverse and being aware of the current applications of educational Metaverse in Egypt. | 1 | 5 | 3.940 | 0.861 | 4.000 | 2.000 |
| **Citizen Satisfaction Now** | 1 | 4 | 2.365 | 0.803 | 2.200 | 1.000 |
| Government-supported educational services meet citizens' needs. | 1 | 5 | 2.340 | 0.907 | 2.000 | 1.000 |
| Educational services offered by government are diverse, affordable, and accessible. | 1 | 5 | 2.570 | 1.019 | 3.000 | 1.000 |
| Student motivation, engagement, and performance in government education are satisfactory. | 1 | 5 | 2.210 | 0.973 | 2.000 | 2.000 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Quality of government-provided education, including curriculum content, teaching methods, and learning outcomes, is satisfactory. | 1 | 5 | 2.240 | 1.019 | 2.000 | 2.000 |
| Level of support, feedback, and guidance provided by educators in government educational institutions meets expectations. | 1 | 5 | 2.340 | 0.957 | 2.000 | 1.000 |
| Opportunities for hands-on learning, practical exercises, and experiential projects in government-supported educational programs are satisfactory. | 1 | 5 | 2.230 | 0.916 | 2.000 | 1.000 |
| Online learning platforms, resources, and technical assistance in government educational programs meet users' needs. | 1 | 4 | 2.510 | 0.901 | 3.000 | 1.000 |
| Academic, administrative, and personal support services, such as advising, mental health resources, and financial aid, are available and accessible in government educational institutions. | 1 | 4 | 2.330 | 1.059 | 2.000 | 2.000 |
| Campus activities, social interactions, and wellness resources in government education settings are satisfactory. | 1 | 4 | 2.340 | 0.977 | 2.000 | 1.000 |
| Career readiness resources, such as job fairs and internships offered by government-provided educational programs, are satisfactory. | 1 | 5 | 2.550 | 0.972 | 3.000 | 1.000 |
| **Citizen Satisfaction considering Metaverse** | 1 | 5 | 3.553 | 0.698 | 3.700 | 1.000 |
| Government-supported educational services enhanced by Metaverse technologies can effectively meet citizens' goals. | 1 | 5 | 3.300 | 0.947 | 4.000 | 1.000 |
| Educational services offered by government are diverse, affordable, and shall be increasingly accessible through Metaverse platforms. | 1 | 5 | 3.440 | 0.882 | 4.000 | 1.000 |
| Student motivation, participation, and performance in government educational programs could be improved through Metaverse integration. | 1 | 5 | 3.600 | 0.879 | 4.000 | 0.000 |
| Quality of government education, including curriculum content, teaching methods, and learning outcomes, could be enhanced with Metaverse-enabled resources. | 1 | 5 | 3.570 | 0.920 | 4.000 | 1.000 |
| Level of support, feedback, and guidance provided by educators in government educational institutions can meet expectations, especially with Metaverse-driven tools for personalized learning. | 1 | 5 | 3.540 | 0.816 | 4.000 | 1.000 |
| Opportunities for hands-on learning, practical exercises, and experiential projects in government-supported educational programs might be enriched by the immersive capabilities of Metaverse applications. | 1 | 5 | 3.620 | 0.827 | 4.000 | 1.000 |
| Online learning platforms, resources, and technical assistance in government education are satisfactory and might be further strengthened by Metaverse innovations. | 1 | 5 | 3.650 | 0.758 | 4.000 | 1.000 |
| Academic, administrative, and personal support services, such as advising, mental health, and financial aid, are readily available in government educational institutions and would be more accessible through Metaverse. | 1 | 5 | 3.620 | 0.786 | 4.000 | 1.000 |
| Campus activities, social interactions, and wellness resources in government education settings would be positively impacted by Metaverse-facilitated experiences. | 1 | 5 | 3.530 | 0.700 | 4.000 | 1.000 |
| Career readiness resources, such as job fairs and internships offered by government-provided educational programs, could be enhanced with Metaverse means, improving access and engagement. | 1 | 5 | 3.680 | 0.751 | 4.000 | 1.000 |

From the above table, we can conclude that:

- Respondents agreed with statements on educational Metaverse, with mean values ranging from 3.50–4.46 and standard deviation of 0.657. Teaching presence received the highest agreement, while cognitive presence had the lowest. Teaching presence was the most homogeneous variable showing the least variance, whereas cognitive presence was the most non-homogeneous exhibiting the highest variance.

- Respondents showed an agreement towards social presence statements, with mean values between 3.57–4.07 and standard deviation of 0.750. The highest agreement was for awareness of online netiquette rules in virtual learning environments, while the lowest was for Metaverse becoming a regular tool in distance learning support in Egypt. The most homogeneous statement was about Metaverse becoming a regular tool in distance learning, while the least homogeneous was about awareness of online netiquette standards.
- Respondents agreed with cognitive presence statements, with mean values between 3.50–3.75 and standard deviation of 0.815. The highest agreement was for motivation in participating in Metaverse-based academic activities, while the lowest was for Metaverse having the potential to transform educational practices in Egypt. The most homogeneous statement was about Metaverse fostering meaningful learning experiences, while the least homogeneous was about Metaverse increasing students' interest in learning.
- Respondents agreed with teaching presence statements, with mean values between 3.70–4.46 and standard deviation of 0.690. The highest agreement was for needing governance structures in place to protect users' privacy, while the lowest was for the perception of potential drawbacks to using Metaverse in education. The most homogeneous statement was that Metaverse platforms for educational purposes should be inclusive and user-friendly, while the least homogeneous was about perception of potential drawbacks to using Metaverse.
- Respondents showed a disagreement regarding their satisfaction with government educational services in the status quo, with mean values between 2.21–2.57 and standard deviation of 0.803. The highest disagreement was regarding satisfaction towards student motivation and performance in government education, while the lowest disagreement was concerning the diversification of educational services. The most homogeneous statement was that online learning platforms and technical assistance in government educational programs meet users' needs, whilst the least homogeneous was concerning the availability of academic and administrative support in educational institutions.
- Respondents agreed with statements on satisfaction with government educational services after considering Metaverse, with mean values between 3.30–3.68 and standard deviation of 0.698. The highest agreement was for enhancement of career readiness resources using Metaverse means, while the lowest was that government educational services enhanced by Metaverse meet citizens' goals. The most homogeneous statement was about the positive impact of Metaverse on campus activities and social interactions in government education settings, whereas the least homogeneous was about meeting the educational services enhanced by Metaverse citizens' needs.

### 4.3.5 Descriptives on open statement items

Concerning the topics related to Metaverse that require to be discussed in workshops, majority of the sample stated that they need to understand the application of Metaverse in general and how it would impact their lives. Otherwise, regarding the courses in which Metaverse would be more effective in their learning environment, participants had different opinions presented below in table (6).

*Table (6)*

***Descriptives on Metaverse usage in scientific courses (n=400)***

| | **Frequency** | **Percentage** |
|---|---|---|
| All courses | 103 | 25.75% |
| Applied courses | 103 | 25.75% |
| Literary and language courses | 45 | 11.25% |
| No answer | 149 | 37.25% |

### 4.3.6 Inferential statistics of variables

#### 4.3.6.1 Normality test

The results expressed in the following table (7) revealed that all variables are not normally distributed because their significance values are below 0.05. However, since the valid collected sample responses here are 400, therefore and according to (Sekaran, 2003); a sample size above 30–50 participants is capable of running parametric tests, especially in multivariate research. Moreover, running a parametric test when data variables are not normally distributed may not be a major violation, if the sample size is large or moderate, and results can still reflect precision and accuracy (Green & Salkind, 2008).

*Table (7)*

***Normality tests of variables***

| **Constructs** | **Kolmogorov-Smirnov** | | | **Shapiro-Wilk** | | |
|---|---|---|---|---|---|---|
| | **Statistic** | **Df.** | **Sig.** | **Statistic** | **Df.** | **Sig.** |
| **Independent Variable** | | | | | | |
| Educational Metaverse | 0.117 | 400 | 0.000 | 0.908 | 400 | 0.000 |
| Social Presence | 0.117 | 400 | 0.000 | 0.947 | 400 | 0.000 |
| Cognitive Presence | 0.103 | 400 | 0.000 | 0.957 | 400 | 0.000 |
| Teaching Presence | 0.210 | 400 | 0.000 | 0.836 | 400 | 0.000 |
| **Dependent Variable** | | | | | | |
| Citizen Satisfaction Now | 0.096 | 400 | 0.000 | 0.963 | 400 | 0.000 |
| Citizen Satisfaction considering Metaverse | 0.117 | 400 | 0.000 | 0.908 | 400 | 0.000 |

#### 4.3.6.2 Correlation test

The next table (8) illustrates the values of Spearman's correlation coefficient for all variables. From these values, we can confirm that:

- There is no significant correlation between satisfaction with government educational services in the status quo and the educational Metaverse whole indicator with its sub-dimensions.

- There is a significant positive correlation between satisfaction with government educational services after considering Metaverse and educational Metaverse with its sub-dimensions.

*Table (8)*
***Spearman's correlation coefficients***

| Constructs | Educational Metaverse | Social Presence | Cognitive Presence | Teaching Presence | Citizen Satisfaction Now | Citizen Satisfaction considering Metaverse |
|---|---|---|---|---|---|---|
| Educational Metaverse | 1 | | | | | |
| Social Presence | .916** | 1 | | | | |
| Cognitive Presence | .904** | .798** | 1 | | | |
| Teaching Presence | .795** | .589** | .536** | 1 | | |
| Citizen Satisfaction Now | 0.026 | 0.022 | .105* | -0.074 | 1 | |
| Citizen Satisfaction considering Metaverse | .771** | .706** | .736** | .568** | .177** | 1 |

** Correlation is significant at the 0.01 level (2-tailed).
* Correlation is significant at the 0.05 level (2-tailed).

### *4.4Testing the research hypotheses:*

Based on the study objectives and its conceptual framework, main and sub-hypotheses were set here as follows:

### 4.4.1 Hypothesis one

*H01: There is no statistically significant impact at α≤0.05 of educational Metaverse on citizen/ user satisfaction with government educational services in Egypt.*

*H01.1: There is no statistically significant impact at α≤0.05 of social presence within educational Metaverse on citizen satisfaction with government educational services.*

*H01.2: There is no statistically significant impact at α≤0.05 of cognitive presence within educational Metaverse on citizen satisfaction with government educational services.*

*H01.3: There is no statistically significant impact at α≤0.05 of teaching/ organizing presence within educational Metaverse on citizen satisfaction with government educational services.*

In this part, the researcher used path analysis to estimate coefficients and significance of each path to test the two theoretical/ Structural Equation (SE) models.

#### 4.4.1.1 First SE model

The first SE model demonstrated in figure (4) includes each of social presence, cognitive presence, and teaching presence as independent variables, along with citizen satisfaction after considering Metaverse as the dependent variable.

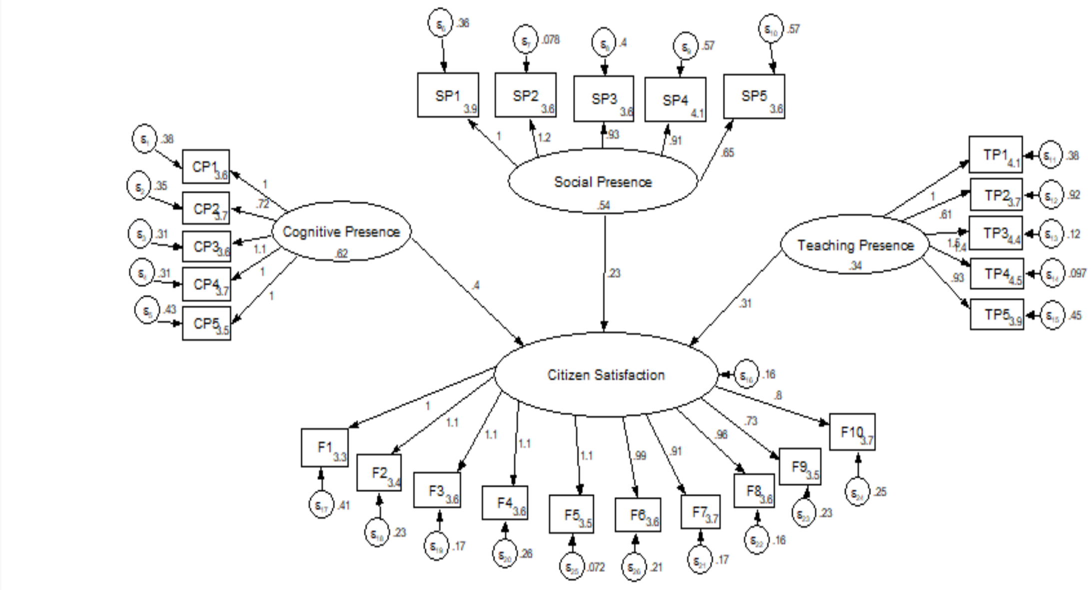


*Figure (4)*

***First path diagram***

<u>*Source:*</u> Prepared by the researcher.

The following table (9) displays the estimates of the above model, which can be interpreted as follows:

- Social presence has a significant direct positive impact on citizen satisfaction, and this impact equals 0.23 with 95% confidence level, which means that social presence in the educational Metaverse environment can explain about 23% of changes in citizen satisfaction with government educational services in Egypt.
- Cognitive presence has a significant direct positive impact on citizen satisfaction, and this impact equals 0.40 with 95% confidence level, which indicates that cognitive presence has the ability to explain approximately 40% from the variation in citizen satisfaction with government educational services.
- Teaching presence has a significant direct positive impact on citizen satisfaction, and this impact equals 0.31 with 95% confidence level, which clarifies that teaching presence could explain about 31% of changes in citizen satisfaction.

*Table (9)*

***Path coefficients and significances***

| Structural Path | Path Coefficient | Critical Ratio (CR) (t-value) | Std. Error | Sig. |
|---|---|---|---|---|
| Citizen Satisfaction ← Social Presence | 0.23 | 4.35 | 0.054 | 0.000 |
| Citizen Satisfaction ← Cognitive Presence | 0.40 | 7.27 | 0.055 | 0.000 |
| Citizen Satisfaction ← Teaching Presence | 0.31 | 5.84 | 0.053 | 0.000 |

On the other hand, the overall model fit was assessed using number of measures. The following table (10) shows that Chi-Square value of 1088.59 with 272 degrees of freedom is statistically significant at 0.05 level, which indicates that the model is not a good fit. However, Chi-Square test is very sensitive to the sample size, so we do not depend on it. The results further exhibit that all fit indices obtained are satisfactory and within suggested boundaries. Accordingly, results confirm an acceptable fit of the proposed model.

*Table (10)*
***Goodness of fit indices***

| Indices | Abbreviation | Recommended Criteria | Results | Conclusion |
|---|---|---|---|---|
| Chi-Square | $\chi^2$ | P-value > 0.05 | 1088.59 | Not Good Fit |
| Degree of Freedom | | | 272 | |
| Level of Significance | | | 0.000 | |
| Normed Chi-Square | $\frac{\chi^2}{DF}$ | $1<\frac{\chi^2}{DF}<5$ | 4.002 | Good Fit |
| RMESA | Root Mean Square Error of Approximation | < 0.05 Good Fit<br>< 0.08 Acceptable Fit | 0.042 | Good Fit |
| NFI | Normed Fit Index | > 0.90 | 0.970 | Good Fit |
| RFI | | > 0.90 | 0.970 | Good Fit |
| IFI | | > 0.90 | 0.925 | Good Fit |
| TLI | Tucker-Lewis Index | > 0.90 | 0.930 | Good Fit |
| CFI | Comparative Fit Index | > 0.90 | 0.978 | Good Fit |

### 4.4.1.2 Second SE model

Another SE model was fitted to study the impact of educational Metaverse overall on citizen satisfaction after considering Metaverse, as illustrated in figure (5) below.

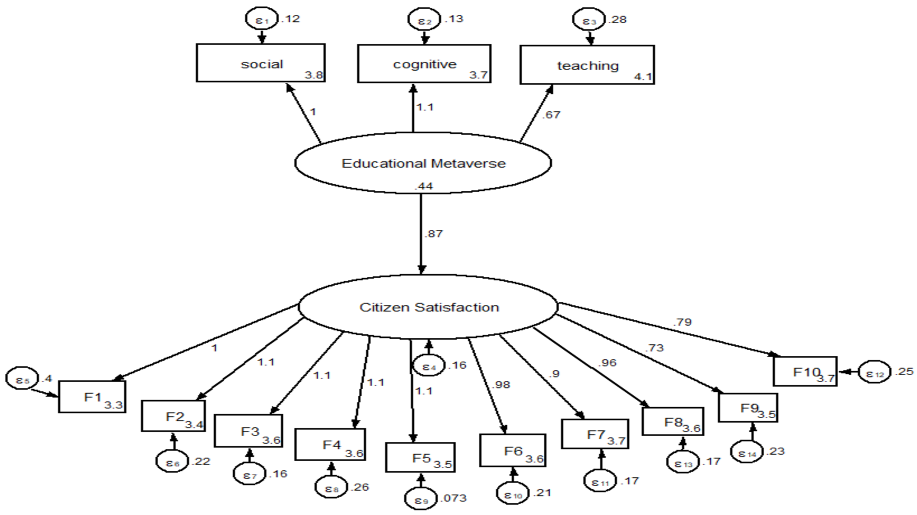


*Figure (5)*
***Second path diagram***
Source: Prepared by the researcher.

The next table (11) clarifies the estimates of the above model, which can be interpreted as follows:

- Educational Metaverse has a significant direct positive impact on citizen satisfaction, and this impact equals 0.87 with confidence level 95%, which means that educational Metaverse has the ability to explain approximately 87% from the variation in citizen satisfaction with government educational services in Egypt, while the remaining maybe due to random errors or other factors that may have impact on citizen satisfaction and have not been addressed here.

*Table (11)*
***Path coefficient and significance***

| Structural Path | Path Coefficient | Critical Ratio (CR) (t-value) | Std. Error | Sig. |
|---|---|---|---|---|
| Citizen Satisfaction ← Educational Metaverse | 0.87 | 14.77 | 0.059 | 0.000 |

Otherwise, the overall model fit was assessed using number of measures. The following table (12) indicates that Chi-Square value of 289.28 with 64 degrees of freedom is statistically significant at 0.05 level, which points out that the model is not a good fit. However, Chi-Square test is very sensitive to the sample size, so we do not depend on it. The results further exhibit that all fit indices obtained are satisfactory and within suggested boundaries. Consequently, results confirm an acceptable fit of the proposed model.

*Table (12)*
***Goodness of fit indices***

| Indices | Abbreviation | Recommended Criteria | Results | Conclusion |
|---|---|---|---|---|
| Chi-Square | $\chi^2$ | P-value > 0.05 | 289.28 | Not Good Fit |
| Degree of Freedom | | | 64 | |
| Level of Significance | | | 0.000 | |
| Normed Chi-Square | $\frac{\chi^2}{DF}$ | $1<\frac{\chi^2}{DF}<5$ | 4.520 | Good Fit |
| RMESA | Root Mean Square Error of Approximation | < 0.05 Good Fit<br>< 0.08 Acceptable Fit | 0.041 | Good Fit |
| NFI | Normed Fit Index | > 0.90 | 0.921 | Good Fit |
| RFI | | > 0.90 | 0.974 | Good Fit |
| IFI | | > 0.90 | 0.915 | Good Fit |
| TLI | Tucker-Lewis Index | > 0.90 | 0.936 | Good Fit |
| CFI | Comparative Fit Index | > 0.90 | 0.978 | Good Fit |

From the previous findings, the study can state that there is significant impact at significance level $\alpha \leq 0.05$ of educational Metaverse (social presence – cognitive presence – teaching presence), whether collectively or separately, on citizen satisfaction with government educational services in Egypt. In sum, we can say that the 1st hypothesis as a whole and its 3 sub-hypotheses as well are all rejected.

### 4.4.2 Hypothesis two

*H02: There is no statistically significant difference at $\alpha \leq 0.05$ towards educational Metaverse and citizen/ user satisfaction with government educational services in Egypt, according to demographic characteristics of respondents.*

*H02.1: There is no statistically significant difference at $\alpha \leq 0.05$ towards educational Metaverse and citizen satisfaction, according to gender.*

*H02.2: There is no statistically significant difference at $\alpha \leq 0.05$ towards educational Metaverse and citizen satisfaction, according to age.*

*H02.3: There is no statistically significant difference at $\alpha \leq 0.05$ towards educational Metaverse and citizen satisfaction, according to education.*

*H02.4: There is no statistically significant difference at α≤0.05 towards educational Metaverse and citizen satisfaction, according to profession.*

*H02.5: There is no statistically significant difference at α≤0.05 towards educational Metaverse and citizen satisfaction, according to Metaverse level of knowledge.*

As shown in table (13), the researcher used both T-test and ANOVA test for comparing means of each of the two main variables here (educational Metaverse – citizen satisfaction after considering Metaverse), according to various demographics.

*Table (13)*

***P-values of demographics' effects on research variables***

| Variables | Demographics | Categories | Mean ± Standard Deviation | P-Value |
|---|---|---|---|---|
| Educational Metaverse | *Gender* | Male | 4.13±0.384 | 0.000** |
| | | Female | 3.72±0.707 | |
| Citizen Satisfaction | | Male | 3.84 ±0.415 | 0.000** |
| | | Female | 3.43 ±0.754 | |
| Educational Metaverse | *Age* | 18-<25 | 4.21±0.313 | 0.000** |
| | | 25-<45 | 3.68±0.812 | |
| | | 45+ | 3.89±0.537 | |
| Citizen Satisfaction | | 18-<25 | 3.48 ±0.561 | 0.206 |
| | | 25-<45 | 3.49±0.865 | |
| | | 45+ | 3.61±0.575 | |
| Educational Metaverse | *Educational Level* | University/institute | 3.92±0.556 | 0.356 |
| | | BSc degree/less | 3.78±0.811 | |
| | | Postgraduates | 3.90±0.440 | |
| | | Other | 3.84±0.226 | |
| Citizen Satisfaction | | University/institute | 3.10 ±0.127 | 0.000** |
| | | BSc degree/less | 3.49±0.766 | |
| | | Postgraduates | 3.66±0.642 | |
| | | Other | 3.97±0.340 | |
| Educational Metaverse | *Work in Education* | Yes | 3.71±0.553 | 0.004** |
| | | No | 3.90±0.695 | |
| Citizen Satisfaction | | Yes | 3.40 ±0.711 | 0.002** |
| | | No | 3.63 ±0.680 | |
| Educational Metaverse | *Level of Knowledge on Metaverse* | Low | 3.60±0.535 | 0.000** |
| | | Average | 3.92±0.703 | |
| | | High | 4.34±0.341 | |
| Citizen Satisfaction | | Low | 3.52±0.550 | 0.011** |
| | | Average | 3.52±0.800 | |
| | | High | 3.90 ±0.355 | |

From the previous table, results are summarized as follows:

- Gender has significant effect on the mean values of educational Metaverse and citizen satisfaction, which means there is significant difference between males and females towards these variables at confidence level 95%, whereas males have scored higher/ agreed more than females with respect to this.
- Age has significant effect on the mean values of educational Metaverse, where at least one of its three groups is different. Whilst, age has no significant effect on the means of citizen satisfaction, because its p-value is greater than 0.05. This emphasizes that

there is significant difference between the three categories of age towards educational Metaverse only (not citizen satisfaction) at confidence level 95%.

- Educational level of respondents has no significant effect on the mean values of educational Metaverse, according to its p-value. However, educational level has significant effect on the means of citizen satisfaction, where at least one of its four groups is different. This confirms that there is significant difference between the four categories of education towards citizen satisfaction solely (not educational Metaverse) at confidence level 95%.
- Status of working in education has significant effect on the mean values of educational Metaverse and citizen satisfaction, which means there is significant difference according to profession, towards these variables at confidence level 95%, whereas those who do not work in educational fields have scored higher/ agreed more than those working in education, as the latter may have better awareness of the difficulties facing the leverage of modern educational technology in Egypt, so that perhaps they could have their own concerns in this regard.
- Level of knowledge on Metaverse has significant effect on the mean values of educational Metaverse and citizen satisfaction, where at least one of its three groups is different. Subsequently, it is emphatic that there is significant difference according to Metaverse level of knowledge, towards those variables at confidence level 95%.

From the results above, the research can prove that there are significant differences at significance level $\alpha \leq 0.05$ towards educational Metaverse and citizen satisfaction with government educational services in Egypt, according to respondents' demographics. Thus, we can conclude that the 2nd hypothesis with its sub-hypotheses are totally rejected, except no. 2 (age) and no. 3 (education), which are partially rejected.

### 4.4.3 Hypothesis three

*H03: There is no statistically significant difference at $\alpha \leq 0.05$ between social presence, cognitive presence, and teaching/ organizing presence within educational Metaverse, in terms of respondents' evaluative attitudes.*

This hypothesis is concerned with the correlation between the three sub-indicators of educational Metaverse and the educational Metaverse whole indicator itself. The following table (14) clarifies Spearman's correlation coefficients and their significances for educational Metaverse sub-indicators.

*Table (14)*

***Spearman's correlation coefficients of educational Metaverse with its sub-indicators***

| | Educational Metaverse |
|---|---|
| Social Presence | 0.887** |
| Cognitive Presence | 0.905** |
| Teaching Presence | 0.619** |

From the table above, it is noticed that:

- There is a significant strong positive relationship between educational Metaverse and social presence, as p-value is less than the significance level of 0.05 and Spearman's correlation coefficient is greater than 0.7.

- There is a significant strong positive relationship between educational Metaverse and cognitive presence, as its p-value is less than 0.05 and Spearman's coefficient is greater than 0.7.
- There is a significant moderate positive relationship between educational Metaverse and teaching presence, as p-value is less than 0.05 and Spearman's coefficient lies between 0.3–0.7.

Therefore, the study can conclude that there is significant difference at significance level α≤0.05 between social presence, cognitive presence, and teaching presence, in terms of respondents' evaluative attitudes, as the value of Spearman's correlation coefficient differs for each. Knowing that the highly-correlated indicator within educational Metaverse is cognitive presence (0.905) and the least is teaching presence (0.619), which reflects their overall influence on the educational Metaverse whole indicator. This means that the 3rd hypothesis is also rejected.

### 4.4.4 Hypothesis four

*H04: There is no statistically significant difference at α≤0.05 between citizen/ user satisfaction without and with considering the potential impact of Metaverse technologies on government educational services in Egypt.*

In this hypothesis, the researcher employed the paired samples T-test for the sake of comparing citizen satisfaction scores before and after considering Metaverse, as exhibited in table (15) below.

*Table (15)*

***P-value of paired samples T-test for citizen satisfaction***

| | Mean ± Standard Deviation | P-Value |
|---|---|---|
| Citizen Satisfaction before considering Metaverse (Now) | 2.36±0.803 | 0.000** |
| Citizen Satisfaction after considering Metaverse | 3.55±0.698 | |

According to the previous table; we can reach that there is a significant difference at significance level α≤0.05 between the mean value of citizen satisfaction before considering Metaverse (responses tended to be somewhere between disagree and neutral in Likert scale (2.36)) on one hand, and the mean of citizen satisfaction after considering Metaverse (responses between neutral and agree (3.55)) on the other hand. In other words, considering Metaverse has significant effect on citizen satisfaction with government educational services in Egypt, which means eventually that the 4th hypothesis is rejected.

*Noteworthy, it was sufficient in the current research to confirm the existence of a difference between the level of citizen satisfaction before and after considering Metaverse, without measuring its value (via subtraction). However, after adopting educational Metaverse in Egypt in the foreseeable future, its actual impact on citizen satisfaction with government educational services might be later examined, by measuring the level of satisfaction before and after, then subtracting the two values from each other. At that time, measuring difference could be justified because it will determine the real change in satisfaction, not the expected one.*

Satisfaction with current *Educational Metaverse* Satisfaction with Meta
government educational services government educational services

**5. Conclusion**

Indeed, Metaverse presents a senior chance for both public and private sectors to usher in a new wave of digital innovation. Obviously, governments can enhance their service delivery by blending digital, physical, and social realms via Metaverse techniques. While some forward-thinking governments are starting to develop their own Metaverses, the realization of this notion appears to be a distant goal. Of course, the Egyptian government is keen on promoting the utilization of modern technology and AI, particularly in educational system, noting that the latter is one of the mainstays of the 4th Industrial Revolution and the locomotive of future.

In this respect, the current research builds upon limited earlier studies, which emphasize the advantages of leveraging Metaverse within public enterprises, proposing significant impacts for this implementation on citizen satisfaction. The paper also embarks on an inclusive exploration of Metaverse applications and their burgeoning role in government education, as it sheds light on the promises and possibilities that lie ahead paving the way for reshaping the future of learning in Egypt. Certainly, this work outlines a series of practical implications concerning its added value and future potential, developing a validated and dependable tool for assessing the teaching experiences conducted within Metaverse. Theoretically, this research contributes to the scientific body of literature on educational Metaverse; an area that remains largely underexplored. Practically, the research results in the establishment of an evaluation instrument for the technological education model and its effects on user satisfaction in the Egyptian scenario.

The primary limitations of this study include the contextual constraints associated with the generalization of findings and the exploratory nature of the research domain, as the questionnaire here has been initially validated in a public setting and within an Egyptian framework, taking into account the sample age levels. Consequently, there is a necessity for more holistic and interdisciplinary approaches that examine the nascent tecchnology of Metaverse with its unique characteristics from an integrative and global standpoint.

Eventually, the research has produced plenty of profitable results and recommendations for further development.

***5.1Results and findings explanation:***

Basically, the capabilities of Metaverse hold the promise of leveraging advanced technologies, reinforcing an environment conducive to simulated interactions, thereby enhancing productivity, accelerating learning, and strengthening connections among people. It is important to note that many of the technologies, which constitute the building blocks of Metaverse, are already in initial phases of development. Thus, governments should have the scope to harness these technologies for immediate benefits until a fully-developed version of Metaverse is realized. Herein, public organizations need to engage with a diverse array of interdependent stakeholders, rather than presuming they possess exclusive knowledge or resources to govern. Therefore, the establishment of regulatory measures within this emerging universe space industry is essential for facilitating the transition, alongside the integration of renewable energy sources to power and sustain Metaverse.

Otherwise, the incorporation of Metaverse into educational sectors has the potential to consolidate teaching activities significantly, fostering student-centered and meaningful learning experiences, while enabling the educational process to occur entirely within digital realms. Furthermore, the immersive and interactive qualities of these novel techniques can create progressive settings tailored to the unique attributes of learners, thence promoting their inclusion in educational activities. In this context, the key outcomes here are as follows:

- It is vital to assist governments in delivering improved services and achieving greater efficiencies through digital transformation. Thereby, it is imperative to commence the establishment of necessary frameworks to support hybrid workplaces expected in the coming decade within public sectors. The benefits of this fresh hybrid model may encompass speedy access to public officials, increased citizen satisfaction and engagement, enhanced employee retention, expanded training opportunities, and operational efficiencies.
- It is emphatic that implications of Metaverse may appear daunting, however it is crucial for governments to be ready for this technology in order to fully harness its capabilities. On a positive note, there are numerous use cases for Metaverse within public sector. These applications cover government services (e.g., virtual city halls), urban planning (e.g., digital twins), virtual work environments that facilitate back-office functions and citizen interactions (e.g., virtual meetings), education (e.g., virtual classes), healthcare (e.g., operation simulations), and tourism (e.g., virtual embassies).
- While Metaverse is a powerful new communication channel, it is not a panacea for all challenges. So that, if governments choose to utilize virtual environments as means of engaging with citizens or providing public services, they must identify a cost-effective, legally-sound, and technologically-feasible approach. Therefore, it is essential to address the digital divide, which involves the accessibility of Internet infrastructure and availability of necessary visual hardware, along with issues related to energy supply. Furthermore, it is urgent for governments to contemplate various actions and strategies to prepare for the potential disruptions that Metaverse may introduce. One of the most impactful measures to mitigate the digital divide and facilitate broader participation in digital worlds is investing in education, whereas this requires the establishment of rudimentary infrastructure to support the functionality of Metaverse.
- Ultimately, Metaverse signifies a neoteric chapter and a paradigm shift in the historical evolution of education, presenting an intriguing outlook on the future of learning. Its immersive educational experiences, worldwide connectivity, tailored pathways, inclusivity, and opportunities for lifelong learning are redefining the perception of education. Educators, learners, policymakers, and technology innovators are

collaborative partners in this educational transformation, utilizing Metaverse to maximize its potential, while addressing its challenges in a responsible manner. Consequently, Metaverse should be viewed not as a substitute for conventional education, but rather a remarkable enhancement, which provides new dimensions and chances to enrich the educational journey for next generations. Noteworthy, although early investments are intrinsic to develop Metaverse-based educational platforms, they may lead to cost savings in the long term. Besides, the incorporation of a Metaverse-based education can minimize the reliance on physical infrastructure and travel, hence reinforcing more environmentally-sustainable and eco-friendly educational framework. As a result, the future of Metaverse will focus on empowering students everywhere with green, high-quality, and affordable education.

- The survey indicated that about one third (35.5%) of the sample have low level of knowledge on Metaverse. Thus, it can be inferred that people in general still lack sufficient familiarity with Metaverse application. For that reason, majority of the sample stated that they already need to understand more about Metaverse tools and techniques. This explains that respondents' attitudes were almost neutral towards their satisfaction with government Metaverse-based educational services (means between 3.30–3.68 in Likert scale), despite their agreement with educational Metaverse in the first place (means ranging from 3.50–4.46). A primary factor contributing to this situation maybe the limited adoption of Metaverse platforms and inadequate research regarding its efficacy in the Egyptian educational contexts yet.
- Findings proved that there are significant differences according to respondents' demographics, towards educational Metaverse and citizen satisfaction with government educational services in Egypt. Also, there is significant difference between satisfaction before and after considering the potential impact of Metaverse on educational services. Alongside, it was confirmed that there is no significant correlation between educational Metaverse and satisfaction with government educational services in the status quo, however there is significant positive correlation and significant direct positive impact for educational Metaverse with its sub-dimensions (social presence – cognitive presence – teaching presence), whether separately or collectively, on citizen satisfaction with government Metaverse-based educational services in Egypt, and the highest impact is for cognitive presence (0.40), which is also the highly-correlated indicator within educational Metaverse (0.905); this ensures the importance of awareness and cognitive engagement generally. Whereas, the total impact of educational Metaverse in this regard equals 0.87, which is considered a relatively-strong expected impact on citizen satisfaction overall; this justifies the need to expedite taking real steps for implementing Metaverse in the Egyptian public education.

### *5.2Recommendations and further research:*

By concentrating on the immediate benefits derived from specific applications of Metaverse continuum technologies, governments can foster their ability to fulfill core missions and establish a groundwork for future advancements. In the education feild, when a novel technology is utilized, research appears to be necessary to obtain in-depth information and to identify the problems that might be faced there. As a result, more ideal educational Metaverse experience could be designed. To achieve this, the following recommendations would be valuable in guiding the way forward:

- Although modern technologies possess the capacity for great benefits, they may create numerous risks, if the society fails to regulate or manage their applications effectively. Metaverse is considered a prominent illustration of this delicate equilibrium. In this context, it is emphatic to set a new legal framework for the virtual realm that addresses the requirements of contemporary digital era and serves the interests of various stakeholders. Also, in order to achieve a harmonious balance between virtual and physical realms, it is advisable to establish boundaries regarding the duration of time allocated to virtual engagements, including social media usage and video gaming. Alongside, it is equally important to participate in a diverse range of real-world activities, like exercising, practicing hobbies, and socializing with others. Besides, maintaining awareness of one's emotional well-being and taking requisite breaks when experiencing feelings of overwhelm, can contribute significantly to sustaining this balance.
- Metaverse is likely poised to introduce entirely new methodologies for work, but at this nascent stage it is critical to create experiences that align with current user expectations, while simultaneously equipping them with required proficiencies to navigate this technology and operate effectively within that evolving environment. In order to completely realize the potential of Metaverse investments in the Egyptian public organizations during these preliminary phases, five major steps should be undertaken here; establishing a robust digital infrastructure, acquiring or developing necessary skills, enhancing security and privacy measures, formulating policies regarding synthetic content and bot usage, and finally cultivating partnerships or joining alliances to strengthen future capabilities.
- Practical results suggested that Metaverse platforms could serve as an innovative approach, promoting the quality of education and level of citizen satisfaction with government educational services in Egypt. In contrast to conventional and online education, educational Metaverse offers distinct advantages that would improve learning experiences, like virtual identity, presence, immersion, and interaction. Herein, findings might carry remarkable implications for both teaching and learning within educational Metaverse. It is essential for teachers to implement pre-course training sessions that enable students to assess their computer capabilities and network conditions, thereby minimizing potential technical difficulties during classes. Teachers should also investigate appropriate instructional strategies tailored to the Metaverse learning environment. Students on their part, must be adequately prepared – physically and mentally – for their studies in Metaverse. They should identify suitable physical spaces equipped with high-speed Internet connections to facilitate seamless and comfortable interactions with others. Furthermore, students should take a proactive approach in leveraging the unique features of Metaverse, such as virtual displays and presentation tools, to maximize their learning experience. Moreover, it is important for students to be aware of the potential challenges associated with Metaverse and to maintain composure when faced with technical difficulties, ensuring

that their learning continues uninterrupted. For platform developers, there is a pressing need for enhancements to address issues related to network instability and latency. Lastly, it is recommended that additional functionalities be incorporated to Metaverse, including lecture-based instruction, annotation capabilities, assignment submission processes, peer evaluation instruments, virtual laboratories, and gamification elements to spur competition (Liang *et al.*, 2023: 87).

- Concerning future work; it is recommended that application of Metaverse in different countries should be examined, hence further research might consider cross-cultural analysis. Also, the leverage of Metaverse in private sector might be addressed in future studies. Whereas in education, further directions encompass refining pedagogical approaches, measuring the effect on learning outcomes, and establishing optimal practices for Metaverse-based education. In future research, scholars may investigate the impact of Metaverse on factors, such as academic achievement, engagement, attitudes, and retention rates as well. Moreover, researchers exploring this subject can analyze the underlying reasons for the lack of preference for Metaverse in educational settings in certain cases, especially the influence of the socio-economic status (social class, income level, place of residence, etc.). Ultimately, it is suggested to iterate the present study with younger age groups considering the diversification of data collection tools to suit them (e.g. adding interviews – observation), and on specific Egyptian educational institutions or governorates. Besides, replicating it after adopting educational Metaverse virtually in Egypt to measure the real change in citizen satisfaction with government educational services then, which may involve a longitudinal research perspective.

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