sustainability

MDPI

Article

Investigating the Social Sustainability of Immersive Virtual Technologies in Higher Educational Institutions: Students' Perceptions toward Metaverse Technology

Abeer F. Alkhwaldi

Department of Management Information Systems, College of Business, Mutah University, Karak 61710, Jordan; abeerkh@mutah.edu.jo

Abstract: The Metaverse technology (MVTECH) is an immersive virtual sphere where people interact with each other via avatars. The MVTECH promised to provide a number of potentials for various sectors including higher education. Despite the fact that MVTECH promotes virtual social interaction between people (e.g., university students), there is a lack of knowledge on what affects users' perceptions regarding its social sustainability in HEIs, specifically in developing nations. Therefore, this research paper aims to determine the variables that affect the learners' perceptions toward social sustainability (SS) of MVTECH in higher educational institutions (HEIs) in Jordan. A study model was formulated by integrating the core factors of the "unified theory of acceptance and use of technology" (UTAUT) ("performance expectancy, PE; effort expectancy, EE; social influence, SI; and facilitating conditions, FC") with "perceived curiosity" (PC) and "extraversion" (EXT) factors. Both PC and EXT were included as context-related variables that may possibly contribute to enhancing the applicability of UTAUT to a wide range of information technologies and settings. Data were collected from 422 students enrolled in Jordanian universities based on an online survey. The analysis of the "structural equation modeling" (SEM) found that students' perceptions toward Metaverse were significantly influenced by PE, FC, and EXT. Furthermore, the PC construct significantly affected the EE construct. However, EE and SI were revealed to have no significant impact on SS. Drawing from these results, the study makes a number of theoretical advances and clarifies a number of practical implications for those involved in the development, design, and decision-making processes that support the use of the Metaverse in HEIs.

Keywords: Metaverse; social sustainability; UTAUT; extraversion; curiosity; developing nations; HEIs

Citation: Alkhwaldi, A.F. Investigating the Social Sustainability of Immersive Virtual Technologies in Higher Educational Institutions: Students' Perceptions toward Metaverse Technology. *Sustainability* **2024**, *16*, 934. https://doi.org/10.3390/su16020934

Academic Editors: Tarah Wright and Hao-Chiang Koong Lin

Received: 13 October 2023
Revised: 25 December 2023
Accepted: 12 January 2024
Published: 22 January 2024

1. Introduction

The next stage of social interactions has been identified as the Metaverse technology (MVTECH). It alludes to a created universe where individuals can "live" in accordance with the guidelines established by the creator [1–3]. The phrase "metaverse" was initially coined by Stephenson in 1992 to describe 3D virtual environments that were described by a science fiction work [4]. The emergence of the MVTECH facilitates regular human interactions and connections. Thus, the MVTECH can be thought of as a virtual sphere that enriches physical space and reality [1]. The MVTECH could be completely virtual or merely partially so. For example, it may be an entirely virtual setting like a "virtual reality" (VR) system or merely partially virtual, like the use of "augmented reality" (AR) in real-world settings [5,6]. People can interact socially in the MVTECH by playing games, debating a topic, working on a project together, and learning from their experience or resolving problems [7]. The MVTECH can be described as "a virtual world where our digital avatars and those of people in our communities and around the globe come together to work, shop, attend classes, pursue hobbies, enjoy social gatherings, and more" [8]. In addition, just like the real world, MVTECH could experience a wide range of actions and events, including political events, natural disasters, and financial activities.

The long-term effects of the COVID-19 crisis have led to a "non-face-to-face" shift in international culture. People all across the world have witnessed how digital technologies have made cultural diffusion feasible in order to overcome the constraints of geographical location and time [9–15]. It is claimed that the health pandemic (i.e., coronavirus) accelerated the shift to the digital era [16–18], which delivers solutions independent of the physical environment and other considerations [19]. Considering this, the COVID-19 crisis has caused the Metaverse to be given a role, such as bringing about digital transformation in all sectors that entails physical practices (e.g., shopping, banking, learning, teaching, etc.). It is also mentioned that in virtual environments (e.g., MVTECH), there is a potential to eliminate concepts like gender, race, and physical disability (i.e., such virtual settings can be deemed as an equalizer) [20]. Furthermore, organizations and people's interest in virtual platforms surged owing to the COVID-19 pandemic. In this aspect, the crisis has prompted many HEIs to swiftly migrate from physical classroom teaching (in-person) to distance learning (online classes) [21]. Based on what universities have encountered, three-dimensional (3D) immersive spatial settings fueled by MVTECH can solve challenges with 2D online learning (e.g., Moodle and Blackboard) [6]. Many countries now use the Metaverse in educational contexts; this innovative technology has become a reality and demonstrated improved performance in terms of web-based learning [22].

Considering "The Metaverse and its Potential for MENA" report (2023), the "Middle East and North Africa" (MENA) region is "on a journey of economic transformation and digitalization", with regional industries and governmental organizations "showing an appetite" for innovative immersive technologies [23]. According to a statement from Meta, "formerly the Facebook company", various applications and business use cases in the area are starting to emerge, illustrating how customers may utilize MVTECH to join virtual concerts, acquire virtual assets, or access educational and training environments [24]. By 2035, if these plans come to fruition in full, Saudi Arabia's economy might gain between USD 20 and 38.1 billion in additional GDP annually. In comparison, the benefits in the UAE might total USD 8.8–16.7 billion, in Egypt USD 11.6–22 billion, in Morocco USD 2.6–5 billion, and in Jordan USD 0.9–1.7 billion annually [23]. From an educational perspective, with the help of Microsoft and Meta, the HEIs were introduced to the world of artificial intelligence in virtual education, which will enable universities to shape the future of higher education without boundaries. This new virtual world is based on virtual technologies that operate within VR, AR, or mixed XR, as well as the education and communication platforms they launched. These solutions alleviate the issues associated with 2D e-learning platforms by enabling multimodal MVTECH interactions with virtual worlds and digital avatars [6]. For instance, in Jordan, Amman Arab University and LivaatVerse, the first Arab MVTECH platform, recently signed an agreement to develop the university with an integrated Digital Twin that is built on MVTECH and situated within LivaatVerse. This will mark the university's official entry into the Metaverse [25]. Also, at Prince Sumaya University for Technology (PSUT), the eLearning Centre developed an experimental course to examine the characteristics and immersive experiences of the MVTECH utilizing the Workrooms app in the Meta Quest VR tools [26].

According to academics, the MVTECH has the potential to be utilized in education in different contexts, such as medical, healthcare education, social sciences, economics, cultural education, science education, training for military service, industrial training, and learning a foreign language [6,27,28]. Many countries now use this technology in educational contexts, and it has been demonstrated that it improves the performance of e-learning [6,29]. With the support of MVTECH, learners can even practice in circumstances that they are unable to experience in real life. For example, most people may not have the opportunity to work in management positions or earn flight experience. Yet, if the creator intends to afford individuals an experience or an opportunity to learn, then this would take place in the realm of metaphysics. MVTECH introduces a safe and well-organized setting for educational purposes; through such virtual technology, users can carry on to learn and broaden their experiential learning alternatives [10,30,31]. Immersive technologies like

virtual reality (VR) and augmented reality (AR) have the potential to significantly transform the learning landscape in higher education. A fundamental advantage of VR and AR lies in their capacity to offer students immersive and interactive learning encounters [32]. These technologies have the capability to generate life-like simulations mimicking real-world situations, enabling students to practice various skills and learn from errors within a safe and controlled setting [33]. For instance, medical students can simulate surgical procedures, while engineering students can troubleshoot machinery without facing any actual risks of harm.

Beyond delivering distinct learning experiences, immersive technologies have the capability to customize teaching methods. They can monitor individual student progress and adapt the complexity level or offer tailored feedback based on each student's specific requirements [32,34]. This personalized approach to learning aids in enhancing students' comprehension of the subject matter, leading to improved learning outcomes. In developing countries, Jordan in particular, education technologies have attracted a large amount of attention recently as a fundamental learning/teaching style to boost flexibility and convenience, student involvement, collaboration and interaction, learning outcomes, as well as better accessibility to education [21,35]. However, there is a scarcity of empirical studies, particularly in developing nations like Jordan, on the variables affecting the acceptance/usage of immersive technologies (such as MVTECH) in HEIs. Due to the lack of sufficient empirical data on its use, immersive technologies are not widely adopted by organizations and/or individuals in developing nations [36]. Thus, the aim of this study is to bridge the gaps in the earlier studies regarding the adoption of MVTECH in Jordanian universities.

The notion of sustainable development comprises three pillars: the social, environmental, and economic dimensions of business development [37]. Social sustainability (SS) refers to "the practice of creating a diverse and equitable society that successfully meets the basic social needs of citizens" [38]. "Social sustainability" could also describe a range of social issues, including health equality, human rights, living standards, worker rights, the development of communities, cultural competency, social equity, social assistance, and responsibility for society [1,25]. In this research paper, the "social sustainability" of Metaverse technology could be defined as the level to which this practice is addressed by this innovative technology (MVTECH). The application of state-of-the-art communication technologies could contribute significantly to social sustainability via effective user engagement [39]. Despite the growing interest in the idea of the Metaverse both from academic and business perspectives, there is limited evidence on the factors influencing its social use [22,40,41]. Human–computer interaction (HCI) could be significantly influenced by different factors, including social, economic, and psychological factors. Amongst these factors, personality traits significantly influence how humans behave in web-based settings [42]. Based on the reviewed literature and to the best of the author's knowledge, few studies addressed the effect of personality traits on the SS of adopting immersive technologies (e.g., MVTECH) (e.g., Ref. [1]). In addition, research work has focused on formulating integrated theoretical models as an endeavor to understand human behavior in web-based contexts due to the complexity of predicting human behavior [43,44]. Therefore, this research investigates the effect of the personality trait that has received the most attention in the IT/IS acceptance and use studies (i.e., extraversion), the key factors of the "Unified Theory of Acceptance and Use of Technology" (UTAUT), and a contextual factor (i.e., perceived curiosity) on the social sustainability of using MVTECH in an educational context.

To understand users' IT/IS acceptance behavior at an individual level, previous researchers developed several theoretical models. Venkatesh et al. (2003) [44] reviewed, compared, and synthesized eight of these theories and models in a more comprehensive theory which is the UTAUT. The UTAUT is deemed one of the most well developed and effective models of technological adoption [45]. Consequently, this research aims to investigate variables that influence learners' acceptance of MVTECH using an extended UTAUT model. With data from a sample of 422 Jordanian participants, a survey was

carried out to achieve the aim of the current research paper. Utilizing "structural equation modeling" (SEM), the structural relationships between each of the constructs on the UTAUT and the acceptance of MVTECH for social sustainability purposes were verified. The study also considered the role of extraversion and perceived curiosity in explaining the social sustainability of the MVTECH platforms.

The remainder of this article is structured as follows. Section 2 provides the theoretical background and hypotheses development. Section 3 illustrates the research methodology, the development of the study instrument, the data collection process, and the procedure applied to conduct this study. Section 4 shows the statistical findings. Section 5 provides the conclusions and implications of this study, along with limitations and recommendations for future research work.

2. Literature Review

2.1. Educational Activities in the Metaverse: A Glimpse into the Future of Higher Education

The Metaverse, an emerging virtual realm with immersive and interactive features, has great potential to revolutionize education in higher education institutions (HEIs). While still in its nascent stages, different educational activities are already being examined and put into practice, demonstrating the potential for captivating and successful learning experiences. Many academic scholars introduced some prominent examples of such educational activities, classified according to their learning focus [46–49]. These include (1) simulations and virtual laboratories in which the Metaverse provided learners with the opportunity to participate in virtual environments for scientific research, historical recreations, architectural designs, and several other activities. Virtual laboratories offer a secure and hazard-free setting for practical learning. (2) Interactive learning modules which involve the development of interactive modules for the learning of intricate disciplines such as physics, mathematics, history, and languages. These courses frequently used gamification aspects to enhance the engagement of the learning process. (3) Virtual field trips allow learners to explore historical locations, museums, landmarks, and global destinations through immersive experiences, all from the comfort of their classroom. (4) Group collaborations and projects in which Metaverse enabled the cooperation of students from various regions to engage in collective group tasks, such as coursework, presentations, or artistic efforts, within a shared virtual environment. (5) Individualized learning paths tailored/customized learning experiences designed according to individual advancement and interests. Personalized courses and adaptable educational paths might be developed within the Metaverse to accommodate the individual requirements of each learner. (6) Training and skill development in which the application of Metaverse technology extended to vocational training, improvement of skills, and immersive professional simulations in diverse sectors such as healthcare, aviation, and hospitality. (7) Role playing and scenario-based learning involve the creation of circumstances in which learners can take on various roles, such as historical figures, scientists, engineers, or professionals. This enables them to gain practical experience in real-world situations and develop their problem-solving skills. (8) Experiential learning which could help in promoting experiential learning through the immersion of learners in real-world scenarios that improve their comprehension and utilization of theoretical knowledge.

It is vital to acknowledge that the Metaverse in higher education is still evolving, and ongoing investigations and research are essential to understanding its value and academic implications. However, the examples offered introduce a glimpse into the transformative potential this state-of-the-art technology holds for the future of learning in HEIs.

2.2. Metaverse Technology and Pedagogical Frameworks in the HEIs

Metaverse technology is incorporated into higher education institutions (HEIs) through various pedagogical and educational frameworks to improve learning experiences. Although the specific frameworks employed may differ, many academic researchers highlighted the following as some frameworks and theories that have been contemplated or implemented [50–58]:

(1) Constructivism: This approach highlights the learner's proactive involvement in knowledge construction through first-hand experiences. Within the Metaverse, educators have the ability to generate immersive settings where students actively participate in creating their comprehension by engaging with the digital realm and working on projects or simulations.
(2) Experiential Learning: Based on the theories of John Dewey and David Kolb, experiential learning emphasizes the acquisition of knowledge through direct encounters and subsequent reflection. The Metaverse provides prospects for immersive and practical education, enabling students to actively participate in virtual simulations, experiments, and role-playing scenarios.
(3) Connectivism: Established by George Siemens, it underscores learning as a process that occurs within a network, wherein learners establish connections with resources, knowledge, and other learners. Within the Metaverse, students have the ability to collaborate without limitations, access a wide range of materials, and participate in interconnected learning communities.
(4) Bloom's Taxonomy is a framework that classifies cognitive abilities into different levels, ranging from basic thinking skills like remembering and understanding, to more advanced thinking skills like applying, analyzing, evaluating, and producing. Teachers have the ability to create tasks within the virtual reality world that are tailored to various levels of Bloom's Taxonomy, promoting the development of analytical thinking and imaginative skills.
(5) Universal Design for Learning (UDL) is an approach that fosters inclusive education through the provision of many methods for presenting information, engaging students, and expressing knowledge. Within the Metaverse, educators possess the ability to generate a wide range of educational resources, inclusive settings, and numerous methods of interaction to cater to various learning preferences and capabilities.
(6) Game-Based Learning and Gamification: By utilizing components of games or concepts of game design, educators can employ the Metaverse to construct learning experiences that incorporate game-like characteristics. These experiences aim to enhance student engagement, motivation, and the acquisition of skills.
(7) Learning Analytics: By harnessing data and analytics derived from students' interactions in the Metaverse, educators can apply learning analytics frameworks to obtain insights into students' advancement, preferences, and areas requiring enhancement. The utilization of data can provide valuable insights to enhance tailored learning experiences.
(8) The utilization of Augmented Reality (AR) and Virtual Reality (VR) in the field of Education: Although not a distinct theory, incorporating AR and VR technology into the Metaverse is consistent with pedagogical methods that prioritize immersive and experiential learning, enabling students to engage with knowledge in novel ways.

The objective of integrating these frameworks with Metaverse technology in higher education institutions (HEIs) is to develop captivating, interactive, and customized learning experiences that address the varying needs of learners while making the most of the distinctive features offered by immersive digital environments.

2.3. Theoretical Background and Hypotheses

In recent years, scholars developed and applied different theories and models to predict the adoption of innovative technologies. From the stream of information systems, psychology, and sociology, "Theory of Reasoned Action" (TRA), "Theory of Planned Behavior" (TPB), "Innovation Diffusion Theory" (IDT), "Technology Acceptance Model" (TAM), "Motivational Model" (MM), "Model of PC Utilization" (MPCU), and "Social Cognitive Theory" (SCT), are merely a few of the main modular theoretical lenses that have set the standard for research and results in the area of IT/IS adoption [43,44]. A review and integration of these competing models of IT acceptance led to the development of the UTAUT. Four fundamental variables, namely, "performance expectancy" (PE), "effort expectancy"

(EE), "facilitating conditions" (FC), and "social influence" (SI) were acknowledged to affect the users' intentions toward using novel information technologies or systems [44]. The UTAUT has been examined and endorsed across different environments [45,59], and can account for about (0.70) of the variation in users' behavioral intentions [44]. Owing to UTAUT parsimony, robustness, and simplicity, this theoretical model became one of the most widely applied compared to others [43,60,61]. UTAUT was also evidenced to be superior to the eight dominant competing theories and models [44,59].

Although extensive replication, application, integration, and extension of UTAUT have facilitated the understanding of IT/IS adoption to many academics, a systematic investigation and theorizing of the vital constructs that are related to context based on consumers' IT acceptance and use are still required [43]. In addition, there is significant debate among researchers who claim that the UTAUT's variables might not be sufficient to explain individuals' acceptance of novel technologies and systems in voluntary contexts as the original UTAUT study addressed the large organizational settings, which in turn limits the explanatory and predictive power of this model [43,59]. Furthermore, for investigating the acceptance and use of Metaverse platforms for social sustainability, there are other constructs that should be addressed such as "perceived curiosity", in addition to the impact of the personality trait "extraversion" in the immersive technologies context (MVTECH). Using the UTAUT model as a foundation by taking into account these variables, a more comprehensive theoretical perception of users' IT/IS acceptance in the MVTECH setting could be introduced.

In fact, "perceived curiosity" seemed to be a critical variable that encouraged the users to be more engaged and motivated to use virtual reality technologies [62,63]. This is due to the fact that in a consumer/user context, curiosity leads to stimulating positive feelings through gaining information about a certain behavior (e.g., using cutting-edge technologies) [64]. The more that individuals are motivated, the more that they desire to look for information and knowledge. Individuals with higher curiosity levels naturally will recognize technology as easier to use as their inclination to explore motivates them to learn and acquire more information about it, particularly in the realm of immersive computing technologies [63]. Therefore, including "perceived curiosity" will strengthen the UTAUT model's original constructs and help in understanding individuals' perceptions toward MVTECH. The inclusion of this factor in the proposed model has been rationalized by the need to focus management attention on crucial enablers to adopt virtual platforms and achieve social sustainability, which allows users to utilize MVTECH capabilities effectively. However, a review of recently published research studies indicates that the significance of personality traits to address social sustainability in the context of IT/IS acceptance and use might importantly shape the users' behavior towards such technology or system [1,65]. In this research, one of the key personality traits, namely, extraversion, is integrated within the UTAUT as an antecedent of the social sustainability of MVTECH. The rationale behind including extraversion is due to the fact that extroverts are those who are sociable, interactive, self-confident, gregarious, and enthusiastic. Therefore, those people have more positive intentions toward new IT/IS that facilitate self-presentation [66]. Extroverts also show high levels of innovation consciousness and a desire to possess the latest technologies [67]. In this regard, extroverts are revealed to be inclined to adopt technology as a means of interaction with others to demonstrate their ideal self through the style represented by the technology itself [67,68]. This is considered another reason to illustrate the integration of extraversion in the context of educational Metaverse platforms. Wang et al. (2012) reported that extroverted learners must be apt to interact via IT/IS with others [69]. Consequently, extroverted learners will probably perceive Metaverse learning platforms as more beneficial and engaging in their education.

The UTAUT was expanded in this study using a novel exogenous technique and an integrated approach. To predict and explain the social sustainability of using MVTECH in the educational setting, a proposed model is formulated by incorporating the UTAUT main constructs with one of the personality qualities, namely, extraversion, and perceived

curiosity. The underlying premise is that the suggested variables would have a significant impact on MVTECH's social sustainability. The proposed theoretical model is depicted in Figure 1 (an adaptation of the UTAUT model developed by Venkatesh et al., 2003 [44] for the purpose of this study).

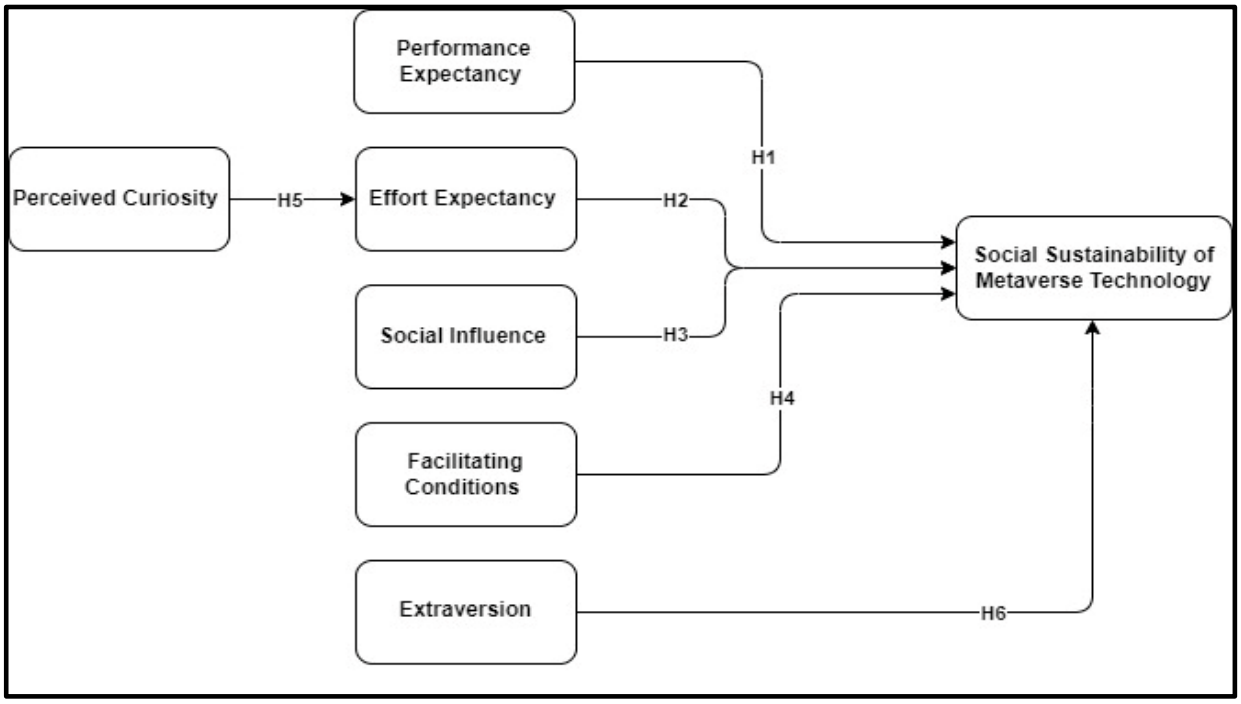

Figure 1. Study model "Factors Affecting the Social sustainability of Metaverse".

2.3.1. Performance Expectancy (PE)

PE can be described as "the degree to which using a technology will provide benefits to consumers in performing certain activities" [43]. The fundamental concepts that support PE according to the earlier IT/IS adoption models and theories are: "perceived usefulness" (TAM), "relative advantage" (IDT), "extrinsic motivation" (MM), "job fit" (MPCU), and "outcome expectations" (SCT). The original and the second versions of the unified theory (UTAUT1/UTAUT2) proposed that PE has a direct influence on behavioral intentions to use novel technologies. Earlier studies supported the relationship between PE and the use behavior of several technologies [60,70–72]. In this research, PE refers to the perceptions held by university students that incorporating the Metaverse into their educational experience will enhance their learning outcomes and boost their academic performance. Assuming that university students perceive that utilizing Metaverse will enhance their academic performance. In this case, it is expected that students will have a favorable inclination to utilize it in their learning. Consequently, the subsequent hypothesis was proposed:

H1. *PE will positively affect students' perceptions toward social sustainability of MVTECH.*

2.3.2. Effort Expectancy (EE)

EE can be described as "the degree of ease associated with consumers' use of technology" [43]. The EE's foundational root variables are: "perceived ease of use" (TAM) and "complexity" (IDT) [44]. A user needs a certain level of knowledge, competence, and understanding to use MVTECH. Users would be more inclined to use MVTECH in the future if they felt confident and could easily use the associated technologies, such as laptops, mobile devices, AR glasses, VR headsets, and VR gloves. Based on the UTAUT1/UTAUT2 models, EE was hypothesized to have a direct influence on the users' behavioral intentions to adopt novel technologies. Earlier literature confirmed the impact of EE as a determinant

of the behavioral intentions to accept and use different information systems and technologies [6,73,74]. The present study aims to evaluate university students' perceptions of the simplicity and user friendliness of the Metaverse by assessing their EE. Consequently, if university students perceive the Metaverse as easy to use (effortless), their inclination to use it will be positive. Thus, the subsequent hypothesis was suggested:

H2. *EE will positively affect students' perceptions toward social sustainability of MVTECH.*

2.3.3. Social Influence (SI)

SI is described as "the extent to which consumers perceive that important others, for example, family and friends, believe they should use a particular technology" [43]. The fundamental concepts that support SI according to the earlier IT/IS adoption models and theories are "social norms" or "subjective norms" in the "theory of planned behavior TPB, theory of reason action TRA, TAM2 and combined TAM-TPB" [44]. Peers, colleagues, friends, and important others who utilize innovative technologies, such as MVTECH, may contribute to improving trust in the technologies and service providers. Previous studies confirmed the impact of SI on the acceptance and use of several technologies [61,75,76]. In this study, "social influence" refers to the degree to which university students feel obligated to utilize the Metaverse based on the judgments of their peers. University students who are influenced by important individuals are more likely to use the Metaverse for educational purposes. Therefore, the following relationship was hypothesized:

H3. *SI will positively affect students' perceptions toward social sustainability of MVTECH.*

2.3.4. Facilitating Conditions (FCs)

FC can be described as "consumers' perceptions of the resources and support available to perform behavior" [43]. The original variables underlying the FC are "perceived behavioral control" (TPB) and "compatibility" (IDT) [44]. Adopting the Metaverse requires a particular set of technical abilities and tools (e.g., laptops, mobile devices, AR glasses, VR headsets, and VR gloves). Therefore, users would be more inclined to accept and utilize MVTECH in the future if they believe they already have the required high-tech tools and skills for using these virtual settings. Previous research supported the relationship between FC and the adoption of innovative technologies [61,70,77]. The term "FC" in this study refers to the perceptions of university students regarding the accessibility of organizational and technical tools that could potentially increase their dependency on the Metaverse. The present study hypothesizes that sufficient organizational and technological resources and support inside HEIs enhance the probability of university students utilizing Metaverse. Consequently, the following relationship was hypothesized:

H4. *FC will positively affect students' perceptions toward social sustainability of MVTECH.*

2.3.5. Perceived Curiosity (PC)

According to Litman (2010), PC can be described as "a desire for acquiring new knowledge and new sensory experience that motivates exploratory behavior" [78]. There are two categories of PC: First, "interest curiosity" which refers to the anticipated positive feeling or pleasure of acquiring novel information, and second, "deprivation curiosity" which refers to the alleviation of uncertainty and unattractive circumstances related to a dearth of knowledge or information [79]. The current research placed emphasis on "interest curiosity" rather than deprivation since individuals are more likely to accept utilizing MVTECH due to their interest. People may become more interested in learning how to use IT/IS if they have a curious mind [62]. Thus, curious users might learn swiftly and consider advanced IT/IS as being effortless to adopt and utilize. PC, in the context of this study, pertains to the inclination of learners to seek out new knowledge and sensory experiences that stimulate their exploratory behaviors concerning the utilization of the

Metaverse within HEIs. In this study, the more enthusiastic and interested MVTECH users will have positive perceptions regarding its perceived usability or effort expectations when accepting and adopting this innovative technology. While this association has not been investigated in earlier UTAUT studies, this research makes the assumption that users who are generally curious will think of the MVTECH as easy to use (i.e., requiring less effort), as their eagerness encourages them to learn about this innovation. This study, hence, postulates the following hypothesis:

H5. *PC will positively affect EE toward social sustainability of MVTECH.*

2.3.6. Extraversion (EXT) as a Critical Personality Trait

Personality is often defined as the most fundamental psychological process that controls a person's cognition, emotions, and behavioral actions [80,81]. When it comes to attitudes, needs, behaviors, feelings, and actions, personality is a term that is frequently used to characterize individual differences. Also, personality has a significant effect on how customers make decisions [82,83]. One of the most prevalent explanations for why an individual behaves differently is due to their personality traits, which are characteristics that set them apart from other individuals (differentiate one person from others). In the case of this study, it could help in understanding individuals' variations in behavioral intention. Thus, "personality traits" could be applied to understand the behaviors of IT/IS users [84,85]. The "five-factor model" (FFM) or the "big five personality traits" model covers the vital elements of personality and is deemed to be the most thorough taxonomy in personality literature [86,87]. It includes the subsequent elements, which are usually regarded as the basic tenets of personality. Agreeableness describes "a person's tendency to be compassionate, tolerant, courteous, and cooperative toward others"; Conscientiousness is "a person's tendency to act in an organized, planned, or thoughtful manner"; Extraversion is "generally associated as socializing with others, being gregarious, and talkative"; Neuroticism describes "the extent to which a person's emotions are sensitive to the environment, and includes being nervous, insecure or anxious"; Openness is "the extent to which a person is open to experiencing a variety of activities, is broad-minded and independent" [88,89].

In the context of IT/IS research, improving our understanding of the effect of personality on users' behaviors allows for better tailoring of communications to meet their needs [90,91]. If carried out ethically, this may further enhance user outcomes by better matching technological products and services. Since extraversion has attracted the most attention among personality traits in the literature on IS/IT adoption, the focus of this research was on analyzing how this trait manifests in behavior. Extraversion, in particular, has been demonstrated to positively influence behavior-related intention to adopt new technology, according to earlier studies [85,92,93]. Alternatively, the trait of openness represents an individual's willingness to participate in a variety of activities as well as their independence and openness to new experiences. It was found that while this aspect had a positive relationship with "perceived ease of use PEoU" [42,94], it had no impact on users' intentions to adopt emerging technology [95]. According to other studies, agreeableness and neuroticism have no effect on how well people accept new technology (e.g., [95]).

Extraversion, one of the "big five personality traits", refers to a person who is sociable, interactive, emphatic, gregarious, and aspiring [67]. Those who describe themselves as extroverted are inclined to be gregarious and enjoy interacting with others, reaching new people, and socializing [83,91]. Additionally, they are more likely to be talkative, especially about people and social interactions, less hesitant and constrained, and to employ language that is positive and self-focused [65]. They also frequently use abstract, descriptive terms that may call for interpretation. Extraversion in this study encompasses qualities such as sociability, interactivity, empathy, and gregariousness by using Metaverse technology for educational purposes. In the HEIs context, extroverted learners are likely to have adequate skills in interacting with others, gesture expressions, and enthusiasm [22], and their goals are learning oriented. It is also revealed that extroverted learners tend

to like networking via IT/IS with peers, classmates, and other important people [22,69]. Consequently, extroverted learners are inclined to perceive Metaverse learning platforms as more beneficial and engaging in their learning process. Therefore, this research suggested the subsequent hypothesis:

H6. *Extraversion will positively affect users' perceptions toward social sustainability of MVTECH.*

3. Research Methodology

3.1. Study Sample and Data Collection

Quantitative research was used in this study to examine the suggested theoretical framework. To collect the responses from a convenience sample of Jordanian university students, a 23-item online questionnaire was used. At any point during the data-gathering process, respondents have the unrestricted right to withdraw. Students from HEIs in Jordan who understood the usage of state-of-the-art IT/IS for educational processes were considered qualified sample members. Consequently, the study included higher education students who possessed prior expertise with interactive technologies such as augmented reality (AR), virtual reality (VR), and virtual worlds. These respondents are in a better position to enable the researcher to accomplish the aim of the current study. The participants were potential future users of MVTECH because the application of this innovative technology in Jordanian HEIs is still in its infancy (or even not in use). A brief description of the Metaverse derived from prior studies and a brief video (roughly one minute in length) that explains the use of this technology for education were included on the introduction page of the online survey to ensure participants were aware that the study was focused on the MVTECH as a type of virtual learning environment in Jordanian universities. After confirming that they understood what the Metaverse is and how it might be applied in the educational process, the participants proceeded to the next parts of the online survey. Contribution to this research was entirely voluntary. Participants were asked to submit their responses to the online questionnaire based on their views and thoughts regarding the social sustainability of MVTECH. Out of the 528 returned questionnaires, 422 were valid to be analyzed using statistical techniques, indicating an 83.52 percent completion rate.

- Demographic profiles of study respondents

As depicted in Table 1, the gender split was 50.1% males and 49.9% females, with ages ranging between (18 and >50 years). Pertaining to their education, 87.2% of the respondents were at the undergraduate level, 8.5% of them were master-level students, and 4.3% of them were PhD students. Most of the participants (51%) were from business administration and information technology faculties. Table 1 indicates also that the majority of respondents in this study have a high level of education and possess adequate knowledge, experience, and proficiency in handling different virtual technologies including MVTECH.

Table 1. Participants' demographic profile.

Demographics	No.	(%)
Gender		
• Male	215	50.1%
• Female	207	49.9%
Age		
• 18–29	346	82%
• 30–39	37	8.8%
• 40–49	30	7.1%
• +50	9	2.1%

Table 1. *Cont.*

Demographics	No.	(%)
Academic level		
• Undergraduate	368	87.2%
• Master	36	8.5%
• PhD	18	4.3%
Majors		
• Business Administration	114	27%
• Information technology	101	24%
• Engineering	46	11%
• Education	17	4%
• Medical Sciences	51	12%
• Arts and sciences	21	5%
• Law	34	8%
• Others	38	9%
Competency levels of using virtual IT and/or Metaverse		
• Beginner	114	27%
• Intermediate	198	47%
• Advanced	110	26%

3.2. Measurement

The scales for this study instrument were all adapted from previously conducted empirical research on perceived curiosity (PC), extraversion (EXT), and current UTAUT-related literature to preserve the validity and reliability of those scales (see Appendix A). The UTAUT aims to evaluate four original constructs, including PE (three items), EE (three items), SI (three items), and FC (four items). These items were adjusted from Venkatesh et al. (2003, 2012) [43,44] and relevant research studies [6,10,61]. Social sustainability was evaluated using three items and the scale was adjusted from the research work of [96,97]. Additionally, PC was measured using four items adapted from the work of [62] and [79]. Lastly, three items were adjusted from the studies of [67–69,98] and were used to measure EXT. A 5-point Likert scale ranging from 1 "strongly Disagree" to 5 "strongly agree" was employed to assess the items that refer to each variable within the proposed study framework. A nominal scale was used to measure the respondents' demographics: gender, age, and degree of education. The online questionnaire was initially created in English, and as Arabic is the official language of Jordan, an expert English-Arabic translator transcribed it into Arabic. The initial phase of any research procedure is usually a pilot study, which is a smaller-scale investigation that helps with the planning and adjustment of the main research [99]. Prior to further research, a pilot investigation was conducted with 30 randomly chosen participants (university students) to review and adjust the online survey items and to demonstrate content validity and reliability. The pre-test was also conducted to evaluate the sufficiency, simplicity, and clarity of the study instrument. Aiming to improve the readability of the instrument, slight modifications were made to the wording of a few items based on the recommendations of the participants of the pilot study.

4. Data Analysis and Results

4.1. Descriptive Statistics

Descriptive statistics serve to condense and arrange the attributes present within a dataset. This dataset comprises responses or observations obtained from the study sample. Both the standard deviation (SD), which is "a summary measure of the differences of each

observation from the mean", and the mean, or M, which is the commonly employed measurement for calculating the average, were identified for the participants' responses [100]. To determine the mean, all the values of responses should be added together and then divided by the total count of responses. The descriptive analysis for each variable in the proposed framework is shown in Table 2. All means were greater than 2.5 which points out that the majority of respondents express positive answers to the factors that are examined in the current research. Moreover, Cronbach's α values revealed that all variables confirmed strong internal reliability.

Table 2. Descriptive statistics of the proposed variables.

Variables	Mean	SD	α
Performance Expectancy (PE)	3.69	1.17	0.903
Effort Expectancy (EE)	3.66	1.16	0.898
Social Influence (SI)	3.69	1.33	0.818
Facilitating Conditions (FC)	3.52	1.09	0.796
Perceived Curiosity (PC)	3.43	1.33	0.910
Extraversion (EXT)	3.67	1.32	0.849
Social sustainability of MVTECH (SS)	3.53	1.19	0.797

4.2. Measurement Model

CFA using AMOS 25.0 was employed to examine the associations between the constructs in the proposed research model [101]. The model's parameters were assessed using the maximum likelihood estimation approach, and all analyses used variance–covariance matrices [102]. At this stage, it is recommended to use some fit indices to evaluate the goodness-of-fit of the proposed model [102,103]. These indices are χ2/df, as well as at least one absolute index, for example, the "root mean square error of approximation (RMSEA)", "standardized root mean square residual (SRMR)", "goodness-of-fit index (GFI)", and "adjusted goodness-of-fit index (AGFI)" and one incremental index, such as "normed fit index (NFI)" and "comparative fit index (CFI)" (Hair et al., 2014; Kline, 2015) [103,104]. These indices are χ2/df, along with at least one absolute index, for instance, the "root mean square error of approximation (RMSEA)", "standardized root mean square residual (SRMR)", "goodness-of-fit index (GFI)", and "adjusted goodness-of-fit index (AGFI)" and one incremental index, such as "normed fit index (NFI)" and "comparative fit index (CFI)" [102,103]. The analysis of model fit indices including, χ2/df, GFI, AGFI, CFI, and SRMR, NFI, RMSEA, indicates an adequate model fit for both "measurement and structural models".

As recommended by [102], "composite reliability" (CR) and "average variance Extracted" (AVE) were applied to evaluate the reliability, convergent validity, and discriminant validity. The authors of [102] recommend that CR is required to be greater than 0.7 to establish sufficient reliability, the AVE is required to be greater than 0.5, and the CR value should be higher than the AVE to indicate convergent validity, where the total AVE of the average value of constructs is required to be higher than their correlation value to establish discriminant validity [102]. The results in Table 3 demonstrate that the AVE values of all the variables were above 0.507 and larger than 0.734 for CR, and this shows that the variables had acceptable reliability and convergent validity. Also, the square root of AVE is larger than their correlation value which indicates that all the variables illustrated have satisfactory discriminant validity.

Table 3. Construct reliabilities, convergent validity, and discriminant validity.

	CR	AVE	PE	EE	SI	FC	PC	EXT	SS
PE	0.734	0.526	**0.725**						
EE	0.830	0.688	0.413	**0.829**					
SI	0.788	0.570	0.485	0.529	**0.754**				
FC	0.756	0.507	0.505	0.506	0.547	**0.712**			
PC	0.801	0.618	0.396	0.424	0.449	0.536	**0.786**		
EXT	0.846	0.765	0.413	0.457	0.458	0.608	0.467	**0.810**	
SS	0.758	0.523	0.410	0.448	0.477	0.468	0.519	0.507	**0.723**

Note: Factor correlation matrix with the square root of AVE on the diagonal line (shown as bold).

4.3. Structural Model

Hair et al., 2021 [104] suggested that "structural equation modeling" (SEM) empowers researchers to concurrently create and evaluate intricate connections among numerous dependent and independent variables. They also highlighted that the "structural model", which is the second stage of the SEM approach, embodies the proposed theory, linking independent and dependent constructs, and the connections among the latent factors should be derived from theoretical reasoning, permitting simultaneous testing using SEM [104]. Thus, the subsequent stage after confirming good convergent and discriminant validities was to evaluate the structural model to examine the hypothesized associations between the proposed constructs.

The values in Table 4. indicate that the social sustainability of MVTECH in Jordanian universities was significantly influenced by PE, FC, and EXT. These constructs explained 66.4 percent of variance (R^2) in the social sustainability of MVTECH. Therefore, further research efforts are recommended to consider other factors, such as cultural dimensions, to obtain a better understanding of the Metaverse and its sustainable use. Also, PC was found to have a significant impact on EE. These findings offer support for H1, H4, H5, and H6. Conversely, EE and SI have an insignificant impact on SS. These findings show that H2 and H3 were not supported in this study.

Table 4. Structural model (hypotheses testing).

Hypotheses	Path	Path Coefficient (β)	Supported
H1	PE >> SS	0.172 *	Yes
H2	EE >> SS	0.042	No
H3	SI >> SS	0.034	No
H4	FC >> SS	0.151 *	Yes
H5	PC >> EE	0.235 **	Yes
H6	EXT >> SS	0.193 *	Yes

Note: * $p < 0.05$, ** $p < 0.01$.

5. Discussion, Implications, Limitations, and Future Research

The last twenty years witnessed substantial changes in people's daily activities as a result of various technological innovations. With the contemporary evolution in VR, AR, AI, and other relevant technologies, there have been shifts and transformations in different sectors, from the educational process to consumption lifestyles and from social interaction to engagement in cultural practices and traditions. It is claimed that the recently introduced "Metaverse" technology will have a significant effect on people's daily lives; it could profoundly influence social life, interaction, social structure, and sustainable development [1]. Thus, it is vital to investigate individuals' perspectives on the social sustainability of MVTECH. Consequently, this research examined the role of one of the

main personality traits, namely, extraversion, along with perceived curiosity and UTAUT original constructs in determining the social sustainability of the MVTECH in the HEIs in Jordan from learners' perspective.

According to the results of statistical analysis, UTAUT constructs such as PE, SI, and FC were revealed to significantly affect the SS of MVTECH. The results of this research were found to be in line with recent research in the field [105,106]. MVTECH will likely be a crucial component of human future lives. One of the key variables that will influence people's future acceptance and adoption of MVTECH is "performance expectancy" (PE) (H1). In earlier literature on the usage intention of different virtual digital tools, for instance, mobile commerce, internet of things (IoT), internet banking, Metaverse, and augmented reality, it has been confirmed that PE has a significant impact on usage intentions [29,105,107–109]. In other words, if users are convinced by MVTECH's benefits and gains, they will likely use this technology to perform their daily activities (e.g., educational practices).

The statistical results revealed that "effort expectancy" (EE) was an insignificant determinant of university students' perspectives regarding the social sustainability of Metaverse technology (H2). This might indicate that the students were prepared to adopt various distance learning systems and applications, irrespective of the individual efforts that could be needed. Being "digital natives" or "millennials", students in HEIs were used to utilizing such technologies in their daily lives, which is another possible explanation for this result; accordingly, they have sufficient experience and skills in using them. Based on the research of [110], EE becomes a significant predictor when IT/IS individuals are not familiar with utilizing the information systems and an insignificant variable for individuals with fair knowledge and skills. Consequently, Metaverse platform designers and developers need to focus on reducing the complexity associated with MVTECH exploration and usage. It is also suggested to provide training sessions, workshops, and helpdesks; this would contribute to improving students' skills and proficiency in using Metaverse and other relevant technologies. Earlier research in the IT/IS area has shown similar findings [21,107].

Another explanation for the insignificant impact of EE could be that users are growing less concerned about the challenges of using web-based services and apps as a result of these technologies becoming more user friendly. Therefore, rather than being primarily motivated by simplicity of use (or effort expectancy), consumers will primarily employ such applications and services according to their perceived benefits (or performance expectancy). Therefore, it is advised that application developers and designers develop Metaverse platforms that are easier to use in order to encourage people with less IT expertise to accept and utilize the Metaverse.

In addition, the findings show that "social influence" (SI), one of the main variables of the UTAUT, was not supported as a significant variable in explaining the SS of MVTECH within the HEI contexts (H3). This finding contradicts the conclusions of the previous research, such as [1,60]. This might be accredited to the fact that most participants in this research are well educated and have fair knowledge, experience, and skills to deal with various virtual technologies. Hence, the HEIs' students are not concerned with the experience of others regarding educational MVTECH platforms. Similarly, as students gain more familiarity and skills in using MVTECH, they are unlikely to be influenced by the support from their social systems. This further demonstrates that word-of-mouth and referrals from important others have a negligible impact on Jordanian students' use of Metaverse technologies in educational settings. Consequently, it makes sense to assume that Jordanian students rely mostly on their first-hand knowledge, previous experience, perceptions, and personal traits when evaluating online instructional settings and practices. In addition, according to Cech's (2014) study, this type of learning could promote a disengagement culture between learners [111]. This recommends future research efforts to investigate such issues, especially when students in HEIs become more familiar with using MVTECH for educational purposes.

"Facilitating conditions" (FCs) were found to be a significant variable in predicting the social sustainability of MVTECH in Jordanian HEIs (H4). The compatibility and the

availability of required resources and IT support are considered vital aspects from the perspective of innovative IT/IS users when using these technologies/systems (e.g., Metaverse). This also points out the significant non-barrier adoption of Metaverse among Jordanian HEIs' students related to the facilitation of MVTECH infrastructure (e.g., mobile devices for AR experience, VR headsets, VR controllers, tablets for immersive 2D and 3D experience) as well as internet access and IT staff support. Such a result is consistent with what has been found by [61,105].

Additionally, the significantly positive influence of FC on the social sustainability of MVTECH means that educational institutional and IT infrastructure is critical for the learning/teaching process. This research, however, reveals that institutional-technological readiness and IT staff support are essential for encouraging university students to accept and use Metaverse. Considering that MVTECH is a type of emergent disruptive technology, it might be challenging for learners in University classes to adopt MVTECH for the educational process in the utter lack of an institutional-technological empowering infrastructure. Also, this research postulates that it is vital to support learners who cannot utilize MVTECH due to a lack of financial resources or other restrictions. To reduce educational inequalities, HEIs and governments have to offer learners access to the required institutional and IT resources.

According to the statistical analysis of the proposed study model, the "perceived curiosity" (PC) variable was revealed to have a significant impact on the EE construct. This result represents one of the first research efforts at incorporating the perceived curiosity within the UTAUT literature, particularly in the virtual technologies context. Therefore, further studies need to be carried out to apply this variable as an antecedent to UTAUT factors across other IT/IS, particularly technologies/systems that are truly considered state-of-the-art. While PC builds a baseline for the person at an individual level, it can be valuable to assess the impact of IT/IS on PC over time. A longitudinal methodology can be carried out in future research by manipulating the release of innovative content, a potential stimulant for the PC, for virtual technologies (e.g., Metaverse). From a more general viewpoint, the "perceived curiosity" variable could be investigated and manipulated by applying experimental research with various technologies and the content relevant to these technologies to generalize the influence of the PC on technologies' acceptance, use, usage intentions, and probably loyalty to a service or brand linked to these technologies or even the content. This finding is in line with what has been concluded by [62] who found a significant impact of PC on the "ease of use" factors in TAM (which is EE in the UTAUT model).

Another significant result of this research is that "extraversion" (EXT) contributes to predicting the SS of MVTECH (H6). The previous research revealed that this personality trait (extraversion) influences determining the intention for IT/IS acceptance and use [112]. In the context of IT/IS, it has been concluded that extroverted individuals adopt and use e-government services more frequently than introverted individuals [113]. Similarly, ref. [112] confirmed that only extroverted users prefer to shop on online group buying (OGB) platforms. In the m-payment research, a similar finding was confirmed by [92]. In TAM and UTAUT-based research, however, ref. [95] provide evidence validating that EXT is one of the significant traits consolidating the behavioral intention and actual usage behaviors of new technologies. Also, ref. [22] found that EXT influenced the behavioral intention of students toward the adoption of virtual reality-based learning only through its effect on the TAM factor: "perceived usefulness" (PU).

The findings of this research that, EXT positively and directly affected social sustainability, will be explained based on an in-depth understanding of this factor. EXT is a trait associated with low emotional arousal, which in turn might result in concentrating on external cues, like social engagement and interactions with others [65]. Therefore, studies have deduced that extroverts perform better in activities demanding significant interactions with colleagues, classmates, or other individuals in general [66]. Conversely, ref. [114] revealed that EXT has a negative relation with artificial intelligence (AI) due to its individualized

nature. Reconciling these contradictory results, the association between EXT and users' attitudes and intentions toward IT acceptance and use might depend on the technologies domain. Technology that facilitates social interactions might be enjoyed by extroverted people, but AI technology, for example, can contribute significantly to minimizing social interaction [115]. Considering the social and interactive nature of Metaverse, in which a real-time multisensory social interaction is allowed, and many tasks that require significant human interactions could be hosted in MVTECH platforms (such as educational tasks mentioned in this paper), perhaps the result that EXT was significantly and positively associated with social sustainability should not be unexpected. If this result is replicated in future research, it could be that extroverts perform well in practices, learning, and training activities where interactions with others are allowed, and then simply decide not to be heavy technology users when using technology could lead to isolation from people.

5.1. Theoretical and Practical Implications

This study offers significant contributions from a theoretical viewpoint. First, to the best of the author's knowledge, the integration between UTAUT constructs and one of the key "personality traits" (extraversion) with the SS of MVTECH has not been examined. This study presents an attempt to bridge this gap by incorporating UTAUT's original constructs and "extraversion" as well as "perceived curiosity" (PC) to provide a better understanding of social sustainability in the context of using MVTECH for educational purposes. It is vital to mention that these predictors were not selected at random, but rather after a comprehensive review of the literature on IT/IS in general, and MVTECH in particular. Second, whereas there is extensive research on using the UTAUT theoretical framework in the field of IT/IS acceptance and use [45], this research linked the main variables of the theory with SS, which validates the theory's power in understanding and investigating SS. Also, the variance explained in the SS of the MVTECH is 66.4 percent, which is superior to the variance explained in the behavioral intentions by 56 percent of the UTAUT original version developed by [44]. Third, while four out of six hypothesized associations were supported by the statistical analysis of empirical data, the results did not strongly establish a relationship between EE and SI constructs with SS. These findings suggest further investigation of the situation and the characteristics of adopting the MVTECH, particularly in developing nations like Jordan.

From a practical perspective, the results of this study support the valuable opportunity that MVTECH affords to society in general and the education sector in particular (the context of this study). From the perspective of UTAUT variables, extraversion, and "perceived curiosity", the statistical analysis presented evidence that PE, FC, and EXT significantly affect the SS of the MVTECH. Consequently, HEIs and private companies who produce content for the MVTECH platforms should significantly consider such variables. Given the result of the PE construct, universities and other educational institutions need to deliberate on learners' demands, requirements, and time restraints while developing their Metaverse platforms for educational purposes. Metaverse appeal in the education context could be attributed to various styles of content delivery, remote accessibility to contexts that are unable to experience in the real world, learners' collaboration, and safe and secure virtual environments.

Also, the findings revealed that the SS of the MVTECH was not influenced by EE and SI. Although EE is an important determinant of accepting and using various technologies, its relationship with MVTECH is not supported. Consequently, decision makers who emphasize the adoption of this technology in their HEIs including universities should offer training courses for their students to facilitate its implementation and use. Also, designers and developers should enhance the user friendliness of the MVTECH platforms to encourage their sustainable usage in the long run. Furthermore, the findings of this research imply that universities need to consider making the Metaverse environments more accessible and user friendly throughout various learning and teaching practices.

The MVTECH is required to have a user-friendly interface, that is easy to be used and understood even for beginners.

HEIs and other sectors engaging in the Metaverse environment should consider the FC in promoting the social sustainability of MVTECH. Such facilitating conditions are varied depending on the sector due to the different levels of skills and competencies needed. These organizations should offer the essential tools, content, and applications that facilitate the implementation of MVTECH. Individuals also should be armed with particular knowledge and experience to utilize these innovative virtual settings. As avatars are used in the Metaverse virtual environment to represent users, users need to have sufficient expertise to deal with them. To support conscientiousness in users, institutions should prepare and implement their scheduled plans to highlight how MVTECH is associated with their long-term goals and strategies. In view of this point, users would seek to accept and adopt these novel settings to reinforce the HEIs' reputation and image, and this is in light of achieving the government's ambitions toward digital societies.

For extraversion, individuals commonly improve their competencies, skills, and expertise by participating in social interactions. Whereas MVTECH promotes social interactions between individuals, this is likely to affect its social sustainability. Thus, users are stimulated to use MVTECH in their educational process and other daily activities and taste the flavor of social interactions with their classmates and other social groups to act in line with the future desires of different institutions. The use of Metaverse is still in its introductory stage; therefore, Metaverse service providers and HEIs should stimulate a feeling of curiosity regarding MVTECH using various social media channels (e.g., YouTube ads). Based on the results of this study, PC about MVTECH may produce positive perceptions regarding the "ease of use" of this technology and could influence its sustainable use in the future. In short, decision makers and companies that provide Metaverse's services could benefit from the results of this research to enhance users' perceptions and experience of MVTECH, or to reach more potential users.

To maintain the social sustainability of the Metaverse, the Metaverse settings should operate with many individuals, and seamless service should be available even when using comparatively low-cost/low-quality mobile devices. For long-term Metaverse services, a sustainable design needs to take into consideration the scalability of the existing constrained infrastructure. To expand the infrastructure and use it effectively, it is imperative to constantly establish open-source platforms that could reinforce collaborations between developers, leading experts, individuals, and institutions seeking to exploit such innovative virtual technologies in the long term.

5.2. Limitations and Future Work

The MVTECH continues to produce new momentum for the expansion of the digital economy at the international level. The current study demonstrates that UTAUT core variables, extraversion as a key personality trait, and perceived curiosity are associated with the social sustainability of MVTECH. Although the results in this research offer a significant contribution to Metaverse literature, particular limitations influence the generalization of the study conclusions. First, this study employed quantitative data to study the research phenomenon, while such empirical data assist in providing more objective insights concerning the significant variables influencing Jordanian students' perspectives toward the social sustainability of MVTECH, it is still vital to gain an in-depth and more insightful view that explains how such factors may affect the individuals' perceptions toward MVTECH. Thus, a qualitative research approach is required by future researchers to provide insightful explanations for this research phenomenon. Second, this research investigated the learners' perceptions toward the Metaverse. Accordingly, future studies are required to focus on other individual behaviors and outcomes such as "actual usage" behavior and users' loyalty. Furthermore, whereas Metaverse presents novel opportunities for educators to motivate learners, it also could increase the dedication hours of students. This issue needs further investigation in future research work. Third, as presented in the

findings section, both EE and SI constructs were not significant predictors as suggested in this research framework. Such results call for further analysis to realize if they could be moderated by demographic variables (such as gender and age). Fourth, this study only studied the application of MVTECH in educational institutions; other areas (e.g., citizens–governments interaction, banking, health, and e-commerce) can be targeted independently or investigated together in future investigations. Finally, this study was conducted in Jordan, which might restrict the generalizability of its results. Therefore, future studies could consider other nations and cultures to gain a more comprehensive understanding of MVTECH adoption and sustainable use based on different contexts.

6. Conclusions

MVTECH is a type of virtual technology platform that will affect social interaction and online service delivery from several aspects, and education is no exception. It is reinforced by advanced technologies, which form a vital component of educational activities. With the recent announcement of the executive chairman and CEO of the popular social media platform (Facebook) who renamed this platform Metaverse [116], people anticipate the development of revolutionary technologies that have great potential to fundamentally transform how they work, learn, and perform daily routines. It is an innovative setting of VR that would replace the traditional web-based platforms and pave the way for a novel style of teaching and learning activities. Engaging in e-learning through immersive VR-based learning systems enables students to immerse themselves in a virtual environment, actively participating and interacting within the learning space. This approach, as highlighted by Ref. [23], enhances learning by rendering it more interactive and lifelike. VR-based learning systems offer an enriched sensory experience, introducing an innovative and novel approach that caters to both technologists and students. Ref. [89] emphasizes that these systems effectively captivate students' interest across diverse subject areas, ranging from medical surgery to industrial design. Within the educational realm, VR-based learning systems stand as compelling and exhilarating developments, promising an engaging and exciting approach to learning [117]. Considering the advantages that this innovative technology can benefit the HEIs, this study examined the learners' perceptions of MVTECH in Jordanian HEIs, investigating the variables influencing their perceptions regarding the social sustainability of this technology. The current research developed a context-specific theoretical framework integrating the UTAUT original constructs with PC and EXT constructs as contextual factors. The findings of the SEM revealed that learners' perceptions toward MVTECH were significantly influenced by PE, FC, and EXT. Furthermore, the PC construct significantly affected the EE construct. The results of this research contribute to the published literature on the acceptance and adoption of IT/IS. It can also show how learners in HEIs understand the virtual technologies implemented in educational activities.

Funding: This research received no external funding.

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: Data are contained within the article.

Acknowledgments: The author would like to thank the editor and anonymous reviewers of Sustainability for taking the necessary time and effort to review the manuscript. The author sincerely appreciates all your valuable comments and suggestions, which helped to improve the quality of this manuscript. Also, many thanks are due to Mutah University for their encouragement and support in completing this study.

Conflicts of Interest: The author declares no conflicts of interest.

Appendix A

Table A1. Study questionnaire (constructs and measurement items).

Construct	Code	Measurement Item	Source (s)
Performance Expectancy	PE1	I find the Metaverse technology to be useful for my study purposes.	[6,10,44]
	PE2	Using the Metaverse technology makes it easier for me to achieve my study goals.	
	PE3	Using the Metaverse technology improves my learning efficiency.	
Effort Expectancy	EE1	My interaction with the Metaverse technology for educational purposes is clear and understandable.	[6,10,44]
	EE2	I think the Metaverse technology for educational purposes is easy to use.	
	EE3	Learning to use the Metaverse technology for educational purposes is easy for me.	
Facilitating Conditions	FC1	There are online resources to show me how to use the Metaverse technology for educational purposes.	[6,10,44]
	FC2	There are online customer service providers to show me how to use the Metaverse technology for educational purposes.	
	FC3	There are online customer service providers to help me when I have difficulties using the Metaverse technology for educational purposes.	
	FC4	Using the Metaverse technology for educational purposes is compatible with other technology I use.	
Social influence	SI1	People who are important to me would think that I should use the Metaverse educational platform.	[6,10,44]
	SI2	People whose opinions I value would like me to use the Metaverse educational platform.	
	SI3	People who influence my behavior would think that I should use the Metaverse educational platform.	
Perceived Curiosity	PC1	I follow the news about Metaverse out of curiosity.	[62,79]
	PC2	I cannot wait to try Metaverse.	
	PC3	I enjoy spending hours on a question related to using Metaverse because I cannot be comfortable without getting an answer.	
	PC4	I enjoy learning about subjects using Metaverse technology as this experience is new to me.	
Extraversion	EXT1	The Metaverse encourages university students to be outgoing and sociable.	[67–69,98]
	EXT2	The Metaverse encourages university students to be conversationalists.	
	EXT3	The Metaverse promotes the cultivation of confidence and sociability among university students.	
Social sustainability	SS1	The use of Metaverse in the educational process ensures equal personal development and engagement opportunities for learners.	[96,97]
	SS2	The use of Metaverse promotes social issues, including the development of communities, cultural competency, social equity, social assistance, responsibility for society, etc.	
	SS3	In general, implementing Metaverse for the educational process contributes to taking aspects like equal opportunities and diversity management into consideration.	

References

1. Arpaci, I.; Karatas, K.; Kusci, I.; Al-Emran, M. Understanding the social sustainability of the Metaverse by integrating UTAUT2 and big five personality traits: A hybrid SEM-ANN approach. *Technol. Soc.* **2022**, *71*, 102120. [CrossRef]
2. Kim, K.; Yang, E.; Ryu, J. Work-in-progress—The effect of students' perceptions on intention to use metaverse learning environment in higher education. In Proceedings of the IEEE 8th International Conference of the Immersive Learning Research Network (iLRN), Vienna, Austria, 30 May–4 June 2022; IEEE: Piscataway, NJ, USA, 2022.
3. Wang, M.; Liu, S.; Hu, L.; Lee, J.-Y. A Study of Metaverse Exhibition Sustainability on the Perspective of the Experience Economy. *Sustainability* **2023**, *15*, 9153. [CrossRef]
4. Stephenson, N. *Snow Crash: A Novel*; Bantam Spectra: New York, NY, USA, 1992.
5. Salar, H.C.; Başarmak, U.; Sezgin, M.E. Educational Integration of the Metaverse Environment in the Context of Web 3.0 Technologies: A Critical Overview of Planning, Implementation, and Evaluation. In *Shaping the Future of Online Learning: Education in the Metaverse*; IGI Global: Hershey, PA, USA, 2023; pp. 154–173.
6. Teng, Z.; Cai, Y.; Gao, Y.; Zhang, X.; Li, X. Factors Affecting Learners' Adoption of an Educational Metaverse Platform: An Empirical Study Based on an Extended UTAUT Model. *Mob. Inf. Syst.* **2022**, *2022*, 5479215. [CrossRef]
7. Park, S.-M.; Kim, Y.-G. A Metaverse: Taxonomy, components, applications, and open challenges. *IEEE Access* **2022**, *10*, 4209–4251. [CrossRef]
8. Needleman, S.E. The Amazing Things You'll Do in the 'Metaverse' and What It Will Take to Get There. *The Wall Street Journal*, 16 October 2021.
9. Huynh-The, T.; Gadekallu, T.R.; Wang, W.; Yenduri, G.; Ranaweera, P.; Pham, Q.-V.; da Costa, D.B.; Liyanage, M. Blockchain for the metaverse: A Review. *Future Gener. Comput. Syst.* **2023**, *143*, 401–419. [CrossRef]
10. Yang, F.; Ren, L.; Gu, C. A study of college students' intention to use metaverse technology for basketball learning based on UTAUT2. *Heliyon* **2022**, *8*, e10562. [CrossRef]
11. Salhab, H.A.; Allahham, M.; Abu-AlSondos, I.A.; Frangieh, R.H.; Alkhwaldi, A.F.; Ali, B.J.A. Inventory competition, artificial intelligence, and quality improvement decisions in supply chains with digital marketing. *Uncertain Supply Chain. Manag.* **2023**, *11*, 1915–1924. [CrossRef]
12. Alharasis, E.E.; Alhadab, M.; Alidarous, M.; Jamaani, F.; Alkhwaldi, A.F. The impact of COVID-19 on the relationship between auditor industry specialization and audit fees: Empirical evidence from Jordan. *J. Financ. Report. Account.* **2023**. *ahead-of-print*. [CrossRef]
13. Alharasis, E.E.; Alidarous, M.; Alkhwaldi, A.F.; Haddad, H.; Alramahi, N.; Al-Shattarat, H.K. Corporates' monitoring costs of fair value disclosures in pre-versus post-IFRS7 era: Jordanian financial business evidence. *Cogent Bus. Manag.* **2023**, *10*, 2234141. [CrossRef]
14. Alharasis, E.; Alkhwaldi, A.; Hussainey, K. Key audit matters and auditing quality in the era of COVID-19 pandemic: The case of Jordan. *Int. J. Law Manag.* **2024**, *in press*.
15. Alkhwaldi, A.F.; Abu-Alsondos, I.; Abdulmuhsin, A.; Shehadeh, M.; Aldhmour, F.M. Toward an understanding of cutting edge technologies in financial industry: Cryptocurrency adoption. In Proceedings of the Conference on Sustainability and Cutting-Edge Business Technologies, Amman, Jordan, 22 May 2023; Springer Nature: Cham, Switzerland, 2023; pp. 64–82.
16. Shehadeh, M.; Almajali, D.; Abu-AlSondos, I.A.; Alkhwaldi, A.F.; Al-Gasaymeh, A.S. Digital Transformation and its Impact on Operational Efficiency and Competitive Advantage in Islamic Banks. In Proceedings of the 2023 International Conference on Business Analytics for Technology and Security (ICBATS), Dubai, United Arab Emiratesm, 7–8 March 2023.
17. Alkhwaldi, A.; Kamala, M.; Qahwaji, R. Security Perceptions in Cloud-Based e-Govemment Services. In Proceedings of the 2019 IEEE 12th International Conference on Global Security, Safety and Sustainability (ICGS3), London, UK, 16–18 January 2019.
18. Abu-AlSondos, I.A.; Abu-AlSondos, I.A.; Alkhwaldi, A.F.; Shehadeh, M.; Ali, B.J.; Al Nasar, M.R. The Role of Industry 4.0 Technologies in Enabling Knowledge Management Practices: United Arab Emirates Perspective. In *The International Conference On Global Economic Revolutions*; Springer Nature: Cham, Switzerland, 2023.
19. Agarwal, S.; Kaushik, J.S. Student's perception of online learning during COVID pandemic. *Indian J. Pediatr.* **2020**, *87*, 554. [CrossRef] [PubMed]
20. Fernandez, C.B.; Hui, P. Life, the metaverse and everything: An overview of privacy, ethics, and governance in metaverse. In Proceedings of the IEEE 42nd International Conference on Distributed Computing Systems Workshops (ICDCSW), Bologna, Italy, 10 July 2022; IEEE: Piscataway, NJ, USA, 2022.
21. Alkhwaldi, A.F.; Abdulmuhsin, A.A. Crisis-centric distance learning model in Jordanian higher education sector: Factors influencing the continuous use of distance learning platforms during COVID-19 pandemic. *J. Int. Educ. Bus.* **2022**, *15*, 250–272. [CrossRef]
22. Wang, G.; Shin, C. Influencing Factors of Usage Intention of Metaverse Education Application Platform: Empirical Evidence Based on PPM and TAM Models. *Sustainability* **2022**, *14*, 17037. [CrossRef]
23. Deloitte. The Metaverse and Its Potential for MENA. 2023. Available online: https://www2.deloitte.com/ (accessed on 14 August 2023).
24. JordanTimes. Metaverse Could Contribute up to $1.7 Billion to GDP in Jordan by 2035, Says Report. 2023. Available online: https://jordantimes.com/news/local/metaverse-could-contribute-17-billion-gdp-jordan-2035-says-report (accessed on 14 August 2023).

25. AAU. Amman Arab University Is the First University In Metaviruses. 2022. Available online: https://www.aau.edu.jo/en/news/21157#:~:text=Amman%20Arab%20University%20has%20concluded,within%20the%20world%20of%20LivatVerse (accessed on 15 January 2023).
26. PSUT. PSUT Creates an Experimental Course on the Metaverse. 2023. Available online: https://psut.edu.jo/en/news/psut-creates-an-experimental-course-on-the-metaverse-2 (accessed on 14 August 2023).
27. Hwang, G.-J.; Chien, S.-Y. Definition, roles, and potential research issues of the metaverse in education: An artificial intelligence perspective. *Comput. Educ. Artif. Intell.* **2022**, *3*, 100082. [CrossRef]
28. Abed, S.N.; Abdulmuhsin, A.A.; Alkhwaldi, A.F. The factors influencing the innovative performance of leaders in nurses' professional: A developing country perspective. *Leadersh. Health Serv.* **2021**, *35*, 228–246. [CrossRef] [PubMed]
29. Akour, I.A.; Al-Maroof, R.S.; Alfaisal, R.; Salloum, S.A. A conceptual framework for determining metaverse adoption in higher institutions of gulf area: An empirical study using hybrid SEM-ANN approach. *Comput. Educ. Artif. Intell.* **2022**, *3*, 100052. [CrossRef]
30. Al-Adwan, A.S.; Li, N.; Al-Adwan, A.; Abbasi, G.A.; Albelbisi, N.A.; Habibi, A. Extending the technology acceptance model (TAM) to Predict University Students' intentions to use metaverse-based learning platforms. *Educ. Inf. Technol.* **2023**, *28*, 15381–15413. [CrossRef]
31. Wu, R.; Yu, Z. Investigating Users' Acceptance of the Metaverse with an Extended Technology Acceptance Model. *Int. J. Hum.–Comput. Interact.* **2023**, 1–17. [CrossRef]
32. Radianti, J.; Majchrzak, T.A.; Fromm, J.; Wohlgenannt, I. A systematic review of immersive virtual reality applications for higher education: Design elements, lessons learned, and research agenda. *Comput. Educ.* **2020**, *147*, 103778. [CrossRef]
33. Calvet, L.; Bourdin, P.; Prados, F. Immersive technologies in higher education: Applications, challenges, and good practices. In Proceedings of the 2019 3rd International Conference on Education and E-Learning, Barcelona, Spain, 5–7 November 2019.
34. Pellas, N.; Mystakidis, S.; Kazanidis, I. Immersive Virtual Reality in K-12 and Higher Education: A systematic review of the last decade scientific literature. *Virtual Real.* **2021**, *25*, 835–861. [CrossRef]
35. Abu-AlSondos, I.A.; Salameh, A.A.; Alkhwaldi, A.F.; Mushtaha, A.S.; Shehadeh, M.; Al-Junaidi, A. Evaluating Mobile E-Learning Systems Acceptance: An Integrated Model. *Int. J. Interact. Mob. Technol.* **2023**, *17*, 30–47. [CrossRef]
36. Salloum, S.; Al Marzouqi, A.; Alderbashi, K.Y.; Shwedeh, F.; Aburayya, A.; Al Saidat, M.R.; Al-Maroof, R.S. Sustainability Model for the Continuous Intention to Use Metaverse Technology in Higher Education: A Case Study from Oman. *Sustainability* **2023**, *15*, 5257. [CrossRef]
37. Nejad, M.C.; Mansour, S.; Karamipour, A. An AHP-based multi-criteria model for assessment of the social sustainability of technology management process: A case study in banking industry. *Technol. Soc.* **2021**, *65*, 101602. [CrossRef]
38. Selvanathan, R.G. Measuring Educational Sustainability. *Int. J. High. Educ.* **2013**, *2*, 35–43. [CrossRef]
39. Bouzguenda, I.; Alalouch, C.; Fava, N. Towards smart sustainable cities: A review of the role digital citizen participation could play in advancing social sustainability. *Sustain. Cities Soc.* **2019**, *50*, 101627. [CrossRef]
40. Ario, M.K.; Santoso, Y.K.; Basyari, F.; Edbert; Fajar, M.; Panggabean, F.M.; Satria, T.G. Towards an implementation of immersive experience application for marketing and promotion through virtual exhibition. *Softw. Impacts* **2022**, *14*, 100439. [CrossRef]
41. Zhang, G.; Wu, J.; Jeon, G.; Chen, Y.; Wang, Y.; Tan, M. *Towards Understanding Metaverse Engagement Via Social Patterns and Reward Mechanism: A Case Study of Nova Empire*; IEEE Transactions on Computational Social Systems: Piscataway, NJ, USA, 2022.
42. Agyei, J.; Sun, S.; Abrokwah, E.; Penney, E.K.; Ofori-Boafo, R. Mobile banking adoption: Examining the role of personality traits. *Sage Open* **2020**, *10*, 2158244020932918. [CrossRef]
43. Venkatesh, V.; Thong, J.Y.L.; Xu, X. Consumer acceptance and use of information technology: Extending the unified theory of acceptance and use of technology. *MIS Q.* **2012**, *36*, 157–178. [CrossRef]
44. Venkatesh, V.; Morris, M.G.; Davis, G.B.; Davis, F.D. User acceptance of information technology: Toward a unified view. *MIS Q.* **2003**, *27*, 425–478. [CrossRef]
45. Dwivedi, Y.K.; Rana, N.P.; Jeyaraj, A.; Clement, M.; Williams, M.D. Re-examining the unified theory of acceptance and use of technology (UTAUT): Towards a revised theoretical model. *Inf. Syst. Front.* **2019**, *21*, 719–734. [CrossRef]
46. Bian, Y.; Leng, J.; Zhao, J.L. Demystifying metaverse as a new paradigm of enterprise digitization. In Proceedings of the International Conference on Big Data, Virtual Event, 10–14 December 2021; Springer International Publishing: Cham, Switzerland, 2021; pp. 109–119.
47. Onggirawan, C.A.; Kho, J.M.; Kartiwa, A.P.; Anderies; Gunawan, A.A.S. Systematic literature review: The adaptation of distance learning process during the COVID-19 pandemic using virtual educational spaces in metaverse. *Procedia Comput. Sci.* **2023**, *216*, 274–283. [CrossRef] [PubMed]
48. Suzuki, S.-N.; Kanematsu, H.; Barry, D.M.; Ogawa, N.; Yajima, K.; Nakahira, K.T.; Shirai, T.; Kawaguchi, M.; Kobayashi, T.; Yoshitake, M. Virtual Experiments in Metaverse and their Applications to Collaborative Projects: The framework and its significance. *Procedia Comput. Sci.* **2020**, *176*, 2125–2132. [CrossRef]
49. Zhao, Z.; Zhao, B.; Ji, Z.; Liang, Z. On the Personalized Learning Space in Educational Metaverse Based on Heart Rate Signal. *Int. J. Inf. Commun. Technol. Educ. IJICTE* **2022**, *18*, 12. [CrossRef]
50. Damaševičius, R.; Sidekersniene, T. Designing Immersive Gamified Experiences in the Metaverse for Enhanced Student Learning. In Proceedings of the 2023 International Conference on Intelligent Metaverse Technologies & Applications (iMETA), Tartu, Estonia, 8–20 September 2023; IEEE: Piscataway, NJ, USA, 2023; pp. 1–6.

51. Lee, H.; Hwang, Y. Technology-enhanced education through VR-making and metaverse-linking to foster teacher readiness and sustainable learning. *Sustainability* **2022**, *14*, 4786. [CrossRef]
52. Moschini, E. The second life researcher toolkit–an exploration of inworld tools, methods and approaches for researching educational projects in second life. In *Researching Learning in Virtual Worlds*; Springer: Berlin/Heidelberg, Germany, 2010; pp. 31–51.
53. Mystakidis, S. Sustainable Engagement in Open and Distance Learning With Play and Games in Virtual Reality: Playful and Gameful Distance Education in VR. In *Research Anthology on Virtual Environments and Building the Metaverse*; IGI Global: Hershey, Pennsylvania, 2023; pp. 297–312.
54. Ng, P.H.F.; Chen, P.Q.; Sin, Z.P.; Jia, Y.; Li, R.C.; Baciu, G.; Li, Q. From Classroom to Metaverse: A Study on Gamified Constructivist Teaching in Higher Education. In *International Conference on Web-Based Learning*; Springer Nature: Singapore, 2023; pp. 92–106.
55. Sinha, E. 'Co-creating'experiential learning in the metaverse-extending the Kolb's learning cycle and identifying potential challenges. *Int. J. Manag. Educ.* **2023**, *21*, 100875.
56. Tlili, A.; Huang, R.; Shehata, B.; Liu, D.; Zhao, J.; Metwally, A.H.S.; Wang, H.; Denden, M.; Bozkurt, A.; Lee, L.-H.; et al. Is Metaverse in education a blessing or a curse: A combined content and bibliometric analysis. *Smart Learn. Environ.* **2022**, *9*, 24. [CrossRef]
57. Wang, M.; Yu, H.; Bell, Z.; Chu, X. Constructing an Edu-Metaverse Ecosystem: A New and innovative framework. *IEEE Trans. Learn. Technol.* **2022**, *15*, 685–696. [CrossRef]
58. Yazdani, M.; Pamucar, D.; Erdmann, A.; Toro-Dupouy, L. Resilient sustainable investment in digital education technology: A stakeholder-centric decision support model under uncertainty. *Technol. Forecast. Soc. Change* **2023**, *188*, 122282. [CrossRef]
59. Venkatesh, V.; Thong, J.Y.L.; Xu, X. Unified theory of acceptance and use of technology: A synthesis and the road ahead. *J. Assoc. Inf. Syst.* **2016**, *17*, 328–376. [CrossRef]
60. Al-Rahmi, A.M.; Shamsuddin, A.; Wahab, E.; Al-Rahmi, W.M.; Alturki, U.; Aldraiweesh, A.; Almutairy, S. Integrating the Role of UTAUT and TTF Model to Evaluate Social Media Use for Teaching and Learning in Higher Education. *Front. Public Health* **2022**, *10*, 905968. [CrossRef] [PubMed]
61. Mahara, T.; Iyer, L.S.; Matta, V.; Alagarsamy, S. Effect of Organizational Culture during Crises on adoption of virtual classrooms: An extension of UTAUT model. *J. Inf. Technol. Case Appl. Res.* **2021**, *23*, 213–239. [CrossRef]
62. Aburbeian, A.M.; Owda, A.Y.; Owda, M. A Technology Acceptance Model Survey of the Metaverse Prospects. *AI* **2022**, *3*, 285–302. [CrossRef]
63. Manis, K.T.; Choi, D. The virtual reality hardware acceptance model (VR-HAM): Extending and individuating the technology acceptance model (TAM) for virtual reality hardware. *J. Bus. Res.* **2019**, *100*, 503–513. [CrossRef]
64. Acikgoz, F.; Elwalda, A.; De Oliveira, M.J. Curiosity on Cutting-Edge Technology via Theory of Planned Behavior and Diffusion of Innovation Theory. *Int. J. Inf. Manag. Data Insights* **2023**, *3*, 100152. [CrossRef]
65. Kaya, F.; Aydin, F.; Schepman, A.; Rodway, P.; Yetişensoy, O.; Kaya, M.D. The Roles of Personality Traits, AI Anxiety, and Demographic Factors in Attitudes toward Artificial Intelligence. *Int. J. Hum. Comput. Interact.* **2022**, *40*, 497–514. [CrossRef]
66. Nguyen, V.T. The perceptions of social media users of digital detox apps considering personality traits. *Education and Information Technologies* **2022**, *27*, 9293–9316. [CrossRef]
67. Krey, N.; Chuah, S.H.W.; Ramayah, T. How functional and emotional ads drive smartwatch adoption: The moderating role of consumer innovativeness and extraversion. *Internet Res.* **2019**, *29*, 578–602. [CrossRef]
68. Wang, Y.M.; Chiu, W.C.; Lin, H.H.; Wang, Y.S.; Wang, Y.Y.; Chen, I.F. Determinants of students' adoption of virtual reality-based learning systems: An individual difference perspective. *Innov. Educ. Teach. Int.* **2022**, *61*, 143–153. [CrossRef]
69. Wang, Y.S.; Lin, H.H.; Liao, Y.W. Investigating the individual difference antecedents of perceived enjoyment in students' use of blogging. *Br. J. Educ. Technol.* **2012**, *43*, 139–152. [CrossRef]
70. Alkhwaldi, A.F.; Alobidyeen, B.; Abdulmuhsin, A.A.; Al-Okaily, M. Investigating the antecedents of HRIS adoption in public sector organizations: Integration of UTAUT and TTF. *Int. J. Organ. Anal.* **2022**, *31*, 3251–3274. [CrossRef]
71. Alkhwaldi, A.F.; Al-Ajaleen, R.T. Toward a Conceptual Model for Citizens' Adoption of Smart Mobile Government Services during the COVID-19 Pandemic in Jordan. *Inf. Sci. Lett.* **2022**, *11*, 573–579.
72. Alkhwaldi, A.F.; Al Eshoush, A.S. Towards A model for Citizens' Acceptance of E-Payment Systems for Public Sector Services in Jordan: Evidence from Crisis Era. *Inf. Sci. Lett.* **2022**, *11*, 657–663.
73. Alkhwaldi, A.F. Understanding the Patients' Usage of Contactless Healthcare Services: Evidence from the Post-COVID-19 Era. In *The Role of Digital Technologies in Shaping the Post-Pandemic World, Proceedings of the 21st IFIP WG 6.11 Conference on e-Business, e-Services and e-Society, I3E 2022, Newcastle upon Tyne, UK, 13–14 September 2022*; Lecture Notes in Computer Science; Papagiannidis, S., Alamanos, E., Gupta, S., Dwivedi, Y.K., Mäntymäki, M., Pappas, I.O., Eds.; Springer: Cham, Switzerland, 2022; Volume 13454, pp. 356–373.
74. Alkhwaldi, A.F.; Al-Qudah, A.A.; Al-Hattami, H.M.; Al-Okaily, M.; Al-Adwan, A.S.; Abu-Salih, B. Uncertainty avoidance and acceptance of the digital payment systems: A partial least squares-structural equation modeling (PLS-SEM) approach. *Glob. Knowl. Mem. Commun.* **2023**. *ahead-of-print*. [CrossRef]
75. Al-Okaily, M.; Alkhwaldi, A.F.; Abdulmuhsin, A.A.; Alqudah, H.; Al-Okaily, A. Cloud-based accounting information systems usage and its impact on Jordanian SMEs' performance: The post-COVID-19 perspective. *J. Financ. Report. Account.* **2023**, *21*, 126–155. [CrossRef]

76. Alkhwaldi, A.F. Understanding the acceptance of business intelligence from healthcare professionals' perspective: An empirical study of healthcare organizations. *Int. J. Organ. Anal.* **2024**. *ahead-of-print*. [CrossRef]
77. Dbesan, A.H.; Abdulmuhsin, A.A.; Alkhwaldi, A.F. Adopting knowledge-sharing-driven blockchain technology in healthcare: A developing country's perspective. *VINE J. Inf. Knowl. Manag. Syst.* **2023**. *ahead-of-print*. [CrossRef]
78. Litman, J.A. Relationships between measures of I-and D-type curiosity, ambiguity tolerance, and need for closure: An initial test of the wanting-liking model of information-seeking. *Personal. Individ. Differ.* **2010**, *48*, 397–402. [CrossRef]
79. Litman, J.A. Interest and deprivation factors of epistemic curiosity. *Personal. Individ. Differ.* **2008**, *44*, 1585–1595. [CrossRef]
80. Halder, S.; Roy, A.; Chakraborty, P.K. The influence of personality traits on information seeking behaviour of students. *Malays. J. Libr. Inf. Sci.* **2010**, *15*, 41–53.
81. Irfan, M.; Ahmad, M. Relating consumers' information and willingness to buy electric vehicles: Does personality matter? *Transp. Res. Part D Transp. Environ.* **2021**, *100*, 103049. [CrossRef]
82. Moon, Y. Personalization and personality: Some effects of customizing message style based on consumer personality. *J. Consum. Psychol.* **2002**, *12*, 313–325. [CrossRef]
83. Shumanov, M.; Cooper, H.; Ewing, M. Using AI predicted personality to enhance advertising effectiveness. *Eur. J. Mark.* **2022**, *56*, 1590–1609. [CrossRef]
84. Camadan, F.; Reisoglu, I.; Ursavas, F.; Mcilroy, D. How teachers' personality affect on their behavioral intention to use tablet PC. *Int. J. Inf. Learn. Technol.* **2018**, *35*, 12–28. [CrossRef]
85. Terzis, V.; Moridis, C.N.; Economides, A.A. How student's personality traits affect Computer Based Assessment Acceptance: Integrating BFI with CBAAM. *Comput. Hum. Behav.* **2012**, *28*, 1985–1996. [CrossRef]
86. Costa, P.T., Jr.; McCrae, R.R. The five-factor model, five-factor theory, and interpersonal psychology. In *Handbook of Interpersonal Psychology: Theory, Research, Assessment, and Therapeutic Interventions*; Wiley: New York, NY, USA, 2010; pp. 91–104.
87. McCrae, R.R.; Costa, P.T., Jr. Understanding persons: From stern's personalistics to Five-factor theory. *Personal. Individ. Differ.* **2021**, *169*, 109816. [CrossRef]
88. Costa, P.T.; McCrae, R.R. Normal personality assessment in clinical practice: The NEO Personality Inventory. *Psychol. Assess.* **1992**, *4*, 5–13. [CrossRef]
89. McCrae, R.R.; Costa, P.T. Validation of the five-factor model of personality across instruments and observers. *J. Personal. Soc. Psychol.* **1987**, *52*, 81–90. [CrossRef]
90. Matz, S.C.; Kosinski, M.; Nave, G.; Stillwell, D.J. Psychological targeting as an effective approach to digital mass persuasion. *Proc. Natl. Acad. Sci. USA* **2017**, *114*, 12714–12719. [CrossRef]
91. Shumanov, M.L.; Johnson, L. Making conversations with chatbots more personalized. *Comput. Hum. Behav.* **2021**, *117*, 106627. [CrossRef]
92. Khan, A.N.; Cao, X.; Pitafi, A.H. Personality traits as predictor of M-payment systems: A SEM-neural networks approach. *J. Organ. End User Comput. JOEUC* **2019**, *31*, 89–110. [CrossRef]
93. Nikbin, D.; Iranmanesh, M.; Foroughi, B. Personality traits, psychological well-being, Facebook addiction, health and performance: Testing their relationships. *Behav. Inf. Technol.* **2021**, *40*, 706–722. [CrossRef]
94. Malik, G.; Singh, D. Personality matters: Does an individual's personality affect adoption and continued use of green banking channels? *Int. J. Bank Mark.* **2022**, *40*, 746–772. [CrossRef]
95. Barnett, T.; Pearson, A.W.; Pearson, R.; Kellermanns, F.W. Five-factor model personality traits as predictors of perceived and actual usage of technology. *Eur. J. Inf. Syst.* **2015**, *24*, 374–390. [CrossRef]
96. Pelletier, L.G.; Legault, L.R.; Tuson, K.M. The environmental satisfaction scale: A measure of satisfaction with local environmental conditions and government environmental policies. *Environ. Behav.* **1996**, *28*, 5–26. [CrossRef]
97. Staniškienė, E.; Stankevičiūtė, Ž. Social sustainability measurement framework: The case of employee perspective in a CSR-committed organisation. *J. Clean. Prod.* **2018**, *188*, 708–719. [CrossRef]
98. Zhou, T.; Lu, Y. The effects of personality traits on user acceptance of mobile commerce. *Intl. J. Hum.–Comput. Interact.* **2011**, *27*, 545–561. [CrossRef]
99. In, J. Introduction of a pilot study. *Korean J. Anesthesiol.* **2017**, *70*, 601–605. [CrossRef]
100. Nick, T.G. Descriptive statistics. In *Topics Biostatistics*; Springer: Berlin/Heidelberg, Germany, 2007; pp. 33–52.
101. Byrne, B.M. *Structural Equation Modeling with AMOS: Basic Concepts, Applications, and Programming*; Routledge: London, UK, 2016.
102. Hair, J.F.; Black, W.C.; Babin, B.J.; Anderson, R.E. *Multivariate Data Analysis: Pearson New International Edition*; Always Learning; Pearson Harlow: Essex, UK, 2014.
103. Kline, R.B. *Principles and Practice of Structural Equation Modeling*; Guilford Publications: New York, NY, USA, 2015.
104. Hair, J.F., Jr.; Lomax, R.G. An introduction to structural equation modeling. In *Partial Least Squares Structural Equation Modeling (PLS-SEM) Using R: A Workbook*; Springer: Cham, Switzerland, 2021; pp. 1–29.
105. Faqih, K.M.; Jaradat, M.-I.R.M. Integrating TTF and UTAUT2 theories to investigate the adoption of augmented reality technology in education: Perspective from a developing country. *Technol. Soc.* **2021**, *67*, 101787. [CrossRef]
106. Alkhwaldi, A.F. Understanding learners' intention toward Metaverse in higher education institutions from a developing country perspective: UTAUT and ISS integrated model. *Kybernetes* **2023**. *ahead-of-print*. [CrossRef]
107. Molla, A.; Licker, P.S. An analysis of the factors affecting mobile commerce adoption in developing countries: Towards an integrated model. *Rev. Int. Bus. Strategy* **2019**, *10*, 83–110.

108. Tarhini, A.; El-Masri, M.; Ali, M.; Serrano, A. Extending the UTAUT model to understand the customers' acceptance and use of internet banking in Lebanon: A structural equation modeling approach. *Inf. Technol. People* **2016**, *29*, 830–849. [CrossRef]
109. Alkhwaldi, A.F.; Abdulmuhsin, A.A. Understanding User Acceptance of IoT Based Healthcare in Jordan: Integration of the TTF and TAM. In *Digital Economy, Business Analytics, and Big Data Analytics Applications*; Springer: Cham, Switzerland, 2022; pp. 191–213.
110. Venkatesh, V.; Zhang, X. Unified theory of acceptance and use of technology: US vs. *China. J. Glob. Inf. Technol. Manag.* **2010**, *13*, 5–27.
111. Cech, E.A. Culture of disengagement in engineering education? *Sci. Technol. Hum. Values* **2014**, *39*, 42–72. [CrossRef]
112. Hossain, M.A.; Rahman, S. Investigating the success of OGB in China: The influence of personality traits. *Inf. Syst. Front.* **2021**, *23*, 543–559. [CrossRef]
113. Venkatesh, V.; Sykes, T.A.; Venkatraman, S. Understanding egovernment portal use in rural India: Role of demographic and personality characteristics. *Inf. Syst. J.* **2014**, *24*, 249–269. [CrossRef]
114. Schepman, A.; Rodway, P. The General Attitudes towards Artificial Intelligence Scale (GAAIS): Confirmatory validation and associations with personality, corporate distrust, and general trust. *Int. J. Hum. Comput. Interact.* **2023**, *39*, 2724–2741. [CrossRef]
115. Yuan, C.; Zhang, C.; Wang, S. Social anxiety as a moderator in consumer willingness to accept AI assistants based on utilitarian and hedonic values. *J. Retail. Consum. Serv.* **2022**, *65*, 102878. [CrossRef]
116. Dwivedi, Y.K.; Hughes, L.; Baabdullah, A.M.; Ribeiro-Navarrete, S.; Giannakis, M.; Al-Debei, M.M.; Dennehy, D.; Metri, B.; Buhalis, D.; Cheung, C.M.; et al. Metaverse beyond the hype: Multidisciplinary perspectives on emerging challenges, opportunities, and agenda for research, practice and policy. *Int. J. Inf. Manag.* **2022**, *66*, 102542. [CrossRef]
117. Perez-Ramirez, M.; Arroyo-Figueroa, G.; Ayala, A. The use of a virtual reality training system to improve technical skill in the maintenance of live-line power distribution networks. *Interact. Learn. Environ.* **2021**, *29*, 527–544. [CrossRef]