The adoption of the metaverse concepts in Romania

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Abstract. *The metaverse is a controversial concept, hyped by some but viewed as a marketing strategy by others. Although the first mentioning of the metaverse dates back to 1992, it has gained attention in the last years, especially after Facebook changed its name to "Meta" in 2021. Based on immersive technologies such as AR and VR, digital interactions and commerce within the virtual world, the metaverse is expected to grow along with its enabling technologies. This article aims to discover the status of the adoption of the metaverse concepts in Romania, among people with digital skills. The analysis was performed based on an online questionnaire, posted on public social media accounts. The results of the study have shown that few people have tried applications within the metaverse, and even fewer have invested in metaverse tokens. People who played RPG or virtual world games seem to have used metaverse applications more than those who have not, thus, this could be a good driver for metaverse adoption. Awareness of the metaverse concept was not a driver of metaverse adoption. However, results show that people who purchase cryptocurrencies and NFTs would also be interested in the metaverse, more than people who have not transacted these digital assets.*

Introduction

Although not a new concept, the metaverse has gained attention in the last years, especially after Facebook changed its name to "Meta" in October 2021. A simple definition of the metaverse would be a system which blends the real, physical world with the digital world. While Artificial Intelligence (AI) and Virtual Reality (VR) technologies also allow people to interact with the digital world in an immersive way, the metaverse is viewed as more, leading to a social construct where commerce within the virtual world takes place (Lee et al., 2011).

Enablers of the metaverse technologies are networks, cloud computing, AI, computer vision, blockchain, non-fungible tokens (NFTs), robotics, the Internet of Things (IoT), user interactivity, and extended reality (Lee *et al.*, 2011). Digital social networks and communications channels, media platforms, role-playing games (RPG), and virtual world games are considered part of the metaverse (Stankovic et al., 2022; Lee *et al.*, 2021; Civelek, et al., 2020), albeit on an incipient level. More developed applications in the sense of immersion and engagement within the cyberspace are platforms such as SecondLife, Roblox, or Pokemon Go. However, when making a projection of the future of the metaverse, these can be considered proto-metaverse applications, which present high potential opportunities. We will call these applications as proto-metaverse applications within our study.

This article focuses on evaluating the current awareness regarding the Metaverse among Romanian people who are familiar with digital technologies, further developing current literature on the topic by answering the following research questions:

RQ1: Did the increased engagement with virtual applications during the pandemic generate an after-pandemic drop in the use of digital technologies?

During the pandemic lockdowns, many people reported spending more time watching television (or streaming movies) and spending time on the Internet or playing games. We wanted to find out if after the pandemic, people became less interested in using digital applications and more in interacting with people offline. This would be an indicator for the desire to spend more time in the virtual world, as opposed to the physical world.

RQ2: "To which degree did people already have contact with proto-metaverse applications?"

RQ3: Have people who engaged in RPG and virtual games tried metaverse applications more than those who were not?

RQ4: Have people who were aware of the metaverse used proto-metaverse applications more than those who were not?

RQ5: Have people who were aware of the metaverse invested in metaverse tokens more than those who were not?

RQ6: Have people who invested in cryptocurrencies or NFTs used proto-metaverse applications more than those who were not?

RQ7: Have people who have invested in NFTs and cryptocurrencies also invested in metaverse tokens more than those who have not?

The novelty of the concepts and the fact that until now there is no research on this subject make this article a unique starting point in finding out what are the main factors that will determine people around the world to adopt the metaverse in the future. For a comprehensive understanding, first, the metaverse concept and the technologies leading to this new concept were defined. Afterward, the article comprises a short analysis of the evolution of the products leading to the metaverse. Finally, the methodology and the results of the study are described in the fourth and fifth section of the article.

The emergence of the metaverse concept

Metaverse is a three-dimensional virtual world where avatars engage in political, economic, social, and cultural activities (Park & Kim, 2022). It is commonly used to refer to a virtual environment based on everyday life in which the real and the unreal interact. The term "metaverse" was used in 1992 by Neil Stevenson in his science fiction novel "Snow Crash" to describe a world where virtual and real worlds collide and generate value through diverse social activities (Stephenson, 1992). Because the Metaverse's range is so vast and expanding, there are numerous definitions and related concepts.

Lee et al. (Lee *et. al,* 2011) divided life-logging, mirror world, augmented reality, and the virtual world depending on whether the implemented area is reality-oriented or virtual-centered, and if the implemented information is external environment-centered or individual-centered. In the beginning, the research on Metaverse focused on the virtual world's composition (e.g., game), but it is now commonly utilized as a medium for exchanging interests and social interaction focusing on content.

The Metaverse is increasing fast, as seen by Zepeto's 200 million subscribers and Animal Crossing's virtual election campaign. Roblox, in particular, has 150 million monthly active users (MAU), which is utilized by 2/3 of children aged 9 to 12 in the United States, and 1/3 of them are under the age of 16. (Meier *et. al*, 2020) In 2006, the first metaverse investigations focused on Second Life (Kaplan & Haenlein, 2009). The present Metaverse, on the other hand, is built on the social principles of Generation Z, who hold that online egos are no different from offline egos (Duan H. *et. al*, 2021). As a result, it differs from the preceding Metaverse in terms of the proportion of social activities and contents, necessitating a new definition for the present.

The experts today classify the metaverse into 4 types, based mostly on the technologies used: Augmented Reality, Lifelogging, Mirror World, Virtual Reality (Kye *et. al*, 2021).

A sort of enhancement of the inner world is **lifelogging**. People utilize smart devices to record their daily lives on the Internet or on their smartphones in the world of lifelogging (Mihalca et al., 2021). Twitter, Facebook, and Instagram are common examples. In the medical field, services that use biometric information saved through wearable devices have just become available. Some apps, such as Nike Plus, connect sensors to track the amount of exercise or location (Ksibi *et. al*, 2021).

Mirror world (e.g., Google Earth, Microsoft Virtual Earth) refers to extending information into the virtual world by reflecting the real environment realistically. Mirror World was inspired by David Gelernter's book "Mirror Worlds", published in 1992 (Grimshaw, 2014). The real-world environment is replicated in digital form, with additional simulation data added. In other words, the mirror world has its own qualities and functions while replicating the appearance of real-world structures or things. Metaverse, multiverse, digital terraforming, and mirror world are all notions that are conceptually identical but have slightly varied meanings depending on where they are employed.

Virtual Reality (VR) (e.g., Second Life, Minecraft, Roblox, Zepeto) is an alternate, fully artificial environment created digitally. Users in virtual reality feel immersed, as if they are in another universe, and act in similar ways to how they do in real life (Slater, M *et al.*, 2016). This experience is intensified through the modalities of vision, sound, touch, movement, and natural contact with virtual things with the use of specialist multimodal equipment such as immersion helmets, VR headsets, and omnidirectional treadmills (Pellas *et al.*, 2021).

Augmented Reality (AR) (e.g., Pokemon Go, Digital Textbook) shifts its focus to actual spaces, incorporating digital inputs and virtual features to enrich the physical experience. It combines the physical and virtual worlds geographically (Klopfer, E., 2008). The final result is a spatially projected layer of digital artifacts mediated by devices such as smartphones, tablets, glasses, contact lenses, or other transparent surfaces (Mystakidis, 2021). Furthermore, by presenting input from integrated camera sensors, AR can be incorporated in VR headsets with pass-through mode capability.

According to Speicher et. al., **Mixed Reality (MR)** is a more complicated notion, and its definition has evolved over time to reflect the current technical advancements and

the prevalent linguistic meanings and narratives. In the sense that the physical environment interacts in real time with the projected digital data, MR is frequently referred to as an advanced AR iteration. For example, in an MR game, a scripted non-player character would recognize the actual surroundings and hide behind a desk or a couch. MR, like VR, necessitates the use of special eyewear. However, for the purpose of this article, we accept the conception of MR as any combination of AR and VR as well as intermediate variations such as augmented virtuality. The rationale behind this decision is the long-term technological evolution and maturation of AR to include interactive affordances. Therefore, AR and VR remain the two fundamental technologies, with MR as their combination.

Extended Reality (XR) or Cross Reality (XR) refers to a group of immersive technologies that encompass electronic, digital environments in which data is represented and projected. Virtual Reality (VR), Augmented Reality (AR), and Mixed Reality (MR) are all part of XR (Milgram *et al.*, 1995). Humans watch and engage in a totally or partially synthetic digital environment created by technology in all of the XR facets outlined above.

Evolving technologies and products leading to the metaverse

According to Sang-Min Park and Young-Gab Kim, the new Metaverse distinguishes from the previous Metaverse (Park & Kim, 2022). First of all, the rapid advancement of deep learning improves the accuracy of visual and language recognition, while the advancement of generative models allows for a more immersive environment and natural movement (Maeng *et. al.*, 2021). Multimodal models called E2E (end-to-end) solutions with a multimodal pre-trained model were used to reduce processing time and complexity (Acun *et. al,* 2021).

Second, the Metaverse was formerly based on PC access and had low consistency due to time and space limits, but thanks to mobile devices that can connect to the Internet at any time, it is now feasible to access the Metaverse anytime, anywhere. People spend more time just on social networking sites (Dima and Vasilache, 2015) like TikTok or YouTube. For example, Roblox registered in April 2021 a total of 202 million active users according to estimates from RTrack (Dean, 2022). It has a virtuous cycle environment, in which producers' intake and income improve as consumers and usage time increase while supplying varied contents, resulting in increased sales of digital advertisements (Han *et. al*, 2022; Hernández-Garrido et al., 2022).

Finally, the present Metaverse varies from the previous one in that program writing may be done there and it is more tied to real life with virtual cash. Based on immersive engagement, the Metaverse expands with many social meanings like fashion, events, games, education, or office (Dahan *et. al.*, 2022; Miron et al., 2009). Cryptocurrencies (such as Dime or Decentraland) act as a link between the Metaverse and the actual world, providing people with a richer sense of social meaning (Liu *et. al.*, 2022). The steep development of e-commerce tools ensures managing these processes successfully (Chornous et al., 2021; Roshchyk et al., 2022).

Also, three factors distinguish today the Metaverse from augmented reality (AR), and virtual reality (VR). For starters, whereas most VR-related research focuses on the physical approach and rendering, Metaverse stands out as a service with more long-term content and social significance. Secondly, AR and VR technologies are not always used in the Metaverse. It can be a Metaverse application even if the platform does not support VR or AR. Finally, to reinforce social meaning, the Metaverse requires a scalable setting that can support a large number of people (Park & Kim, 2022).

The large-scale Metaverse implementation involves a set of factors such as: hardware improvements (e.g., GPU memory, 5G); the development of a recognition and expression model that takes advantage of the hardware's parallelism; and the availability of content that people can immerse themselves in and participate in (Park & Kim, 2022).

Methodology

The study is based on a self-administered online survey conducted in May 2022, comprising of 7 items regarding activities and concepts related to the metaverse. We used a purposive sampling technique, relying on the authors' own networks, which comprise of digitally skilled people, mostly millennials and generation Z members. This category of people has been perceived as a tech-savvy generation, which would be representative for our metaverse research (Buhalis and Karatay, 2022). A total of 190 people answered the survey, however, one of the responses was excluded because it was an extreme outlier. A percentage of 32,3% of the respondents were female, while 67,7% were male. Most of the participants to the study were between 18-24 years old (35,4%), 25,9% were between 25-30, 19% were between 31-36, 10,6% were between 37-42, 5,3% were between 43-50 and 3,7% were older than 50. The majority of the respondents was familiar with the metaverse concept (89,95%).

The Kolmogorov-Smirnoff test was used to test the distribution of the data (Chakravarti, Laha, and Roy, 1967). Nonparametric tests Mann-Whitney and Kruskal-Wallis were used (see Waliszewski & Warchlewska, 2021). The Mann-Whitney test was used when testing with two independent groups, while Kruskal-Wallis was used for more than two independent groups. The null hypotheses of the Mann-Whitney and Kruskal-Wallis tests state that the analyzed populations are equal (there is no statistically significant difference between the two groups, in the case of the Mann-Whitney test, or between several groups, in the case of the Kruskal-Wallis test). By rejecting the null hypothesis (with a p value <0.05), we can state that there is a statistically significant difference between the analyzed groups.

Research results

Answering RQ1 – "Did the increased engagement with virtual applications during the pandemic generate an after-pandemic drop in the use of digital technologies?"

In order to answer *RQ1,* we assessed the time and money spent playing games which are considered forerunners for the metaverse. Two items were used:

Q1: "*On average, how much time did you use to spend playing RPG, within virtual worlds, VR or AR games (e.g., Fortnite, Roblox, Minecraft, Pokemon Go) per week, and how much do you spend now?*"

Q2: "*On average, how much money did you use to spend playing RPG, within virtual worlds, VR or AR games (e.g., Fortnite, Roblox, Minecraft, Pokemon Go) per week, and how much do you spend now?*"

Time and spending were used as proxies for the respondent's engagement with this type of games. While it was obvious that people spent more time with these applications during the pandemic, due to the fact that they had more free hours and had to stay at home, we wanted to see if the engagement after the pandemic remained higher than before the pandemic.
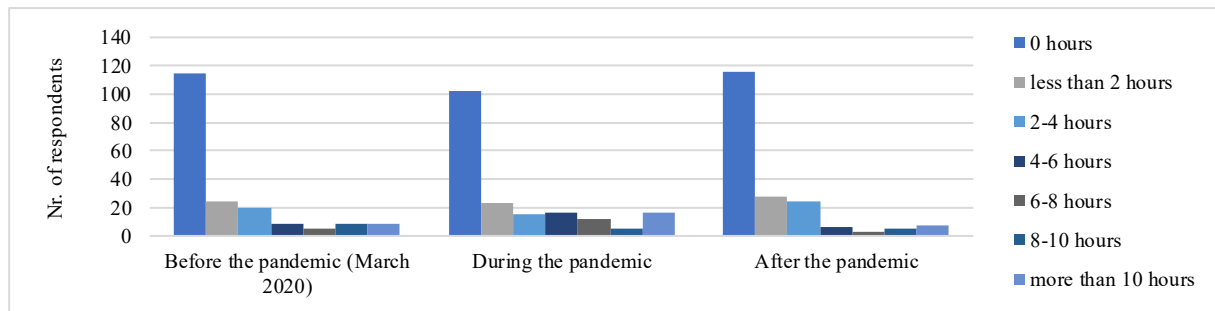
Figure 1. Average time spent playing RPG, within virtual worlds, VR or AR games

Source: Authors' own research results.

Most of the respondents did not play RPG or virtual games. This behavior can be recognized in all analyzed time frames – before the pandemic, during the pandemic, and after the pandemic. During the pandemic, people have spent more time playing such games than before the pandemic.

Table 1. Descriptive statistics of responses for time spent playing RPG, within virtual worlds, VR or AR games

	N	Minimum	Maximum	Mean	Std. Deviation
Play_game_before	189	0	6	1.05	1.700
Play_game_during	189	0	6	1.43	1.976
Play_game_now	189	0	6	.92	1.538

Source: Authors' own research results.

An interesting outcome of the questionnaire is that the self-assessed time spent playing such games decreased after the pandemic, in comparison with the period before the pandemic. The averages are based on a 7 points scale, as seen in Figure 1 (where 1 is "0 hours" and 7 is "more than 10 hours").

Regarding the in-game spending, the behavior is similar – most of the respondents did not spend money for in game perks. During the pandemic, the number of people who did not spend money in games decreased – according to the results of the study, most spending was registered in this period.
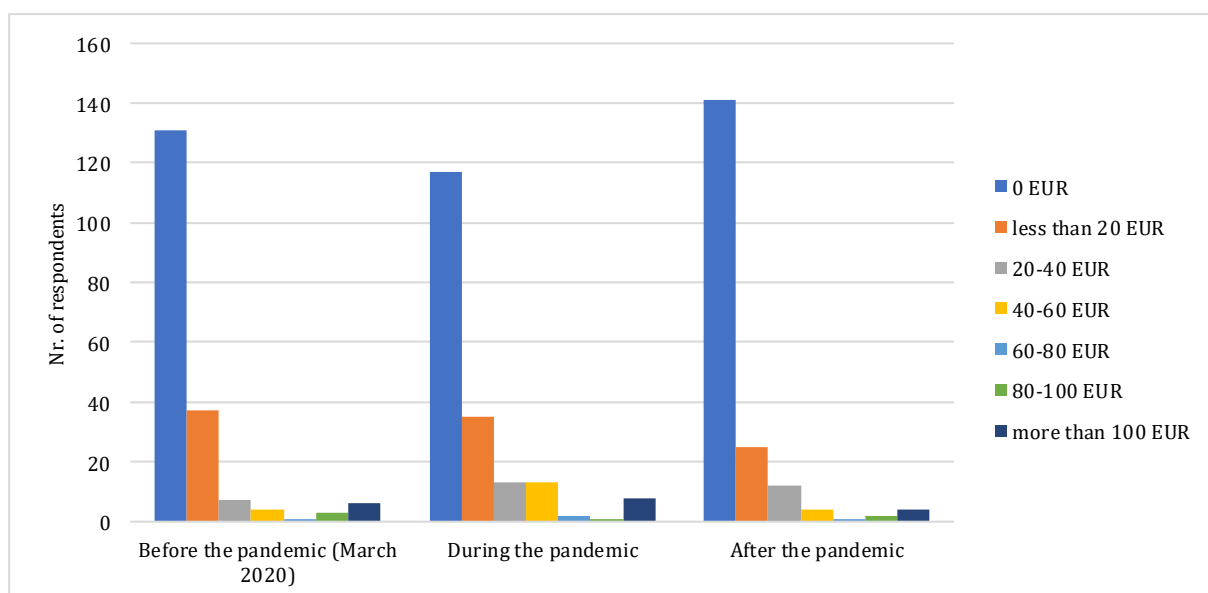
Figure 2. Average amount spent playing RPG, within virtual worlds, VR or AR games

Source: Authors' own research results.

Like the time spent engaging with these applications after the pandemic, the amount of money spent within games decreased after the pandemic, in comparison with the period before the pandemic (Table 2). The results are based on a 7 points scale, where 1 is "0 EUR" and 7 is "more than 100 EUR".

Table 2. Descriptive statistics of responses for money spent playing RPG, within virtual worlds, VR or AR games

	N	Minimum	Maximum	Mean	Std. Deviation
Game_spending_before	189	0	6	.62	1.334
Game_spending_during	189	0	6	.85	1.480
Game_spending_now	189	0	6	.52	1.192

Source: Authors' own research results.

The reason for this behavior might be the increased interest for social activities after the pandemic, and a decrease in interest in virtual applications. This could mean that people still prefer face-to-face interactions than virtual interactions.

To analyze what drives additional engagement in games, explained by spending in games, we asked people what makes them spend money within games (Q3 – "What determines you to spend in-game money?"). Most of the respondents were interested in personalizing the game (36%), or made additional spending for fun (32%).
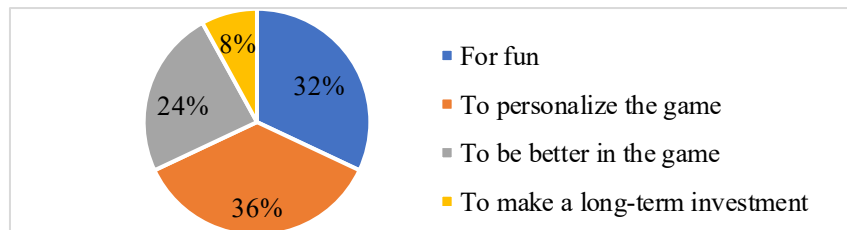

Figure 3. Determinants for in game spending

Source: Authors' own research results.

Answering RQ2 – "To which degree did people already have contact with proto-metaverse applications?"

Further engagement with applications which are currently considered part of the metaverse was analyzed through Q4 – "Have you tried any of the platforms below?". A small percentage has tried any of the listed platforms (22,8%). The most popular platforms were Sandbox and Second Life.
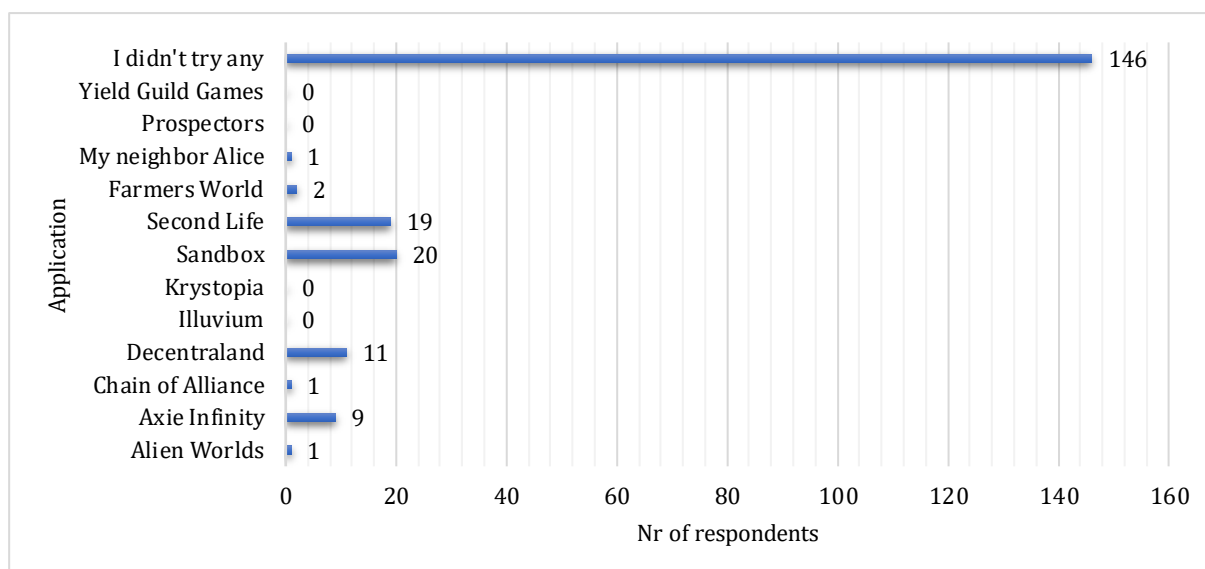
Figure 4. Proto-metaverse applications usage

Source: Authors' own research results.

The next questionnaire item related to Metaverse adoption was Q5 – "Have you invested in any of the tokens below? If yes, how much?". The tokens listed are used in the metaverse universe.
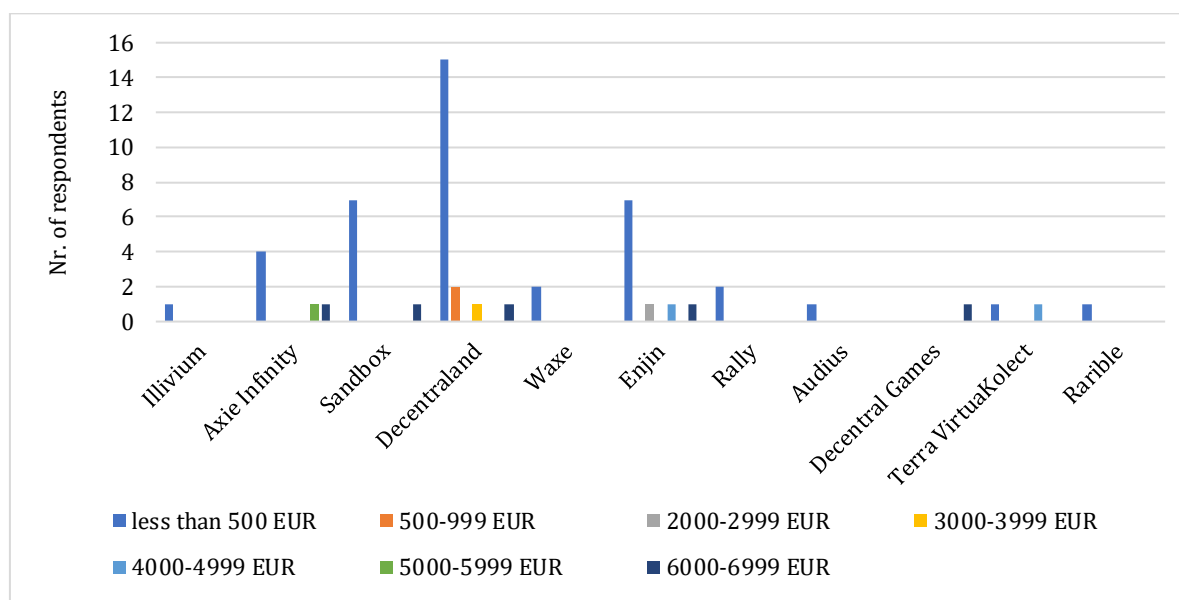

Figure 5. Amounts spent on metaverse tokens

Source: Authors' own research results.

Most investments were made into the Decentraland token, followed by Enjin, and Sandbox. Most investors did not invest amounts higher than 500 EUR per game (78,26% of token investors). 34,78% of metaverse token investors spent maximum 500 EUR in total, 43,47% spent amounts up to 1500 EUR in total and 21,74% spent a total amount of more than 1500 EUR on different tokens.

Answering RQ3: Have people who engaged in RPG, virtual worlds, VR or AR games tried metaverse applications more than those who have not?

In order to assess if engaging with RPG, virtual worlds, VR or AR games has influenced people into engaging with platforms which are considered metaverse applications, or at least proto-metaverse applications, we analyzed if there is any

difference in terms of contact with the metaverse applications between the two groups consisting of respondents who have played these types of games and those who have not.

Results of the Kolmogorov-Smirnov test have shown that the data of the two variables is not normally distributed (play_game_now K-S = 0.303, p<0.000; game_spending_now K-S=0.371, p<0.000). The non-parametric Kruskal-Wallis test was further used and revealed that there is no difference between those who spend money within RPG, virtual worlds, VR or AR games and those who have not. However, there is a difference between those who spend more time with such games, and those who don't, with a K-W result of H=13.128, p=0.041.

Table 3. Kruskal-Wallis test results for the usage of Meta prototypes depending on game spending and time spent playing RPG and virtual games

Grouping variable	Time spent playing	Grouping variable	Game spending now
Kruskal-Wallis H	13.128	Kruskal-Wallis H	7.474
df	6	Df	5
Asymp. Sig.	.041	Asymp. Sig.	.279

Source: Authors' own research results.

Answering RQ4: Have people who were aware of the metaverse used proto-metaverse applications more than those who were not?

Results of the Kolmogorov-Smirnov test have shown that the data for metaverse awareness (K-S=0.538, p<0.000) and proto-metaverse applications usage (K-S=0.434, p<0.000) was not normally distributed. Since there were two independent groups tested, we used the non-parametric Mann-Whitney test. There was no difference between people who were aware of this concept and those who were not, in terms of using Metaverse applications (Mann-Whitney U=1551.00; p=0.697) which shows that people who were aware of the metaverse did not use Metaverse applications more than those who were not.
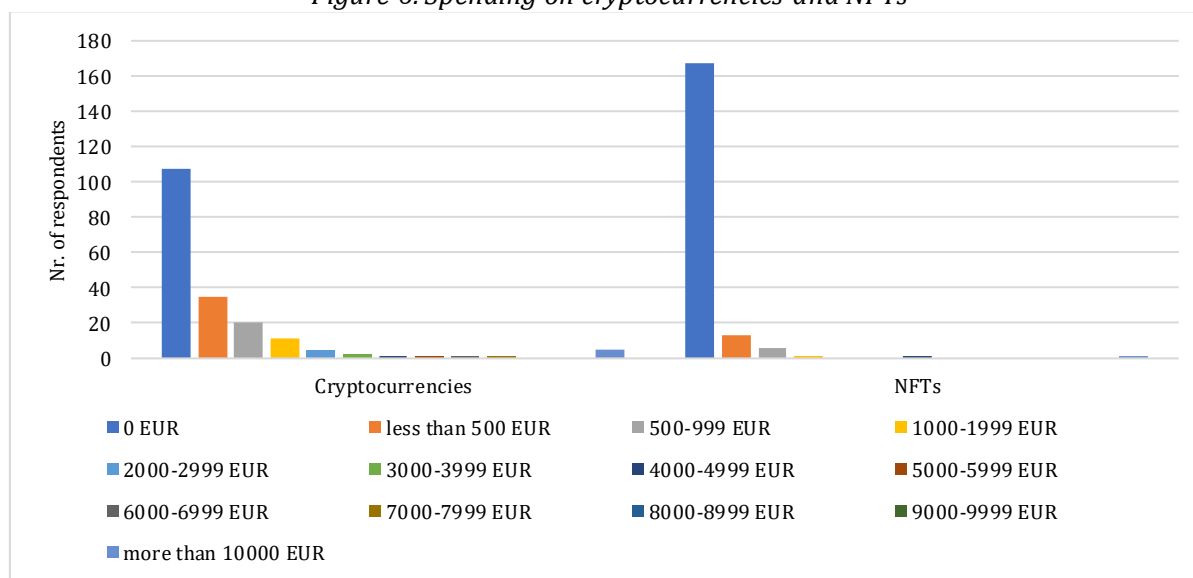
Answering RQ5: Have people who were aware of the metaverse invested in metaverse tokens more than those who were not?

Results of the Kolmogorov-Smirnov test have shown that the data for metaverse awareness (K-S = 0.538, p<0.000) and metaverse tokens (K-S=0.509, p<0.000) was not normally distributed. Since there were two independent groups tested, we used the non-parametric Mann-Whitney test. There was no difference between people who were aware of this concept and those who were not, in terms of investing in Metaverse tokens (Mann-Whitney U=1500.5; p=0.362) which shows that people who were aware of the metaverse did not invest in Metaverse tokens more than those who were not.

Answering RQ6: Have people who invested in cryptocurrencies or NFTs used proto-metaverse applications more than those who were not?

Most of the respondents did not invest in cryptocurrencies or NFTs. The majority of those who invested in cryptocurrencies or NFTs did not spend more than 500 EUR.

Figure 6. Spending on cryptocurrencies and NFTs

The Kruskal-Wallis test was used to assess if prior investments in the crypto and NFT market have any influence on the adoption of proto-metaverse applications. For this analysis, we recomputed the data for variables Cryptocurrency_spending and NFT_spending in order to have a better distribution of the answers across groups (0 was recomputed into 0, range 1-3 into 1, range 4-6 into 2, 7-9 into 3 and 10-12 into 4). The Kolmogorov-Smirnov test showed that the data for crypto (K-S=0.471, p<0.000) and token investments (K-S=0.509, p<0.000) was not normally distributed.

Results have shown that people who have invested in cryptocurrencies and NFTs have tried out proto-metaverse applications more than those who have not (Kruskal-Wallis H 11.802, 13.576; p values 0.019, 0.004;).

Tabel 4. Kruskal-Wallis test results for the usage of Meta prototypes depending on crypto and NFT investments

Meta prototypes	Grouping Variable: Crypto_recoded	Grouping Variable: NFT_recoded
Kruskal-Wallis H	11.802	13.576
Df	4	3
Asymp. Sig.	.019	.004

Answering RQ7: Have people who have invested in NFTs and cryptocurrencies also invested in metaverse tokens more than those who have not?

The Kolmogorov-Smirnoff test showed that the data was not normally distributed for NFT spending (K-S=0.371, p<0.000), cryptocurrency spending (K-S=0.278, p<0.000) and metaverse tokens investments (K-S=0.509, p<0.000). Results of the Kruskal-Wallis test have revealed no correlation between segments who have invested in NFTs and that of people who have purchased metaverse tokens. The Kruskal-Wallis test for the recoded NFT variable had a value of 6.901 at a p level of 0.075, while the Mann-Whitney test for the Boolean NFT variable had a value of 17950 at a p value of 0.726.

Results of the Kruskal-Wallis test have revealed no correlation between segments who have invested in in cryptocurrencies and those who have purchased metaverse

tokens. The Kruskal-Wallis test for the recoded cryptocurrency variable had a value of 5.365 at a p level of 0.252, while the Mann-Whitney test for the cryptocurrency boolean variable had a value of 810 at a p value of 0.837.

Conclusions

Nowadays, the Z generation in Romania spends a lot of time in the virtual world, interacting with metaverse applications more than their older friends, family, or teachers. Games and social media occupy most of their time at a young age, a reason why the adoption of upcoming digital innovations have more chances of a successful early adoption. There is a high probability that young people who are spend today time playing computer games will be transposed faster in the virtual space to make friends or buy goods because of the high daily use of the technology, assumption which was supported by the result of our study, which showed a connection between time spent playing RPG games, within virtual worlds, VR or AR games, and usage of current applications considered part of the evolving metaverse.

The educational system, academic institutions, and businesses all need to evolve in preparation for the future and consider the fact that the next generation of adults has a much stronger connection to virtual reality and has the potential to immediately adapt to changes in the digital landscape. Additionally, we will be dealing with a generation that has distinct life perspectives; for this reason, all of the instructors and managers should get ready to implement new techniques of integrating the labor market.

Furthermore, the society as a whole will face new challenges. Metaverse is growing and is involving more and more activities similar to those people do in real life on a daily basis. Investing and spending money in general need to be done in a safe manner, a reason why the metaverse could face some legal regulations in the future and also, we have to be careful with the content created in the virtual space because on long term it could affect the users in the real life.

The metaverse concept has become familiar to the majority of people who use technology, however, very few have engaged with applications which are now considered to be part of the metaverse field or have acquired metaverse tokens. Being aware of the metaverse concept did not mean that people were also more inclined into trying out applications or investing in metaverse tokens, however, people who have spent time playing immersive games with social interactions seem to have tried metaverse applications more than those who have not. Results of the study showed that people who have invested in cryptocurrencies and NFTs might be representative for the adopters of the metaverse.

The limitation of the research is caused by the limited sample, the distribution of the data and the self-reporting of information by the respondents, which might be inaccurate. Results give, however, a trajectory for further research. The metaverse adoption in Romania is in an incipient stage. Future research of the authors will focus on the main reasons for trying out metaverse applications.

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