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CLIMATE + WEB3

USING THE METAVERSE TO TEACH CLIMATE CHANGE

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Project Overview:
This paper explores the use of Web3 in climate education, utilizing metaverses for immersive learning experiences and communities through Decentralized Autonomous Organizations. While offering positive change opportunities, we argue the need for guidelines and safeguards for children and young adults on Web3 platforms.

Using the Metaverse to Teach Climate Change

Abstract

Web3 technology will have a large impact on the education sector. This paper will explore applications of Web3 in climate education. Specifically using interactive virtual worlds, known as metaverses, that will create an immersive learning experience and learning communities through Decentralized Autonomous Organizations. While this technology has the opportunity to create positive and meaningful change, there must also be guidelines and safeguards for children and young adults engaging with Web3 platforms.

Policy and Advocacy Recommendations

There are significant hurdles to the metaverse's uptake in education that need to be addressed. For example, parents may question the safety, security, and privacy of students while they use this technology. This comes at a time when many psychologists are pointing out the negative impacts of other technologies (such as social media) on childhood development. Still, there are questions from climate experts about the net impact of the metaverse. Do the benefits of greater virtual connectivity and remote experiences outweigh the emissions produced from developing and running the technology?

We acknowledge the importance of these questions around new technology and the need to research and regulate it. At the same time, we recognize the rapid development and uptake of the metaverse for educational purposes (the "eduverse"). We believe that, with proper oversight and development, this technology can play an important role in K-12 education, particularly in the teaching of concepts such as climate change.

How would we create an eduverse that is safe, secure, and truly informative in teaching about climate change? First, we need to identify various stakeholders and their respective roles in developing, implementing, and utilizing this technology. In addition to identifying individual stakeholders, we also urge cross-sectoral collaboration between stakeholders to encourage accountability.

First and foremost, we recognize the importance of eduverse developers in designing platforms that are safe and secure for students. This includes:

A. Developing structural features from the very beginning such as: closed or restricted worlds, moderation of chat functions, and limited visibility of minors to outside metaverse users.

B. Ensuring that the technology is accessible to students of various abilities and representative of various identities. This is where developers should collaborate and consult with DEI specialists and disability advocates.

Another stakeholder group that plays an important role in developing this technology are climate education experts. If the eduverse is going to deliver on robust and transformative climate education, then the curriculum is foundational to this mission. Climate experts should:

A. Identify key themes and benchmarks appropriate for various age groups and formulate educational activities based on these themes.

B. Collaborate with other climate scientists and educators to ensure internal messages and environments are in-line with desired education outcomes.

C. Facilitate the experience for teachers and students after development. This could look like leading virtual field trips through digital worlds, leading discussions, guiding students through activities, and answering questions about the curriculum.

Finally, we consider teachers, school boards, and parents to be a category of stakeholder that plays an important role as the "middle man" between the eduverse and the student. We advise that the school board:

A. Approve eduverse curriculums only after extensive review and testing of technology.

B. Consult experts familiar with technology in education for implementation and usage best-practices-

C. Equip teachers with proper training in delivering the technology to the student.

D. Inform parents with up-to-date and relevant information.

By identifying existing stakeholders, we hope to lay the groundwork for the development of emerging policies related to K-12 use of the metaverse. As a nascent technology with limited existing regulation surrounding it, there is a need for local, state, and federal policy to oversee and regulate outcomes. It is important that climate advocates understand various actors in order to leverage power and influence change in this sector. We encourage further discussion, debate, and advocacy of this topic among climate activists, educators, scientists, and parents.

Introduction

The "metaverse" is a word that has been buzzing around the world for years and a topic that has recently gained an increase in interest as the internet begins to shift from Web 2.0 to Web 3.0. Web 2.0 is the internet we know today and is characterized by its "interactivity, social

connectivity, and user-generated content", [1] whereas Web 3.0 is "built upon the core concepts of decentralization, openness, and greater utility".[1] Essentially, Web 3.0 is where users have ownership and control of their data in a place that can be accessed by anyone from anywhere.

The metaverse comes with many opportunities, however it also comes with concerns surrounding accessibility, inclusivity, and potential climate impacts – both positive and negative. Climate change has been a rising dilemma and is one of the top priorities of the current administration in the U.S. making it a main topic for policy formation today.

One of the many opportunities that the metaverse brings is the capability to teach people about climate change. Specifically, the metaverse can be used by educators to teach students how actions impact climate change and what the world will look like if enough is not done to reduce our impact. Different methods of delivery are evaluated in this literature review pointing to experiments conducted by researchers all over the world. Along with education methods, efficacy, sustainability of metaverses, Decentralized Autonomous Organizations, and scalability are considered. Ultimately, based on our findings, policy and advocacy recommendations are made.

Education Methods in the Metaverse

According to researchers Sungin Park and Sangkyun Kim, "The metaverse is expected to turn imagination into reality through the convergence of various technologies and should be considered as a medium for sustainable education, free from the constraints of time and space."[2] Because of its immersive abilities, the metaverse can serve as an effective tool to educate

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[1] The Investopedia Team. "Web 2.0 and Web 3.0 Definitions." Investopedia. Investopedia, July 8, 2022. https://www.investopedia.com/web-20-web-30-5208698#:~:text=Web%202.0%20is%20the%20current%20version%20of%20the%20web%20with,exponential%20growth%20of%20Web%202.0

[2] Park, Sungjin, and Sangkyun Kim. 2022. "Identifying World Types to Deliver Gameful Experiences for Sustainable Learning in the Metaverse." Sustainability 14 (3): 1361.

students about climate change issues in a way that allows them to see and feel the change. There are different methods of accessing and delivering education in the metaverse including virtual reality (VR), augmented reality (AR), computer and smartphone access. Researchers in Singapore conducted a study using a game called PEAR that utilized AR to increase awareness of climate change and determined natural tendencies towards developing sustainable behavior.[3] Other studies have been done that deliver educational content through immersive virtual "field trips" where students were taught about rising sea water acidity and climate change consequences in Greenland.[4] [5] Roblox, a popular gaming platform, has also started creating a space for students called "learn and explore" where they can build their own game and develop skills.[6] In addition to these efforts, Roblox has granted money to Project Lead the Way (PLTW) to develop educational experiences for students and teachers that will be used on the Roblox platform.[7] Metaverse worlds have been created on platforms that can be accessed via computer or phone, however there is limited research as to the efficacy of these methods compared to a VR or AR approach.

Efficacy of Education in the Metaverse

There have been numerous studies completed over the past few years that focus on the efficacy of delivering education via the metaverse. Efficacy here points to different aspects of the experience such as increasing awareness of topics, behavior change following the experience,

[3] Wang, Kyra, Zeynep Duygu Tekler, Lynette Cheah, Dorien Herremans, and Lucienne Blessing. 2021. "Evaluating the Effectiveness of an Augmented Reality Game Promoting Environmental Action." Sustainability 13 (24): 1.

[4] Markowitz, David M., Rob Laha, Brian P. Perone, Roy D. Pea, and Jeremy N. Bailenson. 2018. "Immersive Virtual Reality Field Trips Facilitate Learning about Climate Change." Frontiers in Psychology 9 (November)," 6.

[5] Makransky, Guido, and Richard E. Mayer. 2022. "Benefits of Taking a Virtual Field Trip in Immersive Virtual Reality: Evidence for the Immersion Principle in Multimedia Learning." Educational Psychology Review, April, 2.

[6] Learn and Explore." 2022. Developer.roblox.com. 2022. https://developer.roblox.com/en-us/resources/learn-and-explore#:~:text=Roblox%20wants%20to%20empower%20our.

[7] Lohia, Devina. 2021. "Roblox to Fund Development of PLTW Educational Experiences." Nasdaq. November 16, 2021. . https://www.nasdaq.com/articles/roblox-to-fund-development-of-pltw-educational-experiences.

and the motivation to learn more. In the study performed by researchers in Singapore, a mobile game, PEAR (Personalized Assistance Robot), was presented to 85 participants from a local university.[2] The game was created using geolocation and AR. In the study, the participants played the game by completing environmentally friendly tasks such as recycling, afforestation, energy conservation, and water contamination cleanup.[2] A similar strategy was implemented in studies conducted where 270 participants in total went on virtual field trips, using VR, to learn more about the effects of increased acidity in seawater.[8] In the first study, 19 high school students were tested on ocean acidification knowledge and then went on scuba diving trips in open water via VR headsets.[9] The students became a piece of coral and listened to a narrator speaking about ocean acidification while they collected calcium and bicarbonate ions to keep themselves (the coral) healthy. While under the water, students witnessed the water change gradually into what it is expected to look like by year 2100 as well as how their bodies as coral would decay. Following the study, the students were tested on their knowledge of ocean acidification again and researchers found that the knowledge of participants had significantly increased.[10] A similar increase in knowledge was experienced through the PEAR mobile game using AR as well as an increase in positive attitudes toward climate change issues.[11] In another study performed by researchers in Copenhagen, 102 middle school students went on a virtual field trip to Greenland.[12] Half of the students used VR headsets while the other half viewed the location via a

[8] Markowitz, David M., Rob Laha, Brian P. Perone, Roy D. Pea, and Jeremy N. Bailenson. 2018. "Immersive Virtual Reality Field Trips Facilitate Learning about Climate Change." Frontiers in Psychology 9 (November), 1.

[9] Markowitz, David M., Rob Laha, Brian P. Perone, Roy D. Pea, and Jeremy N. Bailenson. 2018. "Immersive Virtual Reality Field Trips Facilitate Learning about Climate Change." Frontiers in Psychology 9 (November), 5.

[10] Markowitz, David M., Rob Laha, Brian P. Perone, Roy D. Pea, and Jeremy N. Bailenson. 2018. "Immersive Virtual Reality Field Trips Facilitate Learning about Climate Change." Frontiers in Psychology 9 (November), 6-7.

[11] Wang, Kyra, Zeynep Duygu Tekler, Lynette Cheah, Dorien Herremans, and Lucienne Blessing. 2021. "Evaluating the Effectiveness of an Augmented Reality Game Promoting Environmental Action." Sustainability 13 (24), 12.

[12] Makransky, Guido, and Richard E. Mayer. 2022. "Benefits of Taking a Virtual Field Trip in Immersive Virtual Reality: Evidence for the Immersion Principle in Multimedia Learning." Educational Psychology Review, April, 1.

projector screen.[13] The study included fictional information about climate change that the students would then perform an experiment on and brief a fake UN panel on the results.[14] Afterward, the students took a posttest on the information. The students who used the VR headsets for the study scored higher in all results including posttest results, presence, interest, and enjoyment.[15] Similar results have been experienced through PLTW's learning platforms with 87% of students in 6th through 8th grade, and 92% of high school students, becoming more interested in STEM.[16] A metaverse platform called Spatial has also been used to educate students. A man named Andrew Wright has created a metaverse for education on Spatial where students can learn about a variety of topics such as fossils, ships, and historical battles.[17] What is important to point out is that students only need access to a computer to take part in these lessons, making it a more accessible point to the metaverse than VR and AR. Schools are slowly adopting Metaverse Platforms that students can use such as Dallas Hybrid Prep which uses the "STEMuli metaverse" where students spend 4.5 hours a week learning with their teachers in the metaverse.[18] These are just a few of the studies that point to the efficacy of learning in a metaverse setting. Nevertheless, evidence does support "learning experiences with higher immersion create higher levels of presence, interest, and long-term test performance."[19]

[13] Makransky, Guido, and Richard E. Mayer. 2022. "Benefits of Taking a Virtual Field Trip in Immersive Virtual Reality: Evidence for the Immersion Principle in Multimedia Learning." Educational Psychology Review, April, 13.

[14] Makransky, Guido, and Richard E. Mayer. 2022. "Benefits of Taking a Virtual Field Trip in Immersive Virtual Reality: Evidence for the Immersion Principle in Multimedia Learning." Educational Psychology Review, April, 2.

[15] Makransky, Guido, and Richard E. Mayer. 2022. "Benefits of Taking a Virtual Field Trip in Immersive Virtual Reality: Evidence for the Immersion Principle in Multimedia Learning." Educational Psychology Review, April, 21.

[16] "Our Impact." 2022. PLTW. 2022. https://www.pltw.org/about-us/our-impact.

[17] "Education in the Metaverse: A New Way of Learning - Andrew Wright — Spatial." 2021. Spatial.io. November 15, 2021. https://spatial.io/blog/teaching-high-school-in-the-spatial-metaverse.

[18] Rudra, Suchi. 2022. "The Metaverse Is Already Here, and K–12 Schools Are Using It for Education." Technology Solutions That Drive Education. June 1, 2022. https://edtechmagazine.com/k12/article/2022/06/metaverse-already-here-and-k-12-schools-are-using-it-education.

[19] Makransky, Guido, and Richard E. Mayer. 2022. "Benefits of Taking a Virtual Field Trip in Immersive Virtual Reality: Evidence for the Immersion Principle in Multimedia Learning." Educational Psychology Review, April, 17.

How can we ensure metaverses will be low carbon or net zero and create sustainable metaverse environments?

Transitioning experiences to the metaverse can both increase and decrease carbon. On the one hand, users will not have to leave their homes in cases such as at Dallas Hybrid Prep. By taking classes on the school's metaverse platform, those students do not have to be taken to school and therefore fewer emissions will be released. However, it is worth considering the environmental impact that the metaverse could have due to the datacenters that will be needed to run the platforms. Intel has estimated that there will be an increase in power needs that exceeds 1000 times "our current collective compute capacity to power the metaverse."[20] As blockchain will be essential to the metaverse, it is important to address and understand its contribution to emissions as well. Blockchain enables the use of nonfungible tokens (NFTs) – "Unique pieces of data associated with photos, videos, audio, and other types of media" including avatars and areas of land in the metaverse. [21] The downfall of NFTs is that they are costly in energy when it comes to "mining" them.

In an attempt to reduce emissions, companies in the metaverse space have been pledging to become net-zero and have set milestone target dates to do so. Specifically, Google has pledged to make all of its data centers carbon neutral by 2030.[20] Other companies are aiming to become carbon negative, such as Microsoft by 2030, while Amazon is focused on using only renewable energy by 2025.[20] Blockchains such as Polygon have also pledged to buy offsets for carbon emissions they produce.[22] While these ambitions are inspiring, the companies who made these

[20] Gartenberg, Chaim. 2021. "Intel Thinks the Metaverse Will Need a Thousand-Fold Increase in Computing Capability." The Verge. December 15, 2021. https://www.theverge.com/2021/12/15/22836401/intel-metaverse-computing-capability-cpu-gpu-algorithms.
[21] Wiggers, Kyle. 2022. "The Environmental Impact of the Metaverse." VentureBeat. January 26, 2022. https://venturebeat.com/2022/01/26/the-environmental-impact-of-the-metaverse/.
[22] Bhardwaj, Shashank. "Homegrown Blockchain Co Polygon Commits to Go Carbon Neutral This Year." Forbes India. Accessed August 6, 2022.

pledges will not be the only companies in the metaverse space by any means. Meaning that they will only be responsible for a fraction of the entirety of emissions that the metaverse will create. Additionally, many companies plan to or are already using carbon offsets to become carbon neutral, a scheme that many scientists and advocates have warned people about as it does not solve the emission problem.[23]

Some studies have pointed out that there is not a close correlation to the increase in technology use and energy consumption. One study from 2020 points out that though "server, storage, and network workloads hosted by cloud datacenters increased 2,600% from 2010-2018, energy consumption for all datacenters rose less than 10%.[24] Another study from 2019 found that gaming PCs could have improved energy savings by reducing hardware speeds and improving power supplies.[20] Companies such as NVIDIA have adopted practices like foveated rendering, an eye tracking system that works with VR headsets, to reduce the demand for processing of pixels, ultimately accounting for less energy consumption.[25] If hardware manufacturers decrease GPU frequency, power consumption can be reduced as well.

There has been evidence pointing to the fact that electricity use required by the internet has been overestimated as well as the climate impacts of its use. This is due to numerous pitfalls such as "rapid changes in pervasive data…", "analytical errors, failure to fact-check cited statistics, inadequate documentation", and the media recycling outdated information.[26] So, it is important

https://www.forbesindia.com/article/crypto-made-easy/homegrown-blockchain-co-polygon-commits-to-go-carbon-neutral-this-year/75321/1#:~:text=Polygon%20intends%20to%20use%20KlimaDAO,credit%20trading%20on%20the%20blockchain.

[23] "Carbon Offsets Are Not Our Get-out-of-Jail Free Card." UNEP. Accessed August 6, 2022. https://www.unep.org/news-and-stories/story/carbon-offsets-are-not-our-get-out-jail-free-card.

[24] Koomey, Jonathan, and Eric Masanet. 2021. "Does Not Compute: Avoiding Pitfalls Assessing the Internet's Energy and Carbon Impacts." Joule 5 (7), 1627.

[25] "Benefits and Costs." n.d. Vr.tobii.com. Accessed July 31, 2022. https://vr.tobii.com/sdk/learn/foveation/rendering/benefits-costs/.

[26] Koomey, Jonathan, and Eric Masanet. 2021. "Does Not Compute: Avoiding Pitfalls Assessing the Internet's Energy and Carbon Impacts." Joule 5 (7), 1627.

that information put out about Web3 energy consumption and climate impact is scrutinized thoroughly for supporting documentation and relevance to current capabilities.

Blockchain, a main component of the metaverse, can also reduce emissions by moving from "proof of work (PoW)" to "proof of stake (PoS)". Essentially, PoW involves many computers competing to solve mathematical problems (mining) to verify legitimacy of transactions in the network to earn cryptocurrency. Alternatively, in PoS, a user is chosen from a pool of users and a fee is gained from each transaction. Because PoS does not involve competition to solve every block, there is less energy requirement to complete transactions. Thus, making it much more energy efficient and much less of a liability for the climate. Ethereum, one of the biggest contenders for the metaverse to be built on, has plans to move to PoS consensus mechanism in fall of 2022 and subsequently "reduce its energy consumption by 99%".[27]

Ultimately, it will be up to metaverse creators to prioritize efficiency over scale using some of the methods mentioned above as well as new ideas that may not be fully fleshed out as the metaverse is still in a proof-of-concept stage.

The Role of DAO's in Education and DEI

Decentralized Autonomous Organizations (DAO's) are virtual member owned communities with a shared treasury that use blockchain and related technologies to achieve its shared vision. They operate without centralized leadership and utilize smart contracts to establish governance rules and for their voting process, which are recorded on permissionless blockchain[28]. The use of smart contracts and a public blockchain strengthens the autonomy and

[27] Jha, Prashant. "Ethereum DEVS Confirm the Perpetual Date for the Merge." Cointelegraph. Cointelegraph, July 15, 2022. https://cointelegraph.com/news/ethereum-dev-confirms-perpetual-date-for-pos-merge.
[28] Weyl, E. Glen, Puja Ohlhaver, and Vitalik Buterin. "Decentralized Society: Finding web3's Soul." SSRN, May 11, 2022. https://papers.ssrn.com/sol3/papers.cfm?abstract_id=4105763.

transparency of the DAO. All DAO participants are able to view financial and operational

information stored on the blockchain. While there are numerous ways to participate in a DAO,

the number of tokens a user has typically determines how the voting power is distributed among

users[29]. Traditional organizational structures rely on executives to make decisions but DAO's, on

the other hand, can allow all token holders to play a decision-making role. By having a vested

interest in the DAO, users will theoretically act in the best interests of DAO to protect their own

stake as well. Stakeholders, not just the DAO creators, determine the future of the organization.

By using this flat and democratic organizational structure, DAO's can achieve greater

transparency, adaptability, and trust[30]. Stakeholders can make a direct effort toward their goal

without the need of an intermediary and reduce the risk of corruption and possible censorship.

Although DAO's are still nascent, they can play an important role in the metaverse. For

example, there are some individual platforms like Decentraland that have a DAO that makes

important governance decisions around issues such as content moderation policies[31]. Further,

DAO's can use their shared resources for education and training programs. DAO's can act as

hubs of decentralized learning and provide an important infrastructure for learning experiences[32].

This can allow students to join a community and learn about any topic they wish such as climate

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[29] Nathan Reiff, "Decentralized Autonomous Organization (DAO)," Investopedia (Investopedia, July 12, 2022), https://www.investopedia.com/tech/what-dao/.

[30] David Gogel et al., "Decentralized Autonomous Organizations: Beyond the Hype," World Economic Forum, accessed August 20, 2022, https://www.weforum.org/whitepapers/decentralized-autonomous-organizations-beyond-the-hype.

[31] Kieron Allen, "How DAOs Impact the Metaverse," Acceleration Economy, March 23, 2022, https://accelerationeconomy.com/metaverse/how-daos-impact-the-metaverse/.

[32] Scott David Meyer and Vriti Saraf, "Dao.edu - the Future of Decentralized Learning," DAO.edu - The Future of Decentralized Learning - Scott David Meyer, February 15, 2022, https://ed3.mirror.xyz/VJUCPEMKKvh5Fyh6Gb1_YEZrl2FCAP6jgmsByuCCkmA.

change, connect with other like-minded students, and share knowledge. DAO's can create more robust educational models or new models entirely[33].

A learning DAO acts as a decentralized hub for learning that can make the benefits of education accessible to a large number of people. DAO's can reach a number of students that expand beyond a physical classroom and can provide an opportunity to learn about a subject matter not taught in their schools. While many DAO's such as Climate DAO and KlimaDAO are focused on combating climate change through an investment focus, other DAO's such as All for Climate DAO focus on connecting active citizens to engage in a variety of climate initiatives such as organizing climate marches, planting trees, making films, starting community gardens, and other projects[34]. One possible utilization of a learning DAO would be to create a platform that provides education lessons and resources focused on climate change. DAO's such as Dream DAO and Invisible College focus on empowering young adults to engage in Web3 projects that regenerate people and the planet and provide educational courses on a variety of topics. A learning DAO with a climate change focus can incorporate aspects of these various DAOs by engaging young adults in a variety of sustainability focused projects and providing lessons by experts on a variety of climate change related topics[35][36]. Further, the utilization of DAO's for education can be used to enhance a teacher's knowledge base and pedagogical approach. K20 serves as a metaverse hub for educators around the globe where they encourage educators to

[33] Scott David Meyer and Vriti Saraf, "Dao.edu - the Future of Decentralized Learning," DAO.edu - The Future of Decentralized Learning - Scott David Meyer, February 15, 2022, https://ed3.mirror.xyz/VJUCPEMKKvh5Fyh6Gb1_YEZrl2FCAP6jgmsByuCCkmA.

[34] "All for Climate DAO," All for Climate DAO, accessed September 2, 2022, https://dao.allforclimate.earth/#our-mission.

[35] "Dream Dao," Dream DAO, accessed September 2, 2022, https://www.dreamdao.xyz/.

[36] "Invisible College," Invisible College, accessed September 2, 2022, https://www.invisiblecollege.xyz/.

connect, collaborate, and learn[37][38]. This platform serves as a comprehensive directory of

professional learning and aims to dismantle silos within education. By using platforms like k20,

educators can learn methods to best educate students about climate change and how to best

utilize Web3 to enhance the student learning experience. Learning DAO's can play an important

role for both students and teachers and create a more democratic learning environment.

While DAO's and metaverses can increase accessibility to new experiences,

understanding and addressing diversity, equity, and inclusion (DEI) issues will create a stronger

user experience and assist in making this emergent technology mainstream[39]. Each metaverse

will have its own platform with different user bases. Therefore, each platform will face different

DEI challenges because of aspects such as platform features and functionality, style, historical

context, and user culture[40]. It will be difficult to create a holistic and long-term DEI strategy

since this is still a nascent field. A few DEI issues that have been identified included: DAO

diversity and inclusivity, DAO's not making decisions for the greater good, decision-making

speed on DEI issues, and that DAO's formation and decision making are vulnerable to

programming errors and attacks[41]. These are issues that are key for decentralized metaverse

platforms. Centralized metaverse platforms, on the other hand, can develop a stronger long-term

[37] "The Eduverse," k20 Educators, accessed September 2, 2022, https://www.k20educators.com/.

[38] Sara Filipčić, "Web3 & DAOs: An Overview of the Development and Possibilities for the Implementation in Research and Education," April 2022, https://www.researchgate.net/publication/361188860_Web3_DAOs_an_overview_of_the_development_and_possibilities_for_the_implementation_in_research_and_education, 6.

[39] Jane Lu, "How to Address the Diversity Challenges of the Metaverse," World Economic Forum, June 14, 2022, https://www.weforum.org/agenda/2022/06/metaverse-platforms-face-diversity-equity-and-inclusion-challenges-heres-how-to-address-them/.

[40] Jane Lu, "How to Address the Diversity Challenges of the Metaverse," World Economic Forum, June 14, 2022, https://www.weforum.org/agenda/2022/06/metaverse-platforms-face-diversity-equity-and-inclusion-challenges-heres-how-to-address-them/.

[41] Jane Lu, "How to Address the Diversity Challenges of the Metaverse," World Economic Forum, June 14, 2022, https://www.weforum.org/agenda/2022/06/metaverse-platforms-face-diversity-equity-and-inclusion-challenges-heres-how-to-address-them/.

strategy for their product and DEI plan. However, this centralized decision making can cause a greater attention to business interests instead of user interests and limit the ability of users to influence the decisions of leadership regarding DEI plan and actions. A new initiative by the World Economic Forum, Defining and Building the Metaverse, engages organizations across sectors to provide guidance on creating a safe, interoperable, and inclusive metaverse[42]. This initiative aims to help build governance and policy frameworks for the metaverse and to support economic and social value creation. While metaverses are still in the preliminary stages of their development, it can be a force for inclusion and equity if done correctly.

Another important DEI consideration is understanding the way underrepresented groups, such as people of color and people with disabilities, will be visible and included. For example, as one navigates through digital worlds, one might use an avatar to serve as a digital representation of themself. It is important that users are given the ability to create or choose an avatar that allows them to present themselves as they are or want to be seen. An example of this is The Unhidden Collection. The Unhidden Collection is an NFT collection from the NFTY Collective that features diverse individuals with visible and non-visible disabilities[43].The collection features different gender identities, global cultures, disabilities, and people of color. This project aims to create a more inclusive Web3 experience by providing the choice to use avatars that represent their physical and cognitive abilities. Through the use of AI and algorithms, Unhidden can create 2D avatars for those with color blindness and audio generated versions of their images for people who are blind or visually impaired. As metaverses are created, creators need to be aware of features needed for an inclusive environment such as a closed caption system, audio descriptions,

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[42]"New Initiative to Build an Equitable, Interoperable and Safe Metaverse," World Economic Forum, May 25, 2022, https://www.weforum.org/press/2022/05/new-initiative-to-build-an-equitable-interoperable-and-safe-metaverse/.

[43] "NFTY Collective," Nfty Collective, July 19, 2022, https://imnfty.com/.

voice activation commands and other features. While it may seem like a niche issue, nearly 1 in 4 adults in the United States are living with a disability[44]. The metaverse has the ability to be inclusive of people of various backgrounds and disabilities.

Another NFT collection with a DEI focus is the AstroSapiens NFT project, a StarChain Ventures initiative. This collection contains thousands of algorithmically generated artworks with 3D portraits of diverse individuals and astrophotography that are metaverse ready[45]. AstroSapiens focuses on a future where all people have equitable access to science, art, and discovery through sustainable Web3 technology. NFT's are minted and transacted on the low-carbon Polygon blockchain, and the creators use carbon offsets to minimize environmental impact. In addition, the AstroSapien community is supported by a diverse group of ambassadors, who are experienced in DEI and professionally engaged in Web3 and/or the space industry. Twenty percent of all proceeds from primary and secondary NFT sales are donated to the AstroSapiens Foundation to fund programs that increase DEI in the space industry and Web3. The Futurist Series is the first collection of AstroSapien NFTs and features a traditional gender-balanced group and will expand to include as many dimensions of diversity as possible.

We must also ensure that this technology does not further the digital divide between those with access to expensive headsets and those who do not have access. Although much of the conversation around metaverses has focused on virtual reality (VR) headsets, metaverses are

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[44] "Disability Impacts All of Us Infographic," Centers for Disease Control and Prevention (Centers for Disease Control and Prevention, September 16, 2020), https://www.cdc.gov/ncbddd/disabilityandhealth/infographic-disability-impacts-all.html.

[45] "Astrosapiens NFT Collection -- Diverse and United in the Cosmos," NFT Collection -- Diverse and United in the Cosmos, accessed August 20, 2022, https://www.astrosapiensnft.com/#About.

more than solely VR headsets[46]. Some decentralized metaverse platforms such as Decentraland, The Sandbox, and others are accessible using a laptop or desktop computer[47]. While headsets might provide a more immersive experience, it is not a prerequisite for being able to participate in metaverses. Many of the metaverse experiences are accessible through computers and smartphones. Accessibility is imperative and will assist in its adoption. By making metaverses accessible on smartphone devices and web browsers, more people will be able to participate and thus drive global adoption. Research from the Pew Research Center shows that nearly 85% of adult Americans own a smartphone and 77% own a desktop/laptop[48]. Since these are devices many people already have access to, it lowers the barrier to entry for engaging in metaverses. Enabling accessibility through devices already available will aid in the adoption of the metaverse worldwide. For example, Challau is a recently funded UK-based startup has a metaverse platform that does not require a headset, high speed internet or high computing power for its immersive environment[49]. They developed their platform to be accessible on personal computers and smartphones.

Scalable Blockchain Platforms for Metaverses

All decentralized metaverses will be built using blockchain technology and will enable users to own anything in the metaverse. Some of the popular metaverses today use blockchains such as

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[46] Jean-Marc Seigneur and Mohamed-Amine Choukou, "How Should Metaverse Augment Humans with Disabilities?: 13th Augmented Human International Conference," AH2022: 13th Augmented Human International Conference, May 1, 2022, https://dl.acm.org/doi/fullHtml/10.1145/3532525.3532534.

[47] "Welcome to Decentraland," Welcome to Decentraland, accessed August 20, 2022, https://decentraland.org/.

[48] "Mobile Fact Sheet," Pew Research Center: Internet, Science & Tech (Pew Research Center, April 7, 2021), https://www.pewresearch.org/internet/fact-sheet/mobile/.

[49] Jonathan Symcox, "UK Metaverse Startup to Take on Facebook's Meta," BusinessCloud, April 27, 2022, https://businesscloud.co.uk/news/uk-metaverse-startup-to-take-on-facebooks-meta/.

Ethereum, Polygon, and Solana[50]. As the number of users and transactions increase, the need for scalability increases as well. Scalability is a critical factor for developers of a blockchain application. While blockchain technology is still in its early stages, efforts are currently being made through the blockchains mentioned previously. Polygon is a secondary scaling solution for the Ethereum blockchain. As a Layer-2 scaling solution, it will help to bring mass adoption of the Ethereum platform[51]. Polygon utilizes a Proof of Stake (PoS) and More Viable Plasma (MoreVP) to allow developers to build scalable decentralized applications[52].Through these solutions, Polygon allows Ethereum to increase the number of transactions and decreases latency[53]. Polygon will help to scale the Ethereum network by increasing the transaction speed and solving inefficiencies.

Another highly scalable solution is the Solana blockchain. Solana is maintained by the Solana Foundation and is an open source, permissionless blockchain[54]. Similar to Polygon, it uses a proof of stake consensus model. This consensus model has been improved upon by the proof of history. Solana combines both proof of stake and proof of history to create a unique consensus model that creates greater efficiency, resiliency, and decentralization. Utilizing proof of history is Anatoly Yakovenko's, co-founder of Solana, solution to the blockchain trilemma issue. The ability of Solana to have a high TPS (transactions per second) speed and low gas fees makes it a

[50] Ziaul, "Scalability of the Metaverse: Challenges and Solutions," Metaverse Troop, May 12, 2022, https://metaversetroop.com/scalability-of-the-metaverse/#what-is-the-metaverse.

[51] Sandeep Nailwal, "Polygon Crypto Layer-2 Scaling (Matic Network)," Gemini, August 11, 2021, https://www.gemini.com/cryptopedia/polygon-crypto-matic-network-dapps-erc20-token.

[52] Sandeep Nailwal, "Polygon Crypto Layer-2 Scaling (Matic Network)," Gemini, August 11, 2021, https://www.gemini.com/cryptopedia/polygon-crypto-matic-network-dapps-erc20-token.

[53] Panther Research, "Polygon: Scaling Solutions Simplified (Matic-USD)," SeekingAlpha (Seeking Alpha, December 29, 2021), https://seekingalpha.com/article/4477231-polygon-scaling-solutions-simplified.

[54] Martin Lee, "Solana: Scalability through Speed," Nansen, April 14, 2022, https://www.nansen.ai/research/solana-scalability-through-speed.

very competitive blockchain option. While there are many concerns about the energy intensity of blockchains, each transaction on the Solana blockchain consumes the same amount of energy as a few google searches[55]. Solana has been used for decentralized finance, gaming, NFT's and the broader Web3 ecosystem. While it is a young network with its own issues, over time one would expect to see greater network stability and other improvements to the blockchain.

One of the greatest improvements to scalability is the Ethereum merge. This will merge the current Ethereum main net with the Beacon Chain proof of stake system as the new consensus layer, which will transition Ethereum from PoW to PoS. This merge will set the stage for future scaling upgrades such as sharding, which will allow greater growth in network capacity[56]. Further, this will allow Ethereum to undergo future upgrades not possible with the PoW model. In addition to the merge, Ethereum will undergo further upgrades which have been named "surge", "verge", "purge", and "splurge". Through these upgrades, Ethereum will achieve greater scale, security, and sustainability. Ethereum plays an important role with Web 3 as the most used blockchain, supporting the second largest cryptocurrency, Ether, and hosting various decentralized applications. Given the significant role Ethereum plays within Web 3, these planned upgrades will transform the Web3 ecosystem and move it toward greater efficiency, development, and adoption.

Conclusion

Web3, a rapidly evolving technology, has democratized how we use the internet. By allowing data ownership, transparency, and collaboration, Web3 platforms have unlocked an array of

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[55] Martin Lee, "Solana: Scalability through Speed," Nansen, April 14, 2022, https://www.nansen.ai/research/solana-scalability-through-speed.

[56] "The Merge," Ethereum, August 18, 2022, https://ethereum.org/en/upgrades/merge/.

opportunities in diverse sectors, especially education. While the potential of the eduverse to revolutionize education with Metaverse technology, particularly climate education, seems promising, it comes with significant challenges. Immersive experiences show a notable increase in engagement and understanding of complex subject matters such as climate change, but an energy intensive technology can also appear counterintuitive. As the technology matures, companies are increasingly steering towards renewables and energy efficiency, gearing towards a more sustainable future. However, the lack of federal and state legislation to protect data sourced from minors poses a safety concern which still persists in the eduverse. Ultimately, there is a need for more extensive legislative policies to protect and safeguard students from the negative impacts of the emerging technologies and to encourage corporate responsibility and sustainability on behalf of developers.

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    se%20KlimaDAO,credit%20trading%20on%20the%20blockchain.

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