Adopting the Metaverse for learning environments means more use of deep learning artificial intelligence: this presents challenges and problems

Pericles ‘asher’ Rospigliosi

As the momentum grows for widespread adoption of the metaverse our reliance on artificial intelligence increases. For educators this could introduce many complex problems. This editorial will outline some of the reasons why those who use interactive learning environments may want to take cautious steps initially into the metaverse. To adequately outline these risks, it will be necessary to describe what the metaverse is; what technologies it uses and how it can be adopted as a place for learning and teaching. This will allow a critical consideration of some problematic areas around the role of artificial intelligence in constructing the metaverse. It is the rapid development of deep learning which makes it possible to build more interactive experiences in the metaverse. However, the use of these self-taught algorithms raises ethical concerns.

What is the metaverse?

There are many definitions of the metaverse, and ideas about what it is are changing as hardware and software increase in capability. At the core of the concept is “a computer-generated universe” (Stephenson, 1992: p23) presented so that “you’re in the experience, not just looking at it” (Zuckerberg, 2021). What being “in the experience” means is changing, rapidly. For many users of current metaverse systems it still means looking at a screen, albeit with the capacity to navigate within 3D and to alter the points-of-view, such as has been possible and popular in many computer games over the last few decades. Where the metaverse already delivers a more immersive experience than “first person shooter” games like Doom, Quake or Call of Duty is in its capacity for users to interact with the environment in a more complex manner. Popular metaverse games such as Roblox and Minecraft allow users to build artefacts and create environments to share and experience with other players. Currently these games tend to be proprietary and have limited and predetermined functions, but the range and complexity of these functions are expanding. For example, the capability to import 3D objects made in one metaverse and use them in another metaverse is growing in sophistication (Roblox, 2022). The metaverse as described so far is not significantly different from the range of virtual reality systems in use over the last thirty years such as Virtual Reality Modelling Language (VRML), Web 3D and Second Life (Rospigliosi, 2022). The new potential metaverse offers a grander model of a computer-generated universe than VR with several supporting technologies which are able to offer persistence and ubiquity. Persistence and ubiquity range from the prosaic, such as being able to re-use a mesh or model across platforms, to the complex such as how to maintain congruence between events and changes

in one environment and enable these to replicate across other and different platforms (Ning et al, 2021). Addressing these challenges of persistence and ubiquity involves exploiting two key technologies: blockchain and AI. The role of blockchain can be characterised as a reliable distributed ledger, recording changes in a distributed system which can be accessed by any authorised platform on which the metaverse is running (Ning et al, 2021). This capability is crucial in allowing changes to permeate beyond the platform on which they occur, but blockchain is not the focus of this editorial. Artificial intelligence plays a range of roles in generating and maintaining the metaverse, and responding to users' actions, and the variety and complexity of the metaverse is increasing what this maintenance entails (Ning et al, 2021). More users on more platforms with more and different purposes and resources are all contributing to the increasing complexity of the emergent metaverse. From the perspective of facilitating teaching and learning, and the concerns of this journal, it is the increasing possibilities of this interactivity which is the key attraction of the emerging edu-metaverse.

Interacting with the metaverse and the role of AI

The metaverse may have a significant role as a platform for learning. This could be far more than just a place to demonstrate and display learning resources. There is potential for learning in the metaverse to be personalised through interactivity (Chen, 2022). Personalized learning in the metaverse is likely to be a fruitful area for future work, but this editorial will focus on the role of artificial intelligence in facilitating interactivity. The benefit of being "in the experience" is that it will have immediacy and engagement but will also enables participants to respond and fully interact. The potential for enhanced learning therefore is wide: the actions and choices of learners can bring about fundamental change and reaction. When we think about learning environments of the past and present, from children's sandboxes to scientists' laboratories, interactivity, and the opportunity to see the impact of our actions are pivotal. But interactivity today is becoming increasingly complex. Simple virtual reality games such as dungeons to explore and battlefields to fight over can rely on a simple rules-based algorithm to determine what happens as players interact, based on a limited number of possible results. In a metaverse where learners are invited to explore, construct, and learn through interaction, the variety and multiplicity of outcomes goes beyond those predetermined by rules. Such an environment must rely on adaptive technologies that change contexts as they are used. In the last twenty years artificial intelligence has moved from rule-based approaches to machine learning: algorithms that develop deep learning and adapt as they process more data (Janiesch et al, 2021). It is this potential for the environment to learn from the actions of the user that makes the metaverse such an exciting platform on which to offer interactive learning.

Machine learning, deep learning, and AI

The growth of Big Data generated by user activities on social media, targeted marketing and user search has enabled developments in AI which go beyond simple machine learning. Machine learning has for decades relied on humans training algorithms to identify patterns in data which took user effort. Vast projects such as Google's use of Captcha data, which provided a secure way for visitors to websites to demonstrate they were "not a robot" by reading a jumbled picture of a scanned text, generated an AI that can read reliably, but were resource intensive (Bostik & Klecka, 2018). As traditional machine learning becomes supplemented by deep learning systems such as CLIP (Contrastive Language-Image Pre-Training) which learns to read words in pictures by searching through existing tags and labels on websites, the possibilities of enhanced interactive learning become more widespread (Li et al, 2021). Recent widely accessible AI packages such as the art generator DAL-E which creates images from text instructions, or the General-Purpose Toolkit (GPT 3) which can perform an open ended range of actions, both indicate how flexible the possibilities for interactive metaverse environments can become (OpenAI, 2022). Already, deep learning tools such as these go far beyond the rigid and predetermined computer-generated universes of games and VR. The use of deep learning AI in edu-metaverses offers an exciting expansion of interactive learning environments, but also poses problems.

The risks of algorithmic injustice for interactive learning in the metaverse

Much has been written about the risk of algorithmic injustice in learning systems that rely on historical data (Rospigliosi, 2021). Omissions that have occurred when software developers have assumed that other users are like them, such as teams building face recognition systems not thinking about the variety of skin tones that exist (Buolamwini & Gebru, 2018), or the perpetuation of historic biases and exclusions which are amplified when the deep learning is determined by what is retrieved from the data exhaust patterns of internet use without appropriate monitoring and supervision (Neff, 2016). Other causes for concern include the tendency for market forces to make corporate educators likely to gather Big Data sets such as happened with powerful platform monopolies such as Google, Amazon and Meta (Zuboff, 2019). Here there has been a tendency for such corporations to own the means to innovate and reinforce and protect their dominant market positions (Brynjolfsson et al, 2014). The role of government and regulators is important here as governance of data and AI adoption can be important for protecting individuals from the excessive power of large corporations, as has been the case with the European Union's concerns about data privacy. Conversely, the state may also facilitate the harnessing of AI such as appears to be the case in China, where many universities are pooling data about their students' learning engagement (Cheng & Zeng, 2022). This vast data set has great potential to support useful insights into the use of the

metaverse as an interactive learning environment but is also a cause for careful and critical ethical concern.

References

Bostik, O. and Klecka, J., 2018. Recognition of CAPTCHA characters by supervised machine learning algorithms. *IFAC-PapersOnLine*, *51*(6), pp.208-213.

Brynjolfsson, E., McAfee, A. and Spence, M., 2014. New world order: labor, capital, and ideas in the power law economy. *Foreign Affairs*, *93*(4), pp.44-53.

Buolamwini, J. and Gebru, T., 2018, January. Gender shades: Intersectional accuracy disparities in commercial gender classification. In *Conference on fairness, accountability and transparency* (pp. 77-91). PMLR.

Chen, Z., 2022. Artificial Intelligence-Virtual Trainer: Innovative Didactics Aimed at Personalized Training Needs. *Journal of the Knowledge Economy*, pp.1-19.

Cheng, J. and Zeng, J., 2022. Shaping AI's Future? China in Global AI Governance. *Journal of Contemporary China*, pp.1-17.

Hwang, G.J. and Chien, S.Y., 2022. Definition, roles, and potential research issues of the metaverse in education: An artificial intelligence perspective. *Computers and Education: Artificial Intelligence*, p.100082.

Janiesch, C., Zschech, P. and Heinrich, K., 2021. Machine learning and deep learning. *Electronic Markets*, *31*(3), pp.685-695.

Li, Y., Liang, F., Zhao, L., Cui, Y., Ouyang, W., Shao, J., Yu, F. and Yan, J., 2021. Supervision exists everywhere: A data efficient contrastive language-image pre-training paradigm. *arXiv preprint arXiv:2110.05208*.

Neff, G., 2016. Talking to bots: Symbiotic agency and the case of Tay. *International Journal of Communication*.

Ning, H., Wang, H., Lin, Y., Wang, W., Dhelim, S., Farha, F., Ding, J. and Daneshmand, M., 2021. A Survey on Metaverse: the State-of-the-art, Technologies, Applications, and Challenges. *arXiv preprint arXiv:2111.09673*.

OpenAI, 2022. https://openai.com/api/

Roblox, 2022. Support for the Unified Smart Mesh Importer. https://devforum.roblox.com/t/pbr-support-for-the-unified-smart-mesh-importer-beta/1735648 [accessed 26/09/2022]

Rospigliosi, P.A., 2022. Metaverse or Simulacra? Roblox, Minecraft, Meta and the turn to virtual reality for education, socialisation and work. *Interactive Learning Environments*, *30*(1), pp.1-3.

Rospigliosi, P.A., 2021. The risk of algorithmic injustice for interactive learning environments. *Interactive Learning Environments*, *29*(4), pp.523-526.

Zuboff, S. 2019. *The age of surveillance capitalism: the fight for a human future at the new frontier of power*. New York: Public Affairs.

Zuckerberg, M. 2021. *Founders Letter*. Meta. https://about.fb.com/news/2021/10/founders-letter/