THE ROYAL SOCIETY

Science in the metaverse: policy implications of immersive technologies

Note of discussions at a Royal Society workshop on 17 June 2022

The Royal Society hosted a roundtable at the University of Exeter, as part of the 'Creating Connections' events series to convene academics and industry professionals from the South West of England to discuss the policy priorities for the use of immersive technologies in scientific research. The roundtable was chaired by Professor Samuel Vine, Professor of Psychology at the University of Exeter. The key topics discussed were the challenges faced by industry and academic researchers working with immersive technologies including training, sustainability, and access to markets.

This note serves as a summary of themes that emerged from the discussion and includes suggestions for action to encourage the responsible use of immersive technologies. References are included to illustrate points raised at the roundtable. This note is not intended as a verbatim record of discussions and does not represent the views or positions of all participants or organisations who took part. The note was drafted by staff at the Royal Society considering comments, feedback, and references submitted by roundtable participants.

Introduction

Scientific research is increasingly relying on data-driven and digital technologies. The Royal Society is interested in understanding how this shift is changing the nature of scientific research, which fields it is most likely to affect, and what implications it may have for society.

Immersive technologies are a prime example of a technology with the potential for significant scientific and social impact in the future. These technologies are being used to teach the scientists of tomorrow, for example to provide therapies for patients and to visualise geographic data to understand the climate crisis.

Key definitions

Metaverse
A virtual reality environment in which users can interact and engage with each other, where transactions are enabled, knowledge exchanged and products purchased.

Immersive technologies
A set of technologies that allow users to experience virtual environments in a more embodied way and reflect new ways of creating and interacting with digital applications and content.

Virtual Reality (VR)
Technologies that completely immerse a user in a virtual environment they can interact with, typically through the use of head-mounted displays (HMDs).

Augmented Reality (AR)
Technologies that overlay virtual content on the real world so users can interact with digital content within this framework.

Avatar
The representation of an individual in the metaverse. These representations can range from a motion picture-like design to hyper realistic design and thus create a risk for deepfakes, fake videos made to look real with the use of deep learning artificial intelligence program.

Many major technology companies are investing in immersive technologies – most notably, Facebook's 2021 rebranding to Meta signals a shift away from the traditional screen-based internet to developing an immersive 'metaverse'. In 2021, the market for virtual (VR) and augmented reality (AR) headsets grew 92.1% reaching 11.2 million units[1].

Against this backdrop, the Royal Society convened a roundtable to understand and develop policy priorities for immersive technologies with a focus on their use for scientific research. This was held in Exeter to take advantage of the hub of immersive technologies in the South West of England, a region known for its creative and technological industries. With large interdisciplinary research projects taking place in Bath and Bristol (My World in Bristol and Bristol + Bath Creative R +D were mentioned by workshop participants) – where some of the roundtable participants travelled from – the region is considered a powerhouse for creative industries. The roundtable intended to highlight both the opportunities and challenges of immersive technologies and explore how policymakers can ensure they encourage the responsible development and innovation of immersive technologies.

Summary of key discussion points

- Policymakers should develop an interdisciplinary education ecosystem that prepares people to develop, create, critique and adopt immersive technologies.
- The interdisciplinary nature of the development of immersive technologies and software should be recognised and opportunities should be granted to conduct interdisciplinary work.
- Research funders and industry must assess the impact of immersive technologies on the environment and work to integrate sustainability into the development of immersive technologies.
- When considering the future of immersive technologies, businesses and researchers might choose to shift away from a focus on the technical hardware and consider software, creative industries and social structures. Interoperability is key to making progress in this space. Policy makers on the other hand will need to be prepared to tackle the regulatory challenges of both hardware and software.
- The UK Government should take steps to address obstacles to domestic and international markets to best support start-ups and SMEs in immersive tech, including those linked to the UK's exit from the European Union.
- The UK has a unique opportunity to set precedents in regulating immersive technologies, with a focus on privacy and data protection.

Promoting the development of skills training for industry and research

More resources, in terms of funding and education, are needed to ensure the UK can deliver interdisciplinary training to support immersive tech companies and research.

Immersive technology developers should draw on a wide range of disciplines and skillsets to make their technology reliable, compelling, and useful. A unique feature of immersive technology highlighted by participants is that it requires both technical skills as well as a creative vision. This poses a unique set of challenges to support interdisciplinary training and skill development.

Given the success of immersive technologies relies heavily on a creative process; artists and creative professionals need to be treated on equal footing with scientists at the inception of projects rather than relegated to communicators or disseminators.

In terms of skills, there is a need to support social scientists, film directors and producers, creative professionals and generalists who can bridge different specialisms. These groups are currently often left out of funding opportunities. To address this, there should be more mechanisms to help arts education complement STEM education and promote a 'STEAM not STEM' approach, whereby arts is directly included into STEM. Interdisciplinary degree programs such as the BA in Immersive Media at Bournemouth University could help address this gap by supporting generalists who are able to work across disciplines.

1 IDC. 2022 AR/VR Headset Shipments Grew Dramatically in 2021, Thanks Largely to Meta's Strong Quest 2 Volumes, with Growth Forecast to Continue, According to IDC See: https://www.idc.com/getdoc.jsp?containerId=prUS48969722 (accessed 25 January 2023).

The UK is in a strong position to support skills development. As the gaming industry is a UK success story, this is a natural place to draw talent for immersive technologies. Some participants suggested that better pathways from the gaming industry into immersive tech is a good way to support the industry pipeline. However, participants also warned of the mismatch between game training skills and scientific research suggesting that any policy must be sensitive to the differing needs of academia and industry.

Many participants highlighted the need to introduce immersive technology training at earlier stages of education. Within the primary and secondary education system, there are several barriers to encouraging students into immersive technology. First, the divide between arts and sciences at schools is an obstacle to developing the interdisciplinary skills needed for this sector. Schools often filter students interested in digital technologies into coding courses rather than creative courses. Second, schoolteachers lack time, resources, and training to adopt immersive technology in classrooms effectively. This is worsened by how quickly the technology, such as HMDs, become obsolete contributing to costs schools are unable to justify. Participants stressed that the need to equip teachers and skill providers with the right knowledge and tools will improve growth and talent.

One key consideration for skills development is the lack of accessibility of devices like headsets. This has further consequences for who can gain skills to develop and use immersive technologies. Some participants pointed to how Augmented Reality was currently underutilised compared to Virtual Reality and that putting more resources into Augmented Reality could solve some of the challenges of who has the skills and who this is accessible for.

Supporting the development of interdisciplinary skillsets related to immersive technologies across all regions of the UK is crucial to fostering a good environment for the use and adoption of these technologies. Ensuring this requires co-ordination and action within industry, higher education, and early education.

Sustainability

The climate crisis needs to be acknowledged and considered in the research, development, and funding of immersive technologies.

The context of the climate crisis weighs heavily on scientific research and immersive technologies are no exception to this. While immersive technologies have the potential to decrease carbon emissions by reducing the need for travel, these technologies still face issues related to their high energy consumption and rapid obsolescence.

Addressing the high energy consumption of the sector was seen as an important factor in rendering immersive technologies viable both within academia and industry. As several universities adopt net zero policies, academic research on immersive technologies needs to align with this. A first step in assessing sustainability is to perform an audit that quantifies how much energy is being saved with immersive technologies – by reducing the need to travel – compared to how much they consume.

Participants favourably noted the shift towards including the evaluation of sustainability in research council grants. However, some pointed to the reliance of immersive technologies on an infrastructure of blockchain and non-fungible tokens (NFTs) as a significant hurdle to overcome for sustainability. In order to address this, there is a pressing need to shift energy consumption to renewable sources or develop technical alternatives reducing the energy consumption of immersive technologies. Requirements for sustainability commitments or carbon offsetting for investors and research grant funding is one potential solution.

The rapid obsolescence of immersive technology hardware was raised by several participants. This is an issue for sustainability due to the lack of options for easily recycling or disposing of this equipment. This also acts as a barrier for start-ups in the immersive technology space who may be unable to afford the investment in hardware which becomes obsolete after a year.

Interoperability and shifting to 'soft' systems

More resources should be devoted to software development and standards should be developed in a way that avoids domination of immersive technology by a small set of companies.

Interoperability – the ability to easily transfer data and information between different technological systems – is widely understood as a crucial factor in expanding the adoption of immersive.

The announcement of the Metaverse Standards Forum[2] in June 2022 (a few days after the Royal Society's workshop took place) emphasises efforts to use standards to tackle interoperability for immersive technologies. While participants supported the need for a blueprint for interoperability, some felt there was a tension between standardisation and open-source approaches. In particular, many were concerned about how the government can support developers in owning their technology and encourage innovation for next-generation immersive tech products in the face of technology companies pushing for sole ownership.

One path is to support a shift from hardware (such as VR headsets) to software systems. While participants felt the UK was unable to compete on hardware, software and content creation was considered a space where smaller firms could still have a significant role to play. The UK is well-placed to capitalise on this opportunity due to its strength in gaming, media, and storytelling as well as English being a common language of digital technologies. It was recommended the UK provide support for developers to own their software and lead in developing immersive technologies through ethical frameworks in partnership with communities who use them.

There is however a potentially intertwined link between the hardware market and the software systems. For example, Meta's VR headset, Oculus(the most popular headset in terms of market share in 2022) requires a Facebook or a Meta account for users to use those headsets, thereby offering Meta a unique access to VR users' data[3].

Access to markets

Immersive tech SMEs need a government procurement system that is fit for purpose and trade agreements that ensure easier access to international markets.

For immersive technology companies in the UK, restrictions to access to domestic and international markets is a significant barrier to growth.

Lack of access to EU markets is creating a difficult environment for businesses starting up in the immersive technology sector. A participant from the workshop explained how a South West-based SME saw its profit dramatically decrease due to loss of access to EU markets. The SME was advised to register the company abroad to avoid this.

On the domestic level, the government procurement system (SPARK) was criticised as not fit-for-purpose. The sign-on system is considered a time-intensive process, without adding meaningful access to upcoming government work. A participant from an SME described a lack of relevant job listings despite there being known public initiatives. Ultimately, the participant said his SME secured a procurement job which had not been advertised on the SPARK platform.

Privacy and data protection

Ethical frameworks for immersive technology development require regulation for privacy and data protection.

Wearable devices enable a surge in the amount of data that can be collected from users. Research has shown data collected through immersive technologies can be personally identifying.[4] Though claims around being able to predict characteristics based on wearable device data are contested and problematic, this capacity is already used in company marketing and treated as a justification to continue to collect data.

2 Metaverse Standards Forum. 2022. Leading Standards Organizations and Companies Unite to Drive Open Metaverse Interoperability. See: https://metaverse-standards.org/news/press-releases/leading-standards-organizations-and-companies-unite-to-drive-open-metaverse-interoperability/ (accessed 26 January 2023).

3 Oculus. 2022. Facebook accounts on Oculus. See: https://www.oculus.com/blog/facebook-accounts-on-oculus/?locale=en_GB (accessed on 26 January 2023).

4 Miller MR, Herrera F, Jun H, Landay JA and Bailenson JN. 2020 Personal identifiability of user tracking data during observation of 360-degree VR video. See: https://www.stanfordvr.com/mm/2020/10/miller-sr-personal-identifiability.pdf (accessed on 26 January 2023). And McGill, M, Khamis, M., Saeghe, P., Abraham, M. 2023 Protecting Extended Reality (XR) user and bystander privacy by supporting legibility of XR sensing and processing. See: https://www.rephrain.ac.uk/prixr/ (accessed on 26 January 2023). And Kröger, JL, Lutz, OHM, Müller, F. 2020. What Does Your Gaze Reveal About You? On the Privacy Implications of Eye Tracking See: https://link.springer.com/chapter/10.1007/978-3-030-42504-3_15 (accessed on 26 January 2023).

The role of government in this space should be to protect the privacy and fundamental rights of users. While it was felt the biometric uses of immersive tech should not overshadow its potential useful benefits, there is much work to be done to transfer and adapt currently existent rights into the immersive tech ecosystem. For this, participants felt there was a need for more legal scholars to be involved in discussions. The social structure of the immersive tech ecosystem should also be considered in future policymaking.

Further consideration of privacy is needed both for academic and industry work on immersive technologies. For example, in an industry context, using a technology should not count as consent to have your data collected. However, since large multinational tech companies own the immersive tech ecosystem, academics and SME find it hard to collaborate in this space since these companies are often commercially motivated by the exploitation of such data. This reinforced the need for supporting smaller responsible companies in the immersive tech industry though some participants noted difficulties working with altruistic companies.

For academic research, researchers should also be cautious and carefully consider the data they collect and the potential risks for research participants of using immersive technologies. Generally, it was argued a shift to alternative business models that reduce the amount of data collected and focus on collective rather than individual data could be an effective way of mitigating privacy concerns. However, it was also noted that anonymisation of data could come into conflict with aspirations for open science and shared datasets.

Many participants felt this was a unique opportunity for the UK to lead and set national precedents on privacy and data protection for immersive technologies. They hope that the upcoming Data Protection and Digital Information Bill and Online Safety Bill will consider immersive technologies in their scope is crucial for capitalising on this opportunity.

Annex

The Royal Society workshop

The Royal Society would like to thank the following workshop participants who have contributed to the development of this note.

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