



Virtual and Augmented Reality in Contemporary Society: A Review of Applications, Social Implications, Challenges, and Emerging Trends

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ABSTRACT

Background: Virtual Reality (VR) and Augmented Reality (AR) are integrated across education, healthcare, communication, libraries, industry, and society. They create opportunities for learning and social engagement while raising concerns about accessibility, inequality, privacy, ethics, and institutional readiness.

Objective: To synthesize literature on the applications, social implications, challenges, and emerging trends of VR and AR from a social-science perspective.

Methods: A narrative literature review was conducted using Google Scholar, Scopus, IEEE Xplore, and SpringerLink. Literature published primarily from 2021 to 2026 was searched using terms related to VR, AR, digital society, education, behaviour, communication, accessibility, participation, and adoption. Approximately 400 records were identified; after screening and full-text assessment, 40 publications were included. Thematic synthesis addressed applications, learning effects, communication, accessibility, inequality, privacy, ethics, adoption, and emerging trends.

Results: The literature indicates that VR and AR can support experiential learning, simulation, collaborative interaction, professional training, healthcare, information access, and immersive communication. Psychological and behavioural outcomes vary with usability, exposure, user characteristics, and specific application purpose. Major barriers include device and infrastructure costs, digital literacy gaps, accessibility limitations, cybersickness, privacy risks, data governance concerns, and uneven institutional capacity. Integration with artificial intelligence and advanced networks is expanding personalization, connectivity, and real-time immersive experiences.

Conclusion: VR and AR are becoming important components of digital society, but their social value depends on inclusive design, affordability, institutional preparedness, privacy protection, ethical governance, and trust. Longitudinal, comparative, and cross-cultural research is needed to clarify their societal consequences.

INTRODUCTION

Virtual Reality (VR) and Augmented Reality (AR) have developed from specialized visualization technologies into increasingly important components of contemporary digital transformation. VR creates computer-generated environments that provide users with immersive experiences, whereas AR integrates digital information with the physical environment (Munoz-Saavedra et al., 2020). The continuing evolution of AR, VR, and Mixed Reality (MR) has expanded their applications across education, healthcare, industry, entertainment, tourism, communication, and other areas of human activity (Jiang et al., 2023). This expansion has positioned immersive technologies not merely as technological tools but as emerging environments that can influence how individuals interact with information, physical spaces, institutions, and other people (Billinghurst, 2021). The societal relevance of immersive technologies is particularly associated with their capacity to alter human–technology interaction. Research on AR/VR applications has identified opportunities for immersive systems to support experiential activities across diverse professional and social contexts (Munoz-Saavedra et al., 2020). In industrial environments, AR and VR have increasingly been incorporated into Industry 4.0 processes, including visualization, training, simulation, and human–machine interaction (Machafa et al., 2022). Their application in retail and marketing has similarly created new forms of consumer interaction

in which digital and physical experiences are increasingly integrated (Fan et al., 2025). These developments indicate that immersive technologies are becoming embedded within broader transformations in how individuals work, consume information, and engage with digital environments. Education represents one of the most rapidly developing areas of immersive technology research. AR and VR can provide simulated environments, interactive visualizations, and experiential learning opportunities that may be difficult to reproduce through conventional teaching approaches (Asyam, 2025). The educational

HIGHLIGHTS	
Research insights	VR and AR support experiential learning, professional training, healthcare, communication, and information access, while their psychological and behavioral effects vary with usability, exposure, and user characteristics.
Practical insights	Inclusive design, affordability, digital literacy, accessibility, privacy protection, and institutional preparedness are essential for effective and equitable adoption of VR and AR.
Industry insights	Integrating VR and AR with artificial intelligence and advanced networks can expand personalization, connectivity, and real-time immersive experiences across education, healthcare, industry, and society.

potential of immersive technologies has also been linked to



increased engagement and opportunities for practical training across different learning contexts (Jiang et al., 2023). Recent research on libraries demonstrates that VR and AR are increasingly being incorporated into learning spaces, potentially expanding access to interactive information and educational experiences (Vamaravalli et al., 2025). University libraries have also begun exploring metaverse-related and immersive practices, reflecting the broader integration of XR into academic information environments (Guo et al., 2024).

The social and collaborative dimensions of immersive learning are equally important. Research on collaborative AR/VR development has emphasized interaction design, usability, and the challenges involved in creating shared immersive experiences (Kraub et al., 2021). Emerging virtual library environments further demonstrate how immersive systems can reproduce or extend conventional spaces for information seeking and interaction (Bonisch et al., 2025; Serghides et al., 2024). Procedurally generated environments may additionally increase the scalability and diversity of immersive learning experiences (Safikhani et al., 2025). These developments suggest that the educational significance of VR and AR extends beyond individual learning outcomes to include collaboration, participation, information access, and digitally mediated social interaction.

Immersive technologies have also attracted growing attention in psychology and behavioural research. VR-based environments can provide controlled and experiential settings for examining human responses and supporting interventions (Fu et al., 2021). Systematic evidence has investigated VR and gamification approaches in relation to anxiety and depression, highlighting their potential while also demonstrating the need for rigorous evaluation of psychological outcomes (Jingili et al., 2023). Healthcare research similarly identifies opportunities for AR, VR, and MR in simulation, training, therapeutic applications, and patient-related experiences (Magalhães et al., 2024; Mergen et al., 2024). VR has also been examined as an educational modality within healthcare, with systematic evidence indicating potential benefits for learning and training (Sung et al., 2024).

Communication and social interaction constitute another major dimension of immersive technology adoption. Shared virtual environments can facilitate interaction through avatars, spatial communication, and digitally represented social environments (Zarei et al., 2024). The development of immersive applications is increasingly supported by advanced communication infrastructures, particularly 5G systems designed to provide low-latency connectivity for demanding XR applications (Zorcec et al., 2023). Beyond conventional 5G deployment, research has explored extended-reality communication at scale and the requirements of time-critical immersive experiences (Alriksson et al., 2021; De Quinto et al., 2024).

The convergence of immersive technologies with artificial intelligence is further expanding their societal implications. AI can facilitate adaptive, personalized, and context-sensitive immersive experiences, particularly within educational environments (Lampropoulos, 2025). AI-enhanced VR has also emerged as an interdisciplinary research area connecting intelligent systems with immersive interaction (Wu et al., 2024). Meanwhile, AI-driven network optimization may improve the delivery of VR/AR applications within mobile learning environments (Liu et al., 2025). Such convergence creates opportunities for more responsive digital environments but also raises questions concerning data governance, transparency, privacy, and algorithmic decision-making.

Accessibility and digital inclusion are therefore central to understanding the social consequences of immersive technology. VR and AR may support participation among users with diverse needs when accessibility is incorporated into system and educational design (Maulidah & Christyodetaputri, 2025). Research

involving deaf and hard-of-hearing individuals demonstrates the potential of AR and VR as accessibility strategies beyond conventional educational settings (Gonzalez-Afonso et al., 2026). However, unequal access to devices, infrastructure, digital literacy, and institutional resources may limit the distribution of these benefits (Mondal, 2025). The social value of immersive technology consequently depends not only on technological capability but also on affordability, usability, accessibility, and inclusive implementation.

The institutional adoption of immersive technologies presents additional challenges. Research in architecture, engineering, construction, and facilities management indicates that successful VR/AR adoption is influenced by organizational conditions, implementation strategies, and contextual requirements (Fathi et al., 2025). Immersive technologies are also increasingly being explored for professional training and workforce development, demonstrating their potential role in changing established organizational learning practices (Dimitrov, 2025). Developments in vocational education further illustrate the growing use of virtual simulation as an alternative or complementary approach to practical training (Wang et al., 2025).

The broader technological ecosystem surrounding immersive environments is also rapidly evolving. Research has examined the integration of AR, VR, and artificial intelligence within digital media communication, indicating increasing convergence among immersive and intelligent technologies (Govindaraju & Thangam, 2025). Applications of immersive technology in architecture, engineering, and construction further demonstrate its expanding role in professional and organizational settings (Tan et al., 2022). Advanced XR applications increasingly depend on high-performance communication networks capable of supporting intensive real-time data exchange (Zorcec et al., 2023). Recent research has examined AI-supported 5G optimization specifically for immersive educational applications, illustrating the convergence of infrastructure and application-level innovation (Liu et al., 2025).

Despite this rapid expansion, the existing literature remains dispersed across technological, educational, psychological, organizational, communication, and applied disciplines. Bibliometric research has demonstrated substantial growth in extended-reality scholarship within education, while also identifying evolving research themes and directions (Hanid et al., 2025). Broader bibliometric analysis of AR in twenty-first-century education similarly demonstrates the increasing scale and interdisciplinary character of the field (Luthfi et al., 2025). Research on immersive technologies in libraries has identified emerging research hotspots and future directions, further illustrating the diversification of scholarly inquiry (Williams & Nwagwu, 2025).

Importantly, technological effectiveness alone does not determine social outcomes. Issues of accessibility, institutional preparedness, user acceptance, digital inequality, privacy, and ethical governance may influence whether immersive technologies generate sustainable and equitable benefits (Dadoo et al., 2025). The growing integration of immersive systems with AI and advanced communication infrastructures makes these questions increasingly significant (Miranda et al., 2025). Recent developments in next-generation immersive applications further suggest that VR and AR will become progressively interconnected with intelligent networks and computational infrastructures (Safikhani & Pirker, 2025). Emerging research on AI-RAN convergence illustrates the broader technological transition toward integrated intelligent communication ecosystems (Liu et al., 2025). At the same time, the continuing development of immersive volumetric experiences highlights the need to understand not only technical advancement but also its implications for users and society (Krieger et al., 2025).

Against this background, the present narrative review examines the social dimensions of VR and AR within contemporary digital society. It synthesizes evidence concerning applications and patterns of use,

learning and human behaviour, communication and social interaction, accessibility and digital inclusion, institutional adoption, ethical and privacy concerns, and emerging forms of social transformation. By adopting an interdisciplinary social-science perspective, this review seeks to contextualize immersive technologies within the social, cultural, educational, psychological, and institutional environments in which they are adopted and experienced.

METHODOLOGY

Review Design

This study employed a narrative literature review to examine the

social, educational, psychological, cultural, and communicative implications of Virtual Reality (VR) and Augmented Reality (AR) in contemporary society. The review was designed within a social-science framework, with particular emphasis on how immersive technologies influence human behaviour, learning experiences, social interaction, communication, accessibility, participation, and emerging forms of digital social engagement. The review primarily addressed literature relevant to Digital Society and Technology Studies, with additional relevance to Education, Psychology, Media and Communication Studies, and other interdisciplinary areas of the social sciences as shown in Fig. 1.

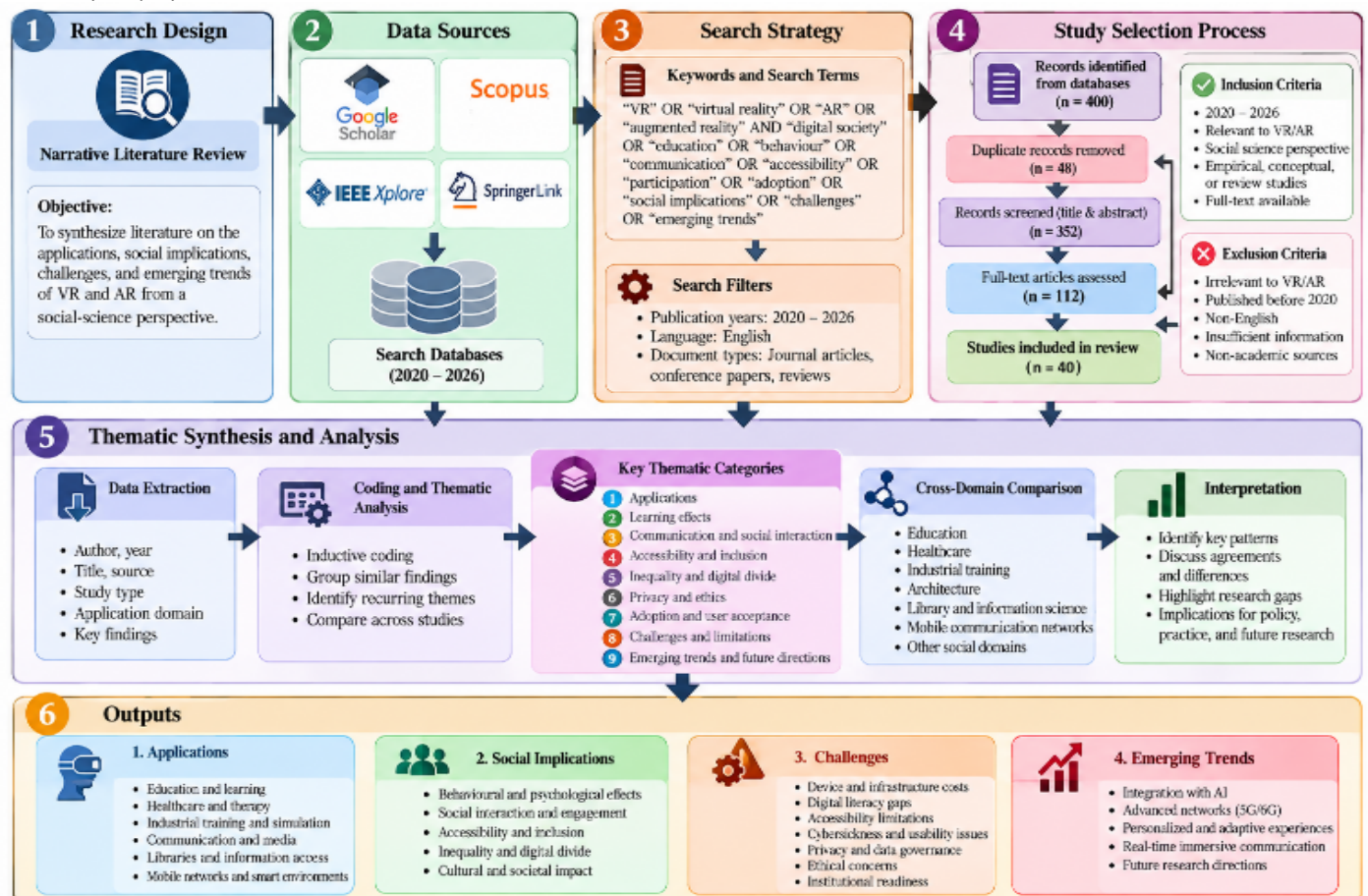


Fig. 1. Methodology

Literature Search Strategy

A structured literature search was conducted using Google Scholar, Scopus, IEEE Xplore, and SpringerLink. The search focused primarily on literature published between 2024 and 2026 to capture recent developments in the rapidly evolving field of immersive technologies. Search terms were developed around combinations of "virtual reality," "augmented reality," "extended reality," "immersive technology," "digital society," "social interaction," "human behaviour," "education," "psychology," "communication," "social participation," "accessibility," "digital inclusion," "social transformation," and "technology adoption."

Representative search combinations included: ("virtual reality" OR "augmented reality" OR "extended reality") AND ("digital society" OR "social interaction" OR "human behaviour"); ("virtual reality" OR "augmented reality") AND ("education" OR "learning"); and ("immersive technology") AND ("communication" OR "social participation" OR "digital inclusion").

Eligibility Criteria

Studies were considered eligible when they directly examined the use, effects, adoption, perception, or social implications of VR, AR, or

related immersive technologies. Empirical studies, systematic and narrative reviews, bibliometric studies, conceptual papers, and relevant interdisciplinary research were considered. Priority was given to peer-reviewed journal articles and scholarly conference publications addressing social, behavioural, educational, psychological, cultural, or communication-related dimensions of immersive technologies.

Studies were excluded when they focused exclusively on hardware engineering, device specifications, network architecture, or purely technical performance without a meaningful connection to social-science questions. Non-scholarly blogs, opinion pieces, duplicate records, and publications without sufficient relevance to the review objectives were also excluded. Foundational publications were retained selectively where necessary to establish key concepts or theoretical background.

Study Selection

The initial search identified approximately 400 potentially relevant records. After removal of duplicate records, approximately 310 unique publications remained. Title and abstract screening reduced the pool to approximately 120 potentially relevant studies, which were subsequently assessed for relevance to the review objectives. Following full-text assessment, 40 publications were included in the final narrative synthesis.

The selection process emphasized conceptual and empirical relevance to the social dimensions of immersive technologies rather than technical sophistication alone. Studies were retained when they contributed evidence concerning human experiences, behavioural outcomes, learning, communication, social participation, accessibility, adoption, or broader societal transformation.

Data Extraction and Thematic Analysis

Information was extracted from the included literature concerning publication year, study context, technology examined, population or users, research approach, principal findings, social or behavioural outcomes, reported benefits, challenges, and implications for future research.

A qualitative thematic synthesis was subsequently conducted. The literature was organized into four major analytical themes: (1) applications and patterns of VR/AR use in society; (2) effects on learning, behaviour, communication, and social interaction; (3) barriers related to accessibility, digital inequality, privacy, ethics, cost, and technology adoption; and (4) emerging trends and implications for future social transformation. Particular attention was given to similarities and differences across educational, psychological, communicative, cultural, and broader digital-society contexts.

Assessment of Literature Quality

As this was a narrative review rather than a systematic review or meta-analysis, no formal risk-of-bias instrument was applied. Nevertheless, the credibility and relevance of the included literature were considered during synthesis, with greater emphasis placed on peer-reviewed studies, transparent research methods, clearly described study populations or contexts, and publications providing substantive evidence relevant to the social-science dimensions of VR and AR.

Methodological Limitations

The narrative design involves a degree of researcher judgement in study selection and thematic interpretation, and therefore cannot provide the same level of reproducibility as a systematic review. The review was also subject to database coverage, publication availability, language restrictions, and the rapidly changing nature of immersive technologies. Furthermore, differences in study populations, research designs, outcome measures, and social contexts limited direct quantitative comparison across studies. These limitations were addressed by emphasizing thematic synthesis and cross-study interpretation rather than quantitative pooling of findings.

Narrative Synthesis:

Social Dimensions of Virtual and Augmented Reality

Virtual Reality (VR) and Augmented Reality (AR) have evolved from specialized visualization technologies into increasingly important components of contemporary digital society. VR generates computer-mediated environments that create an immersive sense of presence, whereas AR integrates digitally generated information with the user's physical surroundings. Together with Mixed Reality (MR) and Extended Reality (XR), these technologies represent a broader transition from conventional screen-based interaction toward spatial, immersive, and increasingly embodied forms of digital engagement (Jiang et al., 2023; Munoz-Saavedra et al., 2020).

The social significance of VR and AR extends beyond their technical capabilities. Their applications across education, healthcare, industry, libraries, retail, communication, and professional training demonstrate their growing integration into every day and institutional practices (Fan et al., 2025; Kraub et al., 2021; Lampropoulos, 2025; Machała et al., 2022; Vamaravalli et al., 2025). This expansion suggests that immersive technologies should increasingly be examined as components of digital society rather than solely as technological innovations. Their capacity to modify how individuals access information, interact with digital content,

collaborate with others, and experience simulated environments creates consequences at individual, organizational, and societal levels (Billinghurst, 2021; Guo et al., 2024).

An important characteristic of immersive technologies is their potential to alter the relationship between users and digital information. Rather than interacting with information primarily through two-dimensional interfaces, users can experience digital content spatially and interactively. This shift may increase perceptions of presence, engagement, and experiential involvement, particularly in learning, training, and collaborative environments (Asyam, 2025; Jiang et al., 2023; Serghides et al., 2024). However, the social implications of this transition are not inherently positive or negative. Outcomes depend on technological design, user characteristics, institutional context, accessibility, and the purpose for which immersive systems are deployed.

The expansion of immersive technologies consequently raises broader questions concerning digital inclusion, accessibility, privacy, trust, and unequal access to technological resources (Gonzalez-Afonso et al., 2026; Maulidah & Christyodetaputri, 2025). Economic resources, digital literacy, infrastructure, and institutional capacity can determine whether individuals and communities are able to participate meaningfully in immersive environments (Dodoo et al., 2025). Thus, the diffusion of VR and AR should be understood within the broader social transformation associated with digitalization, in which technological innovation can simultaneously create new opportunities and reproduce existing inequalities.

Immersive Technologies and Human Behaviour

One of the central themes emerging from the literature concerns the relationship between immersive technologies and human behaviour. The defining characteristic of VR is its capacity to provide an embodied and spatial experience that may produce a stronger perception of presence than conventional digital media (Fu et al., 2021; Jiang et al., 2023). AR similarly modifies users' interaction with their physical surroundings by integrating digital information into real-world contexts (Billinghurst, 2021; Munoz-Saavedra et al., 2020). These characteristics can influence attention, motivation, perception, engagement, and patterns of interaction.

Research across education, healthcare, psychology, and professional training indicates that immersive environments may increase user involvement and provide opportunities for experiential interaction (Asyam, 2025; Jingili et al., 2023; Mergen et al., 2024; Sung et al., 2024). The psychological significance of these environments is particularly evident in applications where simulation, controlled exposure, or repeated practice is required. VR-based interventions, for example, have been investigated in relation to anxiety and depression, while healthcare research has examined immersive environments for education and professional training (Jingili et al., 2023; Mergen et al., 2024).

Nevertheless, increased engagement should not be equated automatically with improved long-term outcomes. An immersive environment may attract attention because of its novelty or sensory richness without necessarily producing sustained changes in knowledge, behaviour, or social participation. The effects of immersive technology may also vary according to exposure duration, system usability, previous technological experience, individual characteristics, and the specific application context (Maulidah & Christyodetaputri, 2025; Sung et al., 2024).

This distinction is particularly important for social-science research. Much of the literature evaluates immediate outcomes such as engagement, satisfaction, usability, or perceived presence, whereas longer-term behavioural and social consequences remain less consistently examined. Consequently, future research should distinguish between short-term experiential responses and sustained behavioural change through longitudinal, comparative, and context-sensitive study designs.

VR and AR in Education and Social Learning

Education represents one of the most extensively investigated social applications of immersive technology. VR and AR can provide simulated environments, interactive visualizations, virtual laboratories, spatial demonstrations, and experiential learning opportunities that may be difficult to reproduce through conventional classroom instruction (Asyam, 2025; Hanid et al., 2025; Tan et al., 2022). The literature increasingly characterizes immersive learning as an approach capable of supporting engagement, practical training, visualization, and learner participation.

The educational significance of VR and AR, however, extends beyond individual academic performance. Immersive environments can facilitate collaborative learning, peer interaction, experiential problem-solving, and shared participation. Research on collaborative AR/VR environments highlights the importance of interaction design and the development of systems that allow multiple users to engage within shared digital spaces (Kraub et al., 2021; Serghides et al., 2024). Such environments may consequently alter traditional relationships between learners, teachers, learning materials, and educational spaces.

The expansion of immersive technologies into libraries further illustrates this transformation. Studies of university libraries and virtual library environments indicate that VR and AR are increasingly being considered for information access, learning spaces, navigation, and collaborative exploration (Guo et al., 2024; Serghides et al., 2024; Vamaravalli et al., 2025). These developments suggest that the educational role of immersive technology may extend beyond formal classroom instruction toward broader information and knowledge ecosystems.

At the same time, the educational benefits of VR and AR cannot be separated from questions of equity. The acquisition and maintenance of head-mounted displays, compatible computing systems, software, and reliable connectivity can impose substantial financial and infrastructural demands (Maulidah & Christyodetaputri, 2025; Mondal, 2025). Institutions with limited resources may therefore experience difficulties implementing immersive learning at the same scale as better-resourced institutions. Teacher preparedness represents another important consideration because effective implementation requires pedagogical knowledge in addition to technical familiarity (Dimitrov, 2025; Hanid et al., 2025).

Accessibility is similarly critical. Immersive technologies can potentially support learners with diverse needs when accessibility is incorporated into system design. Research involving deaf and hard-of-hearing learners demonstrates the potential of AR/VR as an accessibility strategy, while broader work on inclusive learning emphasizes the importance of designing immersive environments around diverse user requirements (Gonzalez-Afonso et al., 2026; Maulidah & Christyodetaputri, 2025). Thus, the educational value of VR and AR should be assessed not only in terms of engagement or learning effectiveness but also in terms of affordability, accessibility, teacher preparedness, and equitable participation.

Psychological and Experiential Dimensions

The psychological dimension of immersive technology is closely associated with the concepts of presence, engagement, motivation, perception, and emotional response. VR creates environments in which users can experience simulated situations from an embodied perspective, making it particularly relevant to experiential learning, behavioural interventions, and controlled simulation (Fu et al., 2021; Jingili et al., 2023).

The therapeutic and educational literature illustrates how these characteristics can be translated into practical applications. VR has been investigated for psychological interventions, including applications related to anxiety and depression, while healthcare education research has examined its capacity to support training and simulated practice (Jingili et al., 2023; Sung et al., 2024). These applications demonstrate the potential of immersive environments to provide repeatable experiences in contexts where direct exposure

may be difficult, costly, or ethically challenging.

However, psychological engagement also requires critical examination. Immersion can produce discomfort, cybersickness, cognitive load, or other adverse user experiences, particularly when systems are poorly designed or used for prolonged periods. These factors may influence both acceptance and the effectiveness of immersive applications (Sung et al., 2024; Toni et al., 2024). The existence of strong experiential effects therefore does not eliminate the importance of usability and human factors; rather, it makes them more significant.

Individual differences should also be considered. Users vary in technological familiarity, accessibility requirements, tolerance of immersive environments, learning preferences, and expectations. Consequently, generalized claims regarding the psychological effectiveness of VR and AR may overlook substantial variation between populations.

From a social-science perspective, this evidence supports a shift from technology-centred evaluation toward human-centred assessment. The relevant question is not simply whether an immersive system can produce a particular psychological response, but under what conditions that response occurs, among which users, and with what consequences over time.

VR, AR, Communication, and Social Interaction

VR and AR are also contributing to the transformation of digitally mediated communication. Conventional digital communication generally relies on text, images, audio, and video, whereas immersive environments can enable users to communicate within shared three-dimensional spaces through avatars and spatial representations (Kraub et al., 2021; Serghides et al., 2024). This creates opportunities for communication that is more spatial, embodied, and interactive than conventional screen-mediated interaction.

Shared immersive environments may support remote collaboration, education, meetings, social communities, cultural experiences, and professional interaction. Collaborative AR/VR research emphasizes the importance of designing systems that allow users to interact effectively within shared environments (Kraub et al., 2021). The development of virtual libraries similarly demonstrates how immersive environments can reproduce or extend physical spaces for information exchange and social interaction (Serghides et al., 2024).

The communication potential of immersive technologies is closely connected with developments in digital infrastructure. XR applications require low-latency, high-capacity communication to support real-time interaction and increasingly complex immersive content (Alriksson et al., 2021; Zorcec et al., 2023). Advances in 5G and related communication architectures therefore contribute to the practical expansion of immersive social environments.

Nevertheless, immersive communication introduces social questions that cannot be resolved through technological optimization alone. Avatar-based interaction may influence identity presentation, self-representation, interpersonal boundaries, and perceptions of social presence. Privacy and authenticity may also become more complex when users interact through digitally mediated identities. These concerns indicate that immersive communication should be conceptualized as an evolving form of social interaction rather than merely as a more advanced version of video conferencing or conventional online communication.

Digital Inclusion, Accessibility, and Social Inequality

Digital inclusion represents one of the most important social dimensions of immersive technology. Although VR and AR may expand access to education, information, cultural experiences, remote participation, and specialized training, the availability of these opportunities depends on users' ability to obtain and effectively operate the required technologies (Gonzalez-Afonso et al., 2026; Maulidah & Christyodetaputri, 2025).

Economic inequality can influence access through the cost of head-mounted displays, computing devices, software, and high-speed

connectivity. Institutional disparities may further amplify these differences because schools, universities, libraries, healthcare organizations, and workplaces do not possess equivalent technological resources. Research on immersive education and library environments illustrates the importance of institutional infrastructure in determining implementation capacity (Fathi et al., 2025; Maulidah & Christyodetaputri, 2025; Vamaravalli et al., 2025). Accessibility presents another dimension of inequality. Individuals with visual, auditory, motor, or cognitive disabilities may encounter barriers when immersive systems are not designed according to inclusive principles (Gonzalez-Afonso et al., 2026). Inclusive education research suggests that AR and VR can nevertheless function as accessibility strategies when systems are intentionally adapted to diverse user requirements (Gonzalez-Afonso et al., 2026). Digital literacy also influences participation. Possession of a device does not necessarily guarantee meaningful use. Users require sufficient knowledge, confidence, and support to navigate immersive environments effectively. Consequently, the digital divide associated with VR and AR is multidimensional, encompassing not only device ownership but also connectivity, affordability, accessibility, digital skills, institutional support, and the ability to derive meaningful benefits from technology.

This perspective shifts the focus from the question of whether immersive technologies are accessible to the broader question of who benefits, under what conditions, and with what consequences. Future research should therefore evaluate distributional outcomes rather than treating technological availability as equivalent to social inclusion.

Privacy, Ethics, and Trust

The growing integration of VR and AR into education, healthcare, communication, libraries, workplaces, and consumer environments creates increasingly important ethical and privacy considerations. Immersive systems may generate extensive information concerning user interactions, movement, behavioural responses, preferences, and engagement patterns. When combined with artificial intelligence, these data can potentially support increasingly detailed personalization and behavioural analysis (Lampropoulos, 2025; Wu et al., 2024).

The convergence of AI and immersive technologies introduces both opportunities and governance challenges. AI can facilitate adaptive learning environments, intelligent interaction, and personalized immersive experiences, but it may also increase the scale and sophistication of data processing (Lampropoulos, 2025; Liu et al., 2025; Wu et al., 2024). This creates questions concerning informed consent, data ownership, transparency, surveillance, algorithmic decision-making, identity protection, and responsible data governance.

Trust is therefore likely to become an important determinant of sustainable adoption. Users may be willing to engage with immersive systems when they perceive the technology as useful, safe, transparent, and appropriately governed. Conversely, uncertainty concerning data collection or the use of behavioural information may reduce acceptance. These considerations indicate that technical performance alone cannot explain adoption; social perceptions, institutional practices, and governance mechanisms must also be considered.

A socially responsible approach to immersive technology should consequently incorporate privacy-by-design principles, clear consent mechanisms, transparent data practices, accessibility standards, and institutional accountability. Further empirical research is required to understand how users perceive and negotiate these risks across different cultural, educational, organizational, and socioeconomic settings.

Emerging Social Transformation

The literature collectively indicates that VR and AR are increasingly becoming embedded within wider processes of digital

transformation. Their applications in education, healthcare, libraries, retail, professional training, communication, and industrial environments demonstrate that immersive technologies can influence both individual experiences and institutional practices (Dimitrov, 2025; Fan et al., 2025; Lampropoulos, 2025; Mergen et al., 2024; Vamaravalli et al., 2025).

An important development is the convergence of immersive technologies with artificial intelligence and advanced communication infrastructures. AI-supported immersive systems may enable adaptive and personalized experiences, while 5G and emerging network architectures can support increasingly demanding real-time applications (Alriksson et al., 2021; Lampropoulos, 2025; Liu et al., 2025; Zorcec et al., 2023). The combination of these technologies may contribute to the development of more responsive, interconnected, and persistent digital environments.

Digital twins, collaborative virtual environments, intelligent learning systems, and immersive workforce training further illustrate this transition (Dimitrov, 2025; Safikhani et al., 2025; Wang et al., 2025). Such developments may change organizational learning, professional preparation, remote collaboration, and interaction with digital information. However, the social consequences of these transformations remain dependent on institutional policies, cultural expectations, socioeconomic conditions, and regulatory frameworks.

The literature also indicates that technological development does not automatically translate into social progress. A technically sophisticated immersive environment may remain socially limited if it is unaffordable, inaccessible, poorly governed, or inappropriate for its intended population (Dodoo et al., 2025; Gonzalez-Afonso et al., 2026; Maulidah & Christyodetaputri, 2025). Consequently, future research should move beyond technology-centred measures of performance and examine the distribution, sustainability, and social consequences of immersive technology adoption.

Longitudinal research is particularly necessary because many existing studies examine short-term perceptions, usability, engagement, or immediate learning outcomes. Comparative and cross-cultural research is also needed to determine whether findings obtained in specific institutions or populations can be generalized across different social contexts. Interdisciplinary approaches integrating social science, education, psychology, communication, information science, and technology studies may provide a more comprehensive understanding of immersive digital transformation.

DISCUSSION

The present narrative review examined the expanding role of VR and AR in contemporary digital society, with particular attention to human behaviour, education, psychological experience, communication, social participation, accessibility, privacy, and institutional adoption. The evidence indicates that immersive technologies are increasingly moving beyond experimental or specialized applications and becoming integrated into broader processes of digital transformation (Fan et al., 2025; Jiang et al., 2023; Munoz-Saavedra et al., 2020; Vamaravalli et al., 2025).

A central finding is that VR and AR modify conventional patterns of interaction between individuals and digital information. VR provides immersive and spatial experiences, while AR integrates digital content into physical environments (Jiang et al., 2023; Munoz-Saavedra et al., 2020). These characteristics may increase experiential engagement and create new possibilities for learning, training, collaboration, and communication (Kraub et al., 2021; Tan et al., 2022). However, the literature does not justify treating engagement as a universal proxy for effectiveness. Immediate engagement may reflect novelty or technological appeal and may not necessarily translate into sustained learning, behavioural change, or improved social outcomes.

Education provides a particularly clear example of this distinction. Immersive technologies can facilitate experiential learning, visualization, simulation, and collaboration (Hanid et al., 2025; Jiang

et al., 2023; Tan et al., 2022). At the same time, their implementation introduces costs related to devices, infrastructure, software, educator training, and technical support (Fathi et al., 2025; Maulidah & Christyodetaputri, 2025). Therefore, the educational contribution of VR and AR should be evaluated through a multidimensional framework incorporating learning outcomes, accessibility, institutional capacity, teacher preparedness, affordability, and long-term educational sustainability.

The psychological evidence similarly demonstrates both opportunities and limitations. VR can provide controlled environments for experiential learning and therapeutic interventions, while research has explored its application to psychological conditions and healthcare education (Jingili et al., 2023; Sung et al., 2024). However, cybersickness, cognitive load, discomfort, technological unfamiliarity, and individual differences may influence user responses. These factors suggest that immersive technology should not be conceptualized as producing uniform psychological effects across populations.

Communication represents another area in which VR and AR may generate qualitative changes rather than simply incremental improvements. Shared immersive environments can facilitate spatial interaction and collaborative participation through avatars and digital representations (Kraub et al., 2021; Serghides et al., 2024). The increasing availability of low-latency communication infrastructure further supports the development of these environments (Alriksson et al., 2021; Zorcec et al., 2023). Nevertheless, questions concerning identity, privacy, authenticity, interpersonal boundaries, and social norms require greater empirical attention.

Digital inclusion emerged as a particularly important cross-cutting issue. Immersive technologies may create new opportunities for remote participation, information access, learning, and accessibility, but these opportunities are mediated by socioeconomic resources, infrastructure, digital literacy, and physical accessibility (Gonzalez-Afonso et al., 2026; Maulidah & Christyodetaputri, 2025). The evidence therefore suggests that the digital divide associated with immersive technologies should be understood as multidimensional. Device ownership alone is insufficient; meaningful participation also requires appropriate skills, accessible design, reliable infrastructure, and institutional support.

The privacy and ethical implications of immersive technology are similarly substantial. The convergence of VR/AR with AI can facilitate personalized and adaptive environments but may also increase the volume and sensitivity of user data processed by digital systems (Lampropoulos, 2025; Liu et al., 2025; Wu et al., 2024). This creates a need for transparent consent, responsible data governance, privacy protection, and institutional accountability. Trust should consequently be treated as a social and organizational component of technology adoption rather than merely as a secondary consideration.

The review also highlights the importance of institutional context. Adoption within universities, libraries, healthcare organizations, and workplaces requires organizational readiness, trained personnel, appropriate infrastructure, financial resources, and policies supporting responsible implementation (Dimitrov, 2025; Fathi et al., 2025; Vamaravalli et al., 2025). The acquisition of hardware alone is therefore unlikely to ensure successful or sustainable adoption.

An additional finding concerns the convergence of VR and AR with AI and advanced communication systems. AI can enable personalization and intelligent interaction, while advanced networks support increasingly demanding immersive applications (Lampropoulos, 2025; Liu et al., 2025). These developments suggest that future immersive environments may become more adaptive, connected, and socially embedded. However, greater technological integration may also increase governance challenges

involving data protection, algorithmic transparency, surveillance, and unequal access.

The findings have important implications for future research. Existing literature frequently emphasizes technological feasibility, user engagement, usability, or immediate learning outcomes, whereas comparatively greater attention is needed toward longitudinal behavioural effects, social relationships, inclusion, cultural variation, institutional consequences, and distributional outcomes. Bibliometric research demonstrates the rapid expansion and increasing interdisciplinarity of the field (Hanid et al., 2025; Luthfi et al., 2025), while research in libraries and other institutional settings indicates that immersive technologies are becoming embedded in diverse knowledge and social environments (Vamaravalli et al., 2025; Williams & Nwagwu, 2025).

Future studies should therefore employ longitudinal, comparative, and cross-cultural designs and should examine heterogeneous user populations rather than relying predominantly on narrowly defined samples. Mixed-method research combining quantitative measures with qualitative investigation of user experiences may be particularly valuable for understanding how individuals and institutions negotiate immersive technologies in real-world contexts.

Overall, the evidence supports understanding VR and AR as emerging components of digital society whose consequences are shaped by the interaction between technological affordances and social conditions. Their future significance will depend not only on advances in hardware, software, AI, and communication infrastructure but also on accessibility, digital literacy, institutional readiness, ethical governance, privacy protection, and public trust. A social-science perspective is therefore essential for examining whether immersive technologies produce sustainable and inclusive forms of digital participation and how they may reshape established patterns of learning, communication, work, and social interaction.

CONCLUSION

Virtual Reality (VR) and Augmented Reality (AR) are increasingly influencing contemporary digital society by transforming learning, communication, professional training, healthcare, information access, and social interaction. The reviewed literature demonstrates that immersive technologies can provide experiential, collaborative, and accessible digital experiences; however, their societal outcomes depend strongly on implementation context and user characteristics. Key challenges include affordability, digital inequality, accessibility barriers, technological discomfort, privacy concerns, ethical governance, data protection, and institutional readiness. The convergence of VR and AR with artificial intelligence and advanced communication networks is expected to expand their capabilities and applications. Future research should prioritize longitudinal, comparative, and cross-cultural studies to examine sustained behavioural, social, educational, and institutional effects and promote inclusive, responsible, and sustainable adoption.

Ethical Considerations

Ethical approval and informed consent were not required for this study because it was a narrative literature review based exclusively on previously published literature and did not involve human participants or the collection of primary data.

Data Availability

The data supporting this review are derived from the published literature cited in the manuscript. No primary dataset was generated or analyzed for this study.

Author Contributions

Faisal Hameed, Atif Masih, Syed Waqas Najeeb, Ahsan Balal Shaker, and Shagufta Sattar: Conceptualization, methodology, data curation,

formal analysis, and writing—original draft preparation and review. All authors contributed to the conception and design of the study, interpretation of the findings, and preparation and critical revision of the manuscript. All authors approved the final version of the manuscript and accept responsibility for the integrity and accuracy of the research work.

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Conflict of Interest

The author declares no conflict of interest.

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Use of AI

Artificial intelligence tools were used in the preparation of this manuscript. ChatGPT was used for language correction, while Gemini AI was used for image generation.

REFERENCES

- Alriksson, F., Phillips, C., Pradas, J. L., & Zaidi, A. (2021). XR and 5G: Extended reality at scale with time-critical communication. *Ericsson Technology Review*, 2021(8), 2–13.
- Asyam, M. R. D. (2025). Integrating augmented reality (AR) in education in the era of Society 5.0: A systematic literature review. *SITEKNIK: Sistem Informasi, Teknik dan Teknologi Terapan*, 2(4), 333–342.
- Billinghurst, M. (2021). Grand challenges for augmented reality. *Frontiers in Virtual Reality*, 2, Article 578080. <https://doi.org/10.3389/frvir.2021.578080>
- Bönisch, K., Mehler, A., Babbili, S., Heinrich, Y., Stephan, P., & Abrami, G. (2025). Viki LibraRy: collaborative hypertext browsing and navigation in virtual reality. *New Review of Hypermedia and Multimedia*, 31(1-2), 45–75.
- De Quinto, C., Navarro, A., Otero, G., Koneva, N., Hernández, J. A., Quagliotti, M., ... & Larrabeiti, D. (2024, July). On the impact of VR/AR applications on optical transport networks: First experiments with Meta Quest 3 gaming and conferencing applications. In *2024 24th international conference on transparent optical networks (ICTON)* (pp. 1-6). IEEE.
- Dimitrov, K. (2025). The growing role of VR and AI industry to transform soft skills development. *Trakia Journal of Sciences*, 23(Suppl. 2), 6.
- Dodoo, J. E., Al-Samarraie, H., Alzahrani, A. I., & Tang, T. (2025). XR and workers' safety in high-risk industries: A comprehensive review. *Safety Science*, 185, Article 106804.
- Fan, X., Xun, J., Dolega, L., & Xiong, L. (2025). The role of augmented and virtual reality in shaping retail marketing: A meta-analysis. *Sustainability*, 17(2), 728.
- Fathi, S., Sabeti, S., Shoghli, O., Heydarian, A., & Balali, V. (2025). Adoption of virtual and augmented reality in the architecture, engineering, construction, and facilities management (AEC-FM): Mixed method analysis of trends, gaps, and solutions. *Frontiers in Built Environment*, 11, Article 1580639.
- Fu, Y., Hu, Y., Sundstedt, V., & Fagerström, C. (2021). A Survey of Possibilities and Challenges with AR/VR/MR and Gamification Usage in Healthcare. *HEALTHINF*, 10, 0010386207330740.
- Gonzalez-Afonso, M. C., Perdomo-López, C. de los Á., Plasencia-Carballo, Z., & Pérez-Jorge, D. (2026). Inclusive education beyond formal settings: AR and VR as accessibility strategies for deaf and hard-of-hearing individuals. *Frontiers in Education*, 10. <https://doi.org/10.3389/educ.2025.1715885>
- Govindaraju, V., & Thangam, D. (2025). Education and training revolution: A review on AR, VR, and IoT integration in educational perspective. In *Intelligent Business Analytics* (pp. 253–271).
- Guo, Y., Li, S., Zhang, X., Fu, Y., Yuan, Y., & Liu, Y. (2024). Embracing the metaverse: A survey of virtual reality and augmented reality practices at the United States' top one hundred university libraries. *College & Research Libraries*, 85(7), 1006.
- Hanid, M. F. A., Zakaria, M. I., & Hassan, R. (2025). The advancement of extended reality in education: Insights from a 2019–2024 bibliometric analysis. *Multimedia Tools and Applications*, 1–25.
- Jiang, J., Zhou, G., Duffy, B. M., & Duffy, V. G. (2023). AR and VR: A review on recent progress and applications. In *International Conference on Human-Computer Interaction* (pp. 46–63). Springer Nature Switzerland.
- Jingili, N., Oyeler, S. S., Nyström, M. B. T., & Anyshchenko, L. (2023). A systematic review on the efficacy of virtual reality and gamification interventions for managing anxiety and depression. *Frontiers in Digital Health*, 5, Article 1239435. <https://doi.org/10.3389/fdgth.2023.1239435>
- Kraub, V., Boden, A., Oppermann, L., & Reiners, R. (2021). Current practices, challenges, and design implications for collaborative AR/VR application development. In *Proceedings of the 2021 CHI Conference on Human Factors in Computing Systems* (pp. 1–15).
- Krieger, K., Egger, J., Kleesiek, J., Gunzer, M., & Chen, J. (2025). Multisensory extended reality applications offer benefits for volumetric biomedical image analysis in research and medicine. *Journal of Imaging Informatics in Medicine*, 38, 646–655. <https://doi.org/10.1007/s10278-024-01094-x>
- Lampropoulos, G. (2025). Combining artificial intelligence with augmented reality and virtual reality in education: Current trends and future perspectives. *Multimodal Technologies and Interaction*, 9(2), 11.
- Liu, X., Zhang, Y., & Chen, W. (2025). AI-driven 5G network optimization for immersive educational VR/AR applications in mobile learning environments. *Discover Internet of Things*, 5, Article 246. <https://doi.org/10.1007/s43926-025-00246-x>
- Luthfi, A., Muskhir, M., Effendi, H., Jalinus, N., & Nikolaevna, G. M. (2025). Mapping the future of augmented reality in 21st century education: A comprehensive bibliometric review. *Journal of Hypermedia & Technology-Enhanced Learning*, 3(2), 165–184.
- Machala, S., Chamier-Gliszczyński, N., & Królikowski, T. (2022). Application of AR/VR technology in Industry 4.0. *Procedia Computer Science*, 207, 2990–2998.
- Magalhães, R., Oliveira, A., Terroso, D., Vilaça, A., Veloso, R., Marques, A., ... & Coelho, L. (2024). Mixed reality in the operating room: a systematic review. *Journal of Medical Systems*, 48(1), 76.
- Maulidah, G., & Christyodetaputri, J. H. (2025). Beyond engagement: Integrating AR and VR for inclusive learning in K-higher education. *Sinergi International Journal of Education*, 3(1), 26–40.
- Mergen, M., Graf, N., & Meyerheim, M. (2024). Reviewing the current state of virtual reality integration in medical education – a scoping review. *BMC Medical Education*, 24, Article 788. <https://doi.org/10.1186/s12909-024-05777-5>
- Miranda, A., Vallejo, A. M., Ayala, P., Garcia, M. V., & Naranjo, J. E. (2025). Enhancing industrial processes through augmented reality: A scoping review. *Future Internet*, 17(8), 358.
- Mondal, D. (2025). Immersive technologies in the library: The role of virtual and augmented reality in AI-based learning. *SSRN*. <https://doi.org/10.2139/ssrn.5388150>
- Munoz-Saavedra, L., Miró-Amarante, L., & Domínguez-Morales, M. (2020). Augmented and virtual reality evolution and future tendency. *Applied Sciences*, 10(1), 322. <https://doi.org/10.3390/app10010322>
- Safikhani, S., Gross, B., & Pirker, J. (2025). The application of procedurally generated libraries in immersive virtual reality. In *International Conference on Immersive Learning* (pp. 217–231). Cham: Springer Nature Switzerland.
- Safikhani, S., & Pirker, J. (2025). Towards next generation immersive applications in 5G environments. *arXiv*. <https://doi.org/10.48550/arXiv.2507.20050>
- Serghides, C. G., Christoforides, G., Iakovidis, N., & Aristidou, A. (2024). Design and implementation of an interactive virtual library based on its physical counterpart. *Virtual Reality*, 28(3), 124.
- Sung, H., Kim, M., Park, J., Shin, N., & Han, Y. (2024). Effectiveness of virtual reality in healthcare education: Systematic review and meta-analysis. *Sustainability*, 16(19), 8520. <https://doi.org/10.3390/su16198520>
- Tan, Y., Xu, W., Li, S., & Chen, K. (2022). Augmented and virtual reality (AR/VR) for education and training in the AEC industry: A systematic review of research and applications. *Buildings*, 12(10), 1529.
- Toni, E., Toni, E., Fereidooni, M., & Ayatollahi, H. (2024). Acceptance and use of extended reality in surgical training: An umbrella review.

Systematic Reviews, 13, Article 299. <https://doi.org/10.1186/s13643-024-02723-w>

Vamaravalli, R., Kattunga, N. B., & Tatipaka, A. (2025). Virtual reality (VR) and augmented reality (AR) in library learning spaces. *International Journal of Research in Library Science*, 11(3), 181–190. <https://doi.org/10.26761/IJRLS.11.3.2025.1930>

Wang, X., Peng, Y., Liu, X., Wang, T., & Wang, J. (2025). Application pathways of virtual simulation technology in vocational education. In *International Conference on Technology in Education* (pp. 168–179). Springer Nature Singapore.

Williams, C. B., & Nwagwu, W. E. (2025). Virtual and augmented reality in the libraries: Situation analysis, hotspots and new directions. *Journal of Librarianship and Information Science*. <https://doi.org/10.1177/09610006251332613>

Wu, Y., Hu, K., Chen, D. Z., & Wu, J. (2024). AI-enhanced virtual reality in medicine: A comprehensive survey. In *Proceedings of the Thirty-Third International Joint Conference on Artificial Intelligence* (pp. 8326–8334). <https://doi.org/10.24963/ijcai.2024/920>

Zarei, T., Emery, M., Saredakis, D., Lee, G. A., Stubbs, B., Szpak, A., & Loetscher, T. (2024). "Being there together for health": A systematic review on the feasibility, effectiveness and design considerations of immersive collaborative virtual environments in health applications. *arXiv*. <https://doi.org/10.48550/arXiv.2412.04760>

Zorcec, T., Masood, A., & Fettweis, G. (2023). Towards an evolved immersive experience: Exploring 5G- and beyond-enabled ultra-low-latency communications for augmented and virtual reality. *Sensors*, 23(7), 3682. <https://doi.org/10.3390/s23073682>