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Perspective Paper

Transforming Information and Learning Resource Centres (ILRCs) with Immersive Technologies for the Future of Learning

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ABSTRACT

Immersive technologies such as Virtual Reality (VR), Augmented Reality (AR), Mixed Reality (MR) and Extended Reality (XR) have the potential to change the ILRCs ecosystem in a big way. These technologies connect the digital and the physical world and make it possible for ILRCs to provide engaging, interactive, and tailored learning experiences. In this paper, the authors discuss how ILRCs are becoming places where innovations, inclusivity, and engagement are visible and how these technologies have the potential to improve educational services, engage the community, and increase access to resources despite the challenges that include high costs and limited access. Also, a SWOT analysis is given to identify the strengths, weaknesses, opportunities, and threats of immersive technologies in the ILRCs context. Some directions for future research are also given to focus upon. This paper presents a conceptual framework within which ILRCs can plan the integration of immersive technologies in the transformation of information access and learning in the future.

Keywords: Augmented Reality, Extended Reality, Immersive Technologies, Multisensory Experience, Smart ILRCs, SWOT Analysis, Virtual Reality.

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INTRODUCTION

The integration of immersive technologies into Information and Learning Resource Centres (ILRCs) would be a significant indication of how the process of accessing and using information has evolved. Immersive technologies consist of Virtual Reality (VR), Augmented Reality (AR), Mixed Reality (MR), and Extended Reality (XR) which connect the digital and physical world for a better learning experience that was unimagined before. AR enhances additional digital information to the existing real environment and VR provides an artificial environment where users can be getting a completely immersed experience. MR enables the user to have real-time interaction with both virtual and physical objects and therefore it is a form of hybrid between the two. XR is a term that includes all these technologies as shown in Figure 1 that offers a better integration between the virtual and the real world enhancing multisensory experiences (Arm Editorial, 2024; Khan *et al*., 2024; Partarakis and Zabulis, 2024; Tremosa, 2024). ILRCs can develop rich, interactive, and engaging platforms that enable users to explore information in a novel and lively manner by adopting such technologies. For instance, creating virtual tours of ILRCs and engaging simulations of historical events, to name a few (Valk *et al*., 2023). The use of VR and AR has already started in creating engaging displays, setting up learning environments and giving virtual tours of ILRCs and their collections, etc. These experiences further can be enhanced with the help of MR and XR which enable the users to interact with both real and virtual worlds at the same time. These technologies not only enhance the delivery of information but also provide a new dimension to the whole experience of the ILRCs itself (Fujiuchi and Riggie, 2019; Sarkar, 2023; Shahzad *et al*., 2024). Therefore, this paper aims at exploring the possible ways of integrating immersive technologies into ILRCs that may be useful in enhancing community engagement and improving ILRCs services in the future.

The Literature Review on Immersive Technologies in ILRCs

AR, VR, MR, and XR technologies have been focused by ILRCs in the recent period and have the potential to convert conventional ILRCs spaces into hubs of experience-based learning and engagement. These technologies were employed to improve the

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user satisfaction with the applications that include the interactive displays and virtual ILRCs visits (Fujiuchi and Riggie, 2019; C. Lau *et al.*, 2017; K. W. Lau, 2024; Zidianakis *et al.*, 2021). VR can create a completely immersive experience, for example creating virtual ILRCs tours, while AR can place a virtual element along with physical ILRCs (Lau *et al.*, 2017; Oyelude, 2018). Some of the emerging technologies that are currently being explored in ILRCs include the MR and the XR which allows for the creation of more dynamic and real-time experiences where the digital and physical worlds blend (Fujiuchi and Riggie, 2019; Sarkar, 2024). Therefore, the transition from the simple digital interfaces to the advanced immersive environments can transform the role of the ILRCs from the source of information to the source of experience, that fosters the active and collaborative learning process.

ILRCs are embracing various technologies that help to provide the customized and personalized learning experience to the ILRCs users, where AR solutions for people with disabilities and VR can recreate of historical events (Creed *et al.*, 2024; Žilak *et al.*, 2022). XR technology also can help ILRCs in achieving their vision of becoming more dynamic and inclusive for serving the information needed by creating engaging and immersive learning experiences (Alnagrat *et al.*, 2022). Mixed Reality, one of the XR categories that enhances the learning experience by creating more engaging, interactive, and flexible spaces that integrate the digital and physical worlds together (Roo and Hachet, 2017). Nevertheless, there are still many obstacles that prevent the use of augmented reality in ILRCs, education and training, such as high cost, the absence of strategies, and the need for skilled personnel, etc. (Cook *et al.*, 2019; Subaveerapandiyan *et al.*, 2024). The following sections discuss how these technologies can improve learning provisions, enhance community interactions, and outline the new strategies for innovative ILRCs services.

Immersive Technologies and the Smart ILRC Ecosystem

Immersive technologies can be used in ways through which ILRCs can become smarter and improve their functions and services. These technologies can help ILRCs offer better services and experiences to the patrons and enhance the approach to information access and use. For example, Virtual Reality can be used to provide virtual ILRCs tours for helping users to navigate through digital or physical collections virtually. That also increases access to resources. Likewise, Augmented Reality can superimpose computer generated information onto the real environment and that enables the users to interface with ILRCs materials in a new manner with real-time information. For example, using mobile phones, the users can perceive an image of a book or an artifact and get detailed information about it (Oyelude, 2018; Subaveerapandiyan *et al.*, 2024). These technologies make the link between the digital and the physical, more integrated and that strengthen the functions of ILRCs as institutions that foster education, research and innovation.

Moreover, by accompanying immersive technologies with Artificial Intelligence (AI), ILRCs can provide improved and more specific individualized services in order to enhance the overall performance of the ILRCs (Praveenraj *et al.*, 2025). For example, AI-based VR environments can be set to provide for the specific needs of learners and their progress through adapting the content that is provided to them. Similarly, the AR also has the potential of evolving based on the user's interaction with it and providing more relevant and helpful information to the user. The use of AI also facilitates personnel to spend time on managing and organizing content as well as curating recommendations and assisting users with special needs. This drive not only makes the users happy but also makes the ILRCs personnel to be more productive and proactive. In the future, as more ILRCs start using more XR and AI-based immersive technologies, they will begin to transform into smart ILRCs which are not only meant for storage of information but also spaces for active, personalized, and engaging learning experiences designed to meet the needs of today's ILRCs users.

Enhancing User Learning Experiences through Immersive Technologies

Alike other sectors, the ILRCs are also interested in integrating the use of immersive technologies to improve the experience

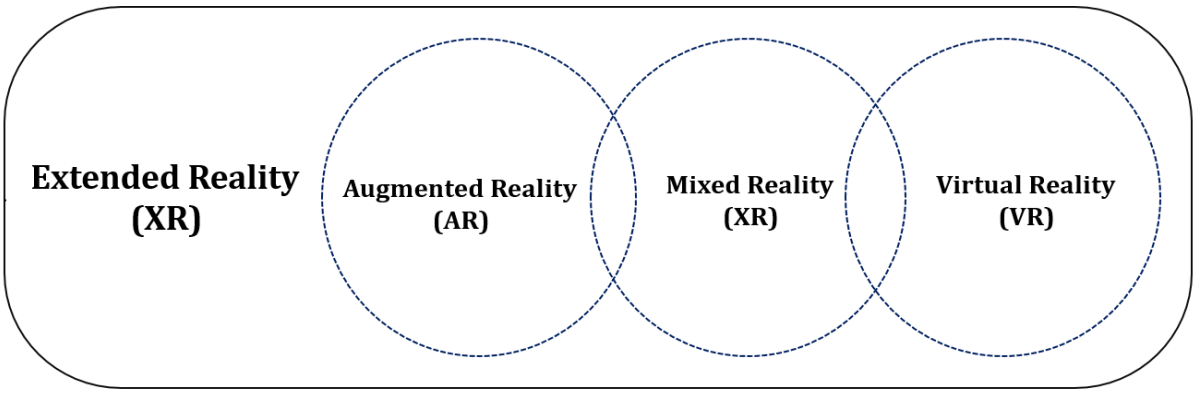

Figure 1: The illustration of different types of immersive technologies (Source: Interaction Design Foundation, 2024).

of the users in the ILRCs premises. With these technologies, it is possible to integrate the virtual with the real world making the user's experience more natural and more effective when it comes to accessing information and learning. Virtual Reality (VR) for instance creates environments through which users can navigate. For example, VR based simulation for history can take the readers and the enthusiasts to the great historical events which would otherwise be explained in the textbooks in a rather passive manner (Remolar *et al*., 2021; Sarkar, 2024; Tene *et al*., 2024). These multi-sensory experiences increase the level of engagement, that makes the learning process more engaging, fun, and effective. Simulations of historical events, historical site reconstructions, characters and virtual exploration of historical artifacts for the users.

On the other hand, Augmented Reality (AR) expands on the real world by additional layers of digital information in real time which makes the interactions between users and their physical environment better and informative. AR can change the way that ILRCs are being visualized and the information and space expected by the users (Oyelude, 2018; Tene *et al*., 2024). For example, users can use their smartphones or AR glasses to direct a beam of information toward a book which is placed on a shelf and then they will get metadata, summary or reviews of the book. Similarly, AR can be used in guided ILRCs tours where the users are required to scan ILRCs items and in return get information, media, or detailed information. This makes the ILRCs a livelier and more attractive place and helps the users to orientate themselves and find the needed data easily.

Extended Reality (XR) that includes AR and VR, provides even greater integration where the user can interact with both the virtual and real world in real time (Alnagrat *et al*., 2022). XR can allow users to use real time assets of the ILRCs and engage with them in virtual environments (Fujiuchi and Riggie, 2019). For instance, an XR-based collaborative environment may incorporate virtual tools and resources with physical resources of ILRCs including books and other tangible objects. This type of immersive interaction makes learning more collaborative, creative and effective as it offers the flexibility of digital resources and the physical presence of learners. This type of immersive multi-sensory happenings fosters more focused, innovative, and fruitful learning experiences, using the digital freedom and individual interaction. These advancements empower ILRCs to meet the changing needs of their users.

ILRCs are going to reinventing themselves from being only places of accessing information in a broader manner into active environments of learning by using these technologies, which encourage learning by individuals. It is now possible for users to navigate, engage and explore in ways that were not possible before, as well as for better and more satisfying learning results with the help of these technologies. There is a great prospect that as these technologies grow, they can revolutionize how ILRCs deliver information services, and improve on the accessibility, inclusivity and effectiveness of ILRCs services to different communities.

The possibilities of embracing Immersive Technologies into ILRCs

There is a great potential of integrating immersive technologies into ILRCs which can be both interesting and exciting, where ILRCs professionals can better meet the needs of their patrons more effectively. These technologies can greatly improve the traditional ILRCs environment and present interactive spaces using these new technologies in ILRCs and content their users with engaged services.

One of the most important application of Virtual Reality (VR) in ILRCs shall be the creation of virtual accessibility for rare and specialized collections (Campbell, 2023). This permits students and researchers to study resources that are difficult to access physically, such as delicate manuscripts and rare artifacts. This helps to overcome the limitations of physical space and addressing preservation concerns. VR enables larger access to these valuable resources and benefit academics and distance learners who cannot visit ILRCs in person. The ability to interact with digital versions of rare materials in an immersive, engaging environment is indeed invaluable.

Similarly, Augmented Reality has been useful in ILRCs to improve the user interactions and providing value added instructions (Lee *et al*., 2020) where students can use their smart devices or AR glasses to identify books, bookshelves or any signs in the ILRCs and get information like the summary of the book, reviews made by other users or links to other resources. This enhances the accessibility and engagement level of users, provided that a more interactive and educational information, especially for new students or those unaware with the layout of ILRCs to explore and navigate the ILRCs.

There is also another great opportunity in VR-based storytelling and narrative creation in ILRCs. ILRCs can make history come alive where visitors can experience firsthand virtual reality restorations of major events as such providing as a major enriched battle understanding or of famous history speeches using VR (Pirkko, 2021). This kind of learning experience elevates understanding and engagement and making history come alive in ways that traditional textbooks cannot replicate.

Extended Reality (XR) and Mixed Reality (MR) includes virtual and real environments and presents a new method of learning that allows students to engage with both virtual and physical collections of historical events. In real-time scenarios, visitors can be able to come across historical texts and places with the help of digital interfaces that include animations, projections, and information overlays and at the same time they can engage with physical objects like historic books or artifacts. This kind of

integration of the real and the virtual would increase the visitors' participation and deepens their understanding as the visitors can touch the objects and at the same time be exposed to histories of the objects.

There are also more possibilities for applying these technologies for immersive learning especially in STEM education. For example, 3D models of scientific concepts including chemical reactions, physics experiments and biological processes that are complex to comprehend (Tene *et al.*, 2024). The ILRCs can be a place where students can themselves study these phenomena, changing parameters and seeing the outcomes as if performing science experiments in laboratories. This approach enhances students' comprehension of hard to understand concepts that are challenging to explain with the help of conventional textbooks. Addition of immersive experience into ILRCs settings can also foster collaborative research and experiential learning by allowing students to interact with virtual data alongside physical resources.

These examples demonstrate how immersive technologies can enhance the learning environment in order to make it more inclusive and accompanying, promote student engagement, and increase information accessibility. The findings from these potential applications support the notion that Virtual Reality (VR), Augmented Reality (AR), Mixed Reality (MR) and Extended Reality (XR) can revolutionize the ILRCs experience by turning ILRCs into sources of research, learning and creativity. In the future, as these technologies evolve, the ILRCs will expand, creating more sophisticated, interactive spaces that meet the diverse needs of contemporary patrons.

SWOT analysis of implementing immersive technologies in ILRCs

Strengths

There are many strong arguments for using immersive technologies in ILRCs which benefit to the increasing user engagement and learning opportunities. This facilitates a tailored learning spaces and dynamic setting for the learners. AR enhances value to the real world by providing useful information layers while VR offers an extensive range of multi-sensory experiences that can able to recreate historical occurrences or explain challenging concepts. This technology makes the process of learning more effective as well as fun, that increases the students' association with the ILRCs. In addition, facilitating access to the valuable materials and rare collections using immersive technologies could provide solution to the concerns like lack of physical space or preservation of materials. With the help of AI, ILRCs can also go a step further to tailor the ILRCs experience to the specific needs of the user making the learning process easier. Further, immersive technologies enhance ILRCs services and make ILRCs more accessible to many individuals including people with disabilities and distance learners (Valk *et al.*, 2023).

Weaknesses

However, there are some weaknesses that associated with the use of immersive technologies in ILRCs. The major challenge is the expensive initial investment which includes procuring hardware like the VR headsets and AR glasses, software and enhancing the infrastructure. These costs may be especially exorbitant for smaller or less well-off ILRCs, which makes their complete adoption difficult. These systems are also rather bit complicated, which means that ILRCs personnel must undergo special training, which may lead to ineffective work process or opposition from the employees. Also, the issue of usability is still an issue of concern especially to the elderly or individuals with little or no technological knowledge to make use of these technologies. Even though immersive technologies create very engaging experiences, they may be quite complicated for both the librarians and the visitors. Other challenges include technical problems such as faults in hardware or software which may hamper the provision of these services.

Opportunities

The integration of immersive technologies in ILRCs creates numerous possibilities for the enhancement of services and the development of the ILRCs as a social institution. Another important benefit is to design more inclusive and user-friendly learning spaces. For example, VR can be applied to re-create historical events or scientific processes, providing enriched and comprehensive learning experiences appropriate for various groups of people and different learning preferences. AR will also enhance the accessibility by offering services that include language translation in real time, sign language interpretation and audio description for the benefit of the visually impaired. Using XR, it is possible to create collaborative learning spaces where users can engage with virtual and real objects, which promotes active learning, group work, and innovation. Moreover, ILRCs can also use the immersive technologies for community engagement through providing virtual exhibitions or interactive storytelling sessions which may appeal to many people. This turns ILRCs into the centre of cultural and educational hubs, meeting the needs of multiple groups of learners and addressing the challenges of the digital environment (Alnagrat *et al.*, 2022; Sarkar, 2024).

Threats

Though there are significant opportunities can be observed with immersive technologies, threats involved with these are unavoidable. One of the challenges is the fast evolution of technology which may create a problem to ILRCs because they may find it difficult to match updates in software and hardware that may in turn increase the cost of operation and maintenance. Apart from this, the use of immersive technologies poses concerns about privacy and security, particularly when user data is collected and stored for personalized experiences. ILRCs must take care

of data protection policies and manage individual information sensibly. Another threat could be absence of equal accessibility of these technologies to all, because of any flaw in devices, network issues and internet speed to engage with all the time. Finally, there is a concern that an overreliance and dependency on these immersive technologies may reduce the value of conventional ILRCs resources and in-person communications and that may devalue the users who still prefer the traditional way of learning or are comfortable with the existing ILRCs environment.

Conclusion and Future Research

The integration of immersive technologies into ILRCs has the capabilities to transform the way the learning and knowledge being experienced. It is possible to design, create, and provide personalized and immersive experiences to the users with these technologies, accordingly providing new ways of engaging with information and services that are not aligned with the traditional ILRCs model. With the help of interactive displays, virtual tours and collaborative study booths, ILRCs are transforming into space of creativity, and promotes community engagement. However, there are some issues noticed including the accessibility of the technologies, the costs of implementing them, and the difficulty in training the staff to operate them. However, these technologies have great potential to improve the user satisfaction by increasing the accessibility and flexibility of the ILRCs to meet the requirements of today's diverse users. The future research could aim at sustainability and scalability of these immersive technologies within ILRCs domain. This will be important as it will ensure that these innovations are available to everyone regardless of the technological infrastructure or the experience. Moreover, the efforts to be made for assessing the long-term impact of these immersive technologies on community engagement and learnings that could enhance the understandings. Also, how these technologies can be advanced and implemented across different ILRCs contexts. Eventually, the integration of the immersive technologies is a significant improvement in the journey of ILRCs and their users' engagement. If ILRCs adopt these technologies wisely, the information institutions will be able to remain relevant in the modern society as centers for learning, research and community interaction.

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