Exploring the Future of Education Through Implementing Virtual Reality to Enhance Learning Outcomes: a Practical Approach

Bushra Akter, Zannat Hossain Tamim, Mst. Sabina Yeasmim and Md. Sazzadur Rahman

June 27, 2025

Exploring the Future of Education through Implementing Virtual Reality to Enhance Learning Outcomes: A Practical Approach

***Abstract*—This paper introduces an innovative approach to leveraging virtual reality (VR) technology in educational settings, specifically designed to meet the demands of Industry 5.0 . VR technology refers to computer-generated simulations of three-dimensional environments that users can interact with using specialized equipment like VR headsets. The aim of this study is to explore how VR can enhance student learning experiences. The methodology involves a comprehensive process of designing, creating, implementing, and evaluating an immersive VR environment using Unity3D. This includes integrating detailed 3D models and interactive elements to replicate historical settings, facilitating experiential learning. The VR environment incorporates an essential audio section to enrich immersion through spatial sound and contextual auditory cues, enhancing the overall learning experience. Additionally, the VR environment features object detection capabilities where students can interact with virtual objects and receive real-time feedback, such as object names and contextual information. This interactive component aims to deepen engagement and understanding of educational content through hands-on exploration. This research contributes to the field by showcasing practical applications of VR in education, highlighting its potential to transform traditional learning methods. By providing students with interactive virtual environments that integrate audio and object recognition technologies, this approach fosters innovative pedagogical practices and explores the future possibilities of immersive learning technologies.**

***Index Terms*—Immersive learning,Unity3D,VR,Oculus2,VR headset,Industry 5.0**

I. Introduction

Industry 5.0 emerges as a transformative force, redefining the relationship between humans and technology. Unlike its predecessor, Industry 4.0, which focused on automation and data exchange in manufacturing technologies, Industry 5.0 emphasizes collaboration between humans and machines, fostering a harmonious relationship that enhances productivity and innovation [1]. This revolution leverages advanced technologies such as artificial intelligence (AI), robotics, the Internet of Things (IoT), big data, and VR, integrating them with human intelligence and creativity [2]. Industry 4.0 and Industry 5.0 significantly enhance the global education sector, particularly by advancing the attributes of modern learning systems [3]. The ultimate goal of Industry 5.0 is to create a more sustainable, resilient, and human-centric industrial landscape, where technology complements human skills, enabling personalized and adaptive solutions across various sectors, including education [4].

Virtual Reality (VR) is a groundbreaking technology that immerses users in computer-generated environments, simulating real-world or entirely fictional experiences [5]. By wearing VR headsets, users can interact with these virtual environments through visual, auditory, and haptic feedback, creating a sense of presence and engagement that transcends traditional interfaces. In the context of Industry 5.0, VR plays a pivotal role by bridging the gap between advanced technological capabilities and human-centric applications. The integration of VR into the educational sector is particularly significant [6].

Traditional educational methods often fall short in addressing the diverse needs of modern learners, who demand more interactive, engaging, and personalized learning experiences. VR offers a solution by providing immersive environments where students can actively participate in their learning journey [7]. Whether exploring complex scientific concepts in a virtual lab, dissecting virtual cadavers in anatomy classes, or stepping into historical events through interactive scenarios, VR transforms passive learning into an active, engaging experience [8]. This shift not only enhances understanding and retention but also prepares students for the technological advancements of Industry 5.0, equipping them with the skills needed to thrive in a rapidly evolving world.

This research embarks on a mission to explore, implement, and critically evaluate the impact of VR technology on conventional educational practices. By designing an immersive VR learning environment using the Unity3D platform and integrating Oculus technology, this study aims to enhance student engagement and learning outcomes across various educational levels and disciplines. The work extends beyond theoretical exploration, implementing VR in diverse learning environments . The ultimate goal is to uncover the transformative potential of VR in education, bridging the gap between traditional learning methods and the dynamic needs of modern learners.

In the dynamic landscape of contemporary education, where traditional classrooms intersect with the digital frontier, VR emerges as a transformative force, reshaping the narrative of immersive learning experiences. Educational institutions are navigating a complex terrain that embraces diverse learning environments, with technology assuming a pivotal role in enhancing student engagement and understanding. The present-day educational ecosystem, characterized by a harmonious blend of traditional and digital platforms, is now enriched with cutting-edge features such as spatial tracking, haptic feedback, and realistic simulations. In this dynamic environment, students traverse a multifaceted learning landscape, seeking interactive and engaging approaches to their studies.

Within the current educational landscape, several challenges and gaps have become evident, signaling the necessity for a profound reevaluation of existing practices. Traditional educational methods, tethered to static classrooms and standardized approaches, often struggle to capture the attention and enthusiasm of today's diverse learners [9]. The limitations of these conventional practices extend to a lack of adaptability to varied learning styles, hindering the holistic development of students. Moreover, the rigid structure of traditional classrooms can limit creativity and the cultivation of critical thinking skills. These challenges highlight the pressing need for innovative solutions that not only address the shortcomings of the current educational paradigm but also pave the way for a more engaging, dynamic, and effective learning environment.

The exploration of VR technology emerges as a strategic response to the challenges faced by traditional learning systems [10]. VR offers immersive, interactive, and personalized learning experiences that can address the diverse needs of modern learners. By transforming passive learning into active engagement, VR fosters deeper understanding and retention of complex subjects. It provides a dynamic, three-dimensional learning environment tailored to individual needs and adaptable to diverse learning styles. Beyond the confines of textbooks, VR facilitates collaborative learning in virtual spaces, breaking down geographical barriers and instilling teamwork and communication skills vital for the modern workforce [11]. This innovative approach not only captivates students but also prepares them for the technological advancements of Industry 5.0, equipping them with the skills needed to thrive in a rapidly evolving world.

The structure of the paper is as follows: Chapter I serves as an introduction, setting the stage for the research and outlining its objectives. Chapter II provides a comprehensive literature review, examining existing research on VR implementation in diverse learning environments while critically analyzing current limitations and proposing future directions for exploration. Chapter III provides context for the research and outlines the methodology, which includes the design in Unity3D, implementation, and Oculus integration. Chapter IV analyzes the results of the VR implementation and discusses its implications. Finally, Chapter V concludes the study, summarizing the findings, discussing their significance, and suggesting avenues for future research, offering a holistic understanding of VR's impact on diverse learning environments.

II. Literature Review

The literature review section aims to synthesize findings from various studies that have investigated the application and impact of VR technology in diverse learning environments. By compiling and condensing insights from scholarly works, research papers, articles, and studies, this review provides a comprehensive overview of VR's utilization in education.

The literature on STEM education finds that Immersive IVR technology offers promising solutions for its challenges. IVR's diverse educational applications and endorsements position it as a valuable tool for K-12 and higher education. Forecasts suggest extensive integration into classroom instruction due to its cost-effectiveness and efficacy in teaching STEM subjects [12].Scholarly discussions on inclusivity and diverse learning styles in VR education emphasize how VR interfaces, incorporating features like voice commands, adjustable font sizes, and customizable controls, facilitate accessibility for learners with diverse physical and cognitive abilities. This fosters an inclusive educational environment [13]. Numerous studies have examined the effectiveness of VR simulations in medical training. These simulations, developed through iterative user feedback, include dynamic communication, clinical scenarios, realistic 3D models, and interactive hand gestures. Research indicates significant enhancements in students' procedural skills, self-assurance, and overall performance in simulated operations, particularly in specific clinical and technical abilities related to imaging procedures [14]. VR technology has been utilized to develop immersive anatomy modules. In a study, medical students explored 3D anatomical structures within a VR environment, revealing significant enhancements in spatial understanding and retention of complex anatomical concepts [15].Studies on VR-based surgical training demonstrated that residents practicing in VR exhibited enhanced precision, reduced errors, and increased confidence during real surgeries. VR-trained residents completed gallbladder dissection 29% faster compared to non-VR-trained counterparts, underscoring the advantages of VR in surgical education [16]. VR has proven instrumental in enhancing students' patient interaction and diagnostic skills. Studies have shown that VR scenarios simulating patient encounters enhance students' clinical reasoning and decision-making abilities [17]. Additionally, VR-based patient case simulations contribute to improved diagnostic accuracy and confidence among medical learners [18].Research on inclusive VR design principles for users with disabilities emphasizes accessible interfaces and sensory feedback. It underscores the necessity of tailored VR experiences for diverse needs, highlighting the importance of inclusivity in VR and advocating for further research on adaptive VR interfaces catering to various disabilities and sensory impairments [19].

Researchers explored the use of VR to create immersive learning environments for engineering students. In a study, engineering students engaged in VR simulations to explore virtual prototypes of mechanical structures [20].A VR-based electrical circuit laboratory simulation improved students' experimental skills and understanding of circuit theory compared to traditional methods [19]. The VR environment supports flexible learning, enabling students to replicate measurements and enhance their grasp of electrical engineering concepts. Challenges include learning curve issues, varying learning preferences, and the need for further research on long-term educational impacts [21].

Cutting-edge technologies like VR are impacting both tourism providers and travelers. Recent research, focusing on head-mounted displays, highlights VR's role as a marketing tool for pre-travel promotion and communication. Ongoing advancements are expected to create new opportunities in the tourism industry [22], [23].VR-based marketing offers a realistic preview of destinations, influencing travel decisions. Future studies should address limitations like conceptual variables, VR headset capabilities, and the impact of COVID-19 on consumer satisfaction, and explore aspects like emotional responses and entertainment experiences [24].VR is crucial for preserving cultural heritage and creating virtual museums, enabling users to explore historical sites and artifacts digitally. This application spans historical reconstruction, social robot integration, alternate reality, and data-driven modeling for cultural education. Further research is needed to refine virtual time travel experiences and understand VR's impact on cultural heritage preservation [25].

VR leads to increased student engagement through interactive, immersive experiences [26]. Tools such as Google Expeditions transport students to diverse environments, fostering shared experiences and revitalizing less engaging subjects. VR's strong sense of presence, exemplified by applications like navigating the human body in The Body VR, underscores its transformative potential in education [27].

In the case of constructivist learning, VR allows for hands-on problem-solving experiences that enhance academic performance, particularly in subjects like astronomy [28]. Tools such as 'Fantastic Contraption' enable students to manipulate objects uniquely to reinforce physics concepts through problem-solving [29]. Aligned with constructivist principles, VR offers engaging and customizable immersive learning environments [30]. It also serves as a therapeutic tool for students with disabilities or social anxieties, providing a safe, consequence-free environment for learning [31]. Applications like VR Language Learning and Public Speaking VR simulate real-world situations, fostering immersive, error-free learning experiences. Overall, VR presents significant opportunities for immersive and practical learning environments in diverse educational and therapeutic settings.

Traditional learning often lacks real-world connections, creating a gap between theoretical knowledge and practical application. This deficit in 'situated' learning is noted in various disciplines [26]. VR serves as an accessible solution, offering immersive environments that enhance academic understanding and application, particularly exemplified in subjects like biology, aligning with perspectives on its potential impact.VR's potential impact on children's development, emphasizing its unique features like virtual embodiment and interactions with virtual characters in applications spanning health, education, and social interventions. Further research is needed to understand VR's psychological effects on child development [32].

III. Methodology

This section provides a comprehensive overview of the methodology employed in the study, outlining the structured approach to the design and implementation of the VR learning environment. It serves as a roadmap for the reader, elucidating the key components of the research process.

The workflow for our work encompassed the implementation of a VR learning environment, focusing on the development and deployment of this technology using Unity3D and Oculus Quest 2. The implementation phase (Figure 1) was central of our project, detailing the step-by-step process required to create an immersive VR learning environment. The workflow began with the design phase in Unity3D, followed by content development and the integration of interactive features [33]. Finally, the VR environment was deployed to the Oculus Quest 2 headset [34]. This structured flowchart served as a visual roadmap, ensuring systematic and efficient execution throughout the implementation phase (Figure 2).

By adhering to this structured workflow, our research enhanced the efficiency of the implementation process. This methodology ensured a holistic understanding of the VR learning environment, facilitating a seamless transition from design to deployment. Through the careful planning and execution of each phase, we created an immersive educational experience that leveraged cutting-edge VR technology to foster enhanced learning outcomes.

In the dynamic landscape of contemporary education, where traditional classrooms intersect with the digital frontier, VR emerges as a transformative force, reshaping the narrative of immersive learning experiences. To create an immersive learning environment, we developed an interactive setting using Unity3D. This report details the step-by-step process of our project, from the initial design to the final deployment, highlighting key components and features of our VR setup.

To begin with, we utilized the terrain tool in Unity3D to lay the foundation for our virtual environment. We then added a player object to navigate this environment. To control the player, we implemented a hidden cylinder that acts as the player's collider and controller. The cylinder was configured to work with mouse, controller, keyboard, and XR toolkit inputs, allowing for seamless movement through the terrain. This setup enabled us to visualize the environment effectively from the player's perspective.The position of the player $P(t)$ at time t is determined by initial position P_0, velocity v, and acceleration a.

$$P(t) = P_0 + vt + \frac{1}{2}at^2$$

Mouse movement controls the orientation of the camera or player's view in Unity3D. This is achieved through rotational transformations $\mathbf{R}_{mouse}$, which are applied based on the change in mouse position $\Delta\theta_x$ and $\Delta\theta_y$.

$$\mathbf{R}_{mouse} = \mathbf{R}_x(\Delta\theta_x) \cdot \mathbf{R}_y(\Delta\theta_y)$$

These rotations around the x-axis $\mathbf{R}_x$ and y-axis $\mathbf{R}_y$ are essential for updating the camera's orientation in response to mouse movements, providing a dynamic and interactive user experience. Rotation Matrix around the X-axis,

$$R_x(\theta) = \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & \cos(\theta) & -\sin(\theta) & 0 \\ 0 & \sin(\theta) & \cos(\theta) & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

Rotation Matrix around the Y-axis,

$$R_y(\theta) = \begin{bmatrix} \cos(\theta) & 0 & \sin(\theta) & 0 \\ 0 & 1 & 0 & 0 \\ -\sin(\theta) & 0 & \cos(\theta) & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

Following our initial setup, we focused on designing the terrain according to our plan. We imported green land assets from the Unity Asset Store to create a lush, verdant landscape [35]. Our project aimed to recreate Moynamoti Shalbon Bihar, a historical site, so we needed to include realistic roads and pathways. We used muddy road assets from the asset store and complemented them with various other necessary elements. We added grass assets with windy motion effects to enhance realism and increased the grass density to make the environment more compact. Additionally, we designed a flower garden featuring various types of flowers, which added color and vibrancy to the setting. Stone assets were placed strategically to simulate natural landscapes, and animated rabbits were introduced to move left, right, up, and down, adding a dynamic wildlife element to the scene.

For the historical structures, we used brick assets to construct key buildings such as the Ancient Buddhist Monastery, Ananda Rajar Badi, the palace of Rani Moynamoti, temples, stairs, and wells. These structures were meticulously designed to reflect the historical and architectural significance of Moynamoti Shalbon Bihar.

To guide users through the virtual environment, we implemented an avatar created using Blender software [36]. Animations were added from the Mixamo site to enhance the avatar's realism and interactivity [37]. This avatar serves as a virtual guide, assisting users if they lose their way. The avatar can communicate with users through a dialog box, facilitating interaction via a question-and-answer method. This feature ensures users can receive help and information about the environment at any time.

To further enhance the user experience, we added box colliders to various objects within the environment. These colliders control the interaction range, so when a player approaches an object, the system automatically displays the name of the object. Additionally, we integrated voice descriptions to provide auditory information about the objects, making the learning experience more engaging and informative.

The final step involved connecting Unity3D with the Oculus VR set using the MetaQuest2 app [38]. We began by logging into the Oculus VR set and connecting the VR headset to the PC via a USB cable. Once connected, we ran the environment in Unity3D, which allowed us to visualize the immersive environment through the VR headset. This seamless integration enabled us to fully experience and interact with the virtual recreation of Moynamoti Shalbon Bihar.

By meticulously designing each component and leveraging Unity3D's extensive tools and assets, we created an immersive and interactive virtual environment that brings Maynamoti Shalbon Bihar to life. This VR setup not only enhances learning by offering a realistic exploration of historical sites but also engages students in an innovative and memorable educational experience. Through careful planning and execution, we successfully demonstrated the transformative potential of VR in contemporary education.

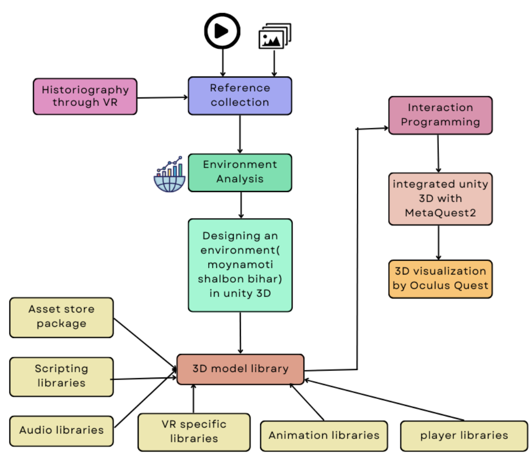

Fig. 1: Optimizing the Implementation Phase of VR Learning Environments

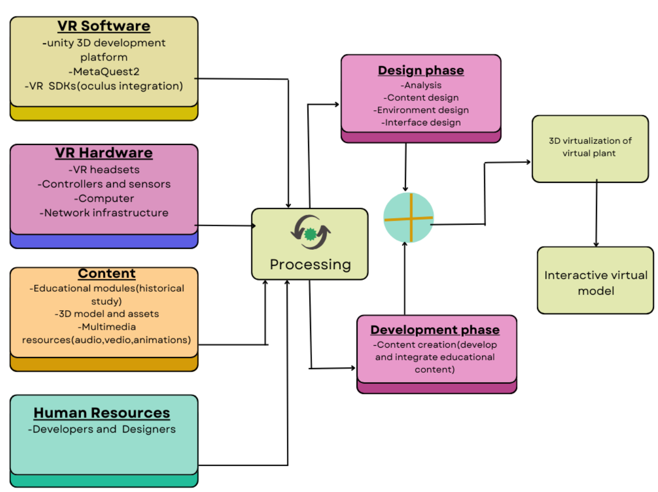

Fig. 2: A conceptual Framework for VR Integration

IV. Result and Discussion

The primary outcome of this work is the creation of a detailed and interactive VR environment for Maynamoti Shalbon Bihar. This VR environment enables students to explore and learn about the historical site through an immersive experience. The design includes 3D models of significant structures, natural elements, and avatars with educational dialog boxes. The VR setup has been tested and optimized for use with Meta Quest, ensuring a seamless user experience.

The Maynamoti Shalbon Bihar includes significant structures such as temples, the ruins of the palace, Kutila Mura, and Ananda Rajar Badi, which are meticulously modeled in our environment. Additionally, various ruins of buildings and historical places have also been reconstructed in 3D. Figure 3 shows the reconstructed 3D structures.

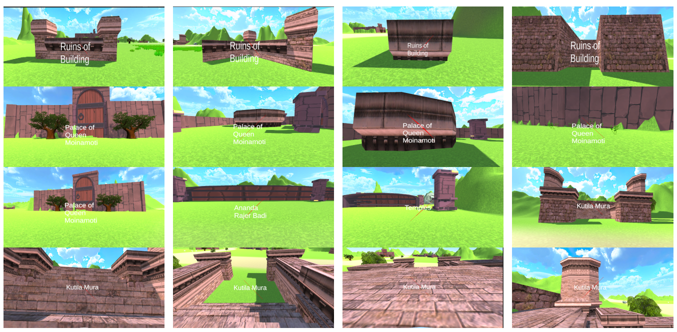

Fig. 3: A collection of historical site images depicting various ruins, temples, and historical places of Maynamati Shalbon Bihar, reconstructed in 3D. These sites are visited through a virtual tour using a VR device.

There are various natural elements such as trees, stones, the sky, rabbits, flower gardens, grass, and hills, which are shown in Figure 4. These elements have been reconstructed to enhance the beauty of Maynamoti, making the environment more engaging and pleasant for students. This integration of natural elements increases student excitement and engagement with the historical site.

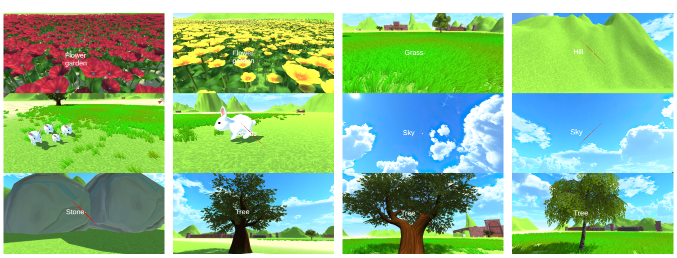

Fig. 4: A collection of images showcasing various natural elements such as trees, stones, sky, rabbits, flower gardens, grass, and hills located in Maynamati. These elements create an engaging and joyful learning environment for students.

To assist and guide students, there are also avatars equipped with control boxes and audio facilities. These avatars provide students with information about Maynamoti, as shown in Figure 5. When a student visits Maynamoti and locates a specific place or natural element, a brief audio description is played. This feature enriches the reconstructed model with educational and informative content.

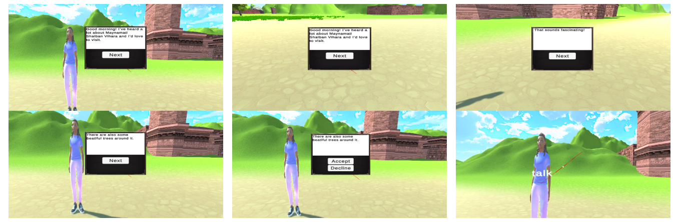

Fig. 5: Avatars used within the VR environment, equipped with dialog boxes to provide information and enhance the learning experience. These avatars guide users through the virtual site, offering educational content and interactive engagement.

The integration of these elements into our VR environment, coupled with XR controller functionalities for navigation, enhances the immersive learning experience. By allowing students to explore Maynamoti Shalbon Bihar with intuitive controls like up, down, left, and right buttons, we have created an interactive platform for historical education. Additionally, the inclusion of audio features that play historical narratives and ambient sounds enriches the experience, providing context and bringing the ancient site to life.

Finally we say that, Our VR recreation of Maynamoti Shalbon Bihar closely mirrors the actual site, offering a detailed and immersive experience. Unlike traditional 2D mediums, the VR environment allows users to explore and interact with the ancient city's landmarks as if physically present. The incorporation of advanced audio features not only enhances the educational value of our VR environment but also brings the ancient site to life in a way that engages students and fosters a deeper appreciation for history and cultural heritage. Users can navigate through the pathways, examine architectural details, and interact with virtual avatars, providing a dynamic and engaging learning experience.

V. Conclution

Our development of a VR environment for Maynamoti Shalbon Bihar represents a significant leap forward in historical education, utilizing immersive technologies to enhance learning experiences. While successful in integrating detailed 3D models, intuitive XR navigation, and immersive audio narratives, several challenges remain. Limitations include constraints in 3D model accuracy due to technological and data availability issues, as well as accessibility barriers with VR equipment requirements.Future work will focus on improving 3D model fidelity through advanced scanning and historical research, making VR more affordable and accessible, and addressing user comfort concerns like motion sickness. Enhancements in audio content with comprehensive historical narratives and integration of interactive elements aim to deepen student engagement and learning outcomes.

Overall, our commitment lies in refining this VR platform to provide an enriching educational tool that fosters a deeper appreciation for history and cultural heritage, transcending traditional learning methods and empowering learners globally.

Acknowledgment

We would like to express our gratitude for the support provided by Institute of Information Technology (IIT), Jahangirnagar University, Savar, Dhaka.

References

[1] A. Raja Santhi and P. Muthuswamy, "Industry 5.0 or industry 4.0 s? introduction to industry 4.0 and a peek into the prospective industry 5.0 technologies," *International Journal on Interactive Design and Manufacturing (IJIDeM)*, vol. 17, no. 2, pp. 947–979, 2023.

[2] I. Taj and N. Zaman, "Towards industrial revolution 5.0 and explainable artificial intelligence: Challenges and opportunities," *International Journal of Computing and Digital Systems*, vol. 12, no. 1, pp. 295–320, 2022.

[3] J. B. Awotunde, E. F. Ayo, G. J. Ajamu, T. B. Jimoh, and S. A. Ajagbe, "The influence of industry 4.0 and 5.0 for distance learning education in times of pandemic for a modern society," in *Advances in distance learning in times of pandemic*. Chapman and Hall/CRC, 2023, pp. 177–214.

[4] J. Leng, W. Sha, B. Wang, P. Zheng, C. Zhuang, Q. Liu, T. Wuest, D. Mourtzis, and L. Wang, "Industry 5.0: Prospect and retrospect," *Journal of Manufacturing Systems*, vol. 65, pp. 279–295, 2022.

[5] A. A. D. Luna, "Introduction to virtual reality," 2022.

[6] P. K. R. Maddikunta, Q.-V. Pham, B. Prabadevi, N. Deepa, K. Dev, T. R. Gadekallu, R. Ruby, and M. Liyanage, "Industry 5.0: A survey on enabling technologies and potential applications," *Journal of industrial information integration*, vol. 26, p. 100257, 2022.

[7] I. Fitrianto, "The role of virtual reality in enhancing experiential learning: A comparative study of traditional and immersive learning environments," *International Journal of Post Axial: Futuristic Teaching and Learning*, pp. 199–212, 2024.

[8] P. Papadopoulou, K. T. Chui, L. Daniela, and M. D. Lytras, "Virtual and augmented reality in medical education and training: innovative ways for transforming medical education in the 21st century," in *Cognitive computing in technology-enhanced learning*. IGI Global, 2019, pp. 109–150.

[9] S. Vayakone, "Organic chemistry in virtual reality: Bridging gaps between two-dimensional and three-dimensional representations," 2024.

[10] G. W. Young, S. Stehle, B. Y. Walsh, and E. Tiri, "Exploring virtual reality in the higher education classroom: Using vr to build knowledge and understanding," *Journal of Universal Computer Science*, no. 8, pp. 904–928, 2020.

[11] D. Sudharson, R. Malik, R. R. Sathya, V. Vaishali, S. Balavedhaa, and S. Gautham, "A novel adaptive framework for immersive learning using vr in education," *Transforming education with virtual reality*, pp. 1–26, 2024.

[12] L. Elme, M. L. Jørgensen, G. Dandanell, A. Mottelson, and G. Makransky, "Immersive virtual reality in stem: is ivr an effective learning medium and does adding self-explanation after a lesson improve learning outcomes?" *Educational technology research and development*, vol. 70, no. 5, pp. 1601–1626, 2022.

[13] S. Singha, *Diversity and Inclusion in VR: A New Frontier in Learning*, 04 2023, pp. 8–18.

[14] J. Varela-Aldás, G. Palacios-Navarro, R. Amariglio, and I. García-Magariño, "Head-mounted display-based application for cognitive training," *Sensors*, vol. 20, no. 22, p. 6552, 2020.

[15] K. Aasekjær, B. Gjesdal, I. Rosenberg, and L. Bovim, "Virtual reality (vr) in anatomy teaching and learning in higher healthcare education," in *How Can we Use Simulation to Improve Competencies in Nursing?* Springer International Publishing Cham, 2022, pp. 117–129.

[16] A. Marougkas, C. Troussas, A. Krouska, and C. Sgouropoulou, "Virtual reality in education: a review of learning theories, approaches and methodologies for the last decade," *Electronics*, vol. 12, no. 13, p. 2832, 2023.

[17] R. Plackett, A. P. Kassianos, S. Mylan, M. Kambouri, R. Raine, and J. Sheringham, "The effectiveness of using virtual patient educational tools to improve medical studentsâ clinical reasoning skills: a systematic review," *BMC medical education*, vol. 22, no. 1, p. 365, 2022.

[18] H. Jiang, S. Vimalesvaran, J. K. Wang, K. B. Lim, S. R. Mogali, and L. T. Car, "Virtual reality in medical studentsâ education: scoping review," *JMIR medical Education*, vol. 8, no. 1, p. e34860, 2022.

[19] M. Dombrowski, P. A. Smith, A. Manero, and J. Sparkman, "Designing inclusive virtual reality experiences," in *Virtual, Augmented and Mixed Reality. Multimodal Interaction: 11th International Conference, VAMR 2019, Held as Part of the 21st HCI International Conference, HCII 2019, Orlando, FL, USA, July 26–31, 2019, Proceedings, Part I 21*. Springer, 2019, pp. 33–43.

[20] J. Radianti, T. A. Majchrzak, J. Fromm, and I. Wohlgenannt, "A systematic review of immersive virtual reality applications for higher education: Design elements, lessons learned, and research agenda," *Computers & Education*, vol. 147, p. 103778, 2020.

[21] A. Suh and J. Prophet, "The state of immersive technology research: A literature analysis," *Computers in Human behavior*, vol. 86, pp. 77–90, 2018.

[22] G. Tuthill and E. B. Klemm, "Virtual field trips: Alternatives to actual field trips," *International journal of instructional media*, vol. 29, no. 4, p. 453, 2002.

[23] J. Beck, M. Rainoldi, and R. Egger, "Virtual reality in tourism: a state-of-the-art review," *Tourism Review*, vol. 74, no. 3, pp. 586–612, 2019.

[24] C. Ouerghemmi, M. Ertz, N. Bouslama, and U. Tandon, "The impact of virtual reality (vr) tour experience on touristsâ intention to visit," *Information*, vol. 14, no. 10, p. 546, 2023.

[25] E. Châng, Y. Cai, and H. Thwaites, "Special issue on vr for culture and heritage: The experience of cultural heritage with virtual reality (part ii): Guest editorsâ introduction," *Presence: Teleoperators and Virtual Environments*, vol. 26, no. 4, pp. iii–iv, 2018.

[26] E. Hu-Au and J. J. Lee, "Virtual reality in education: a tool for learning in the experience age," *International Journal of Innovation in Education*, vol. 4, no. 4, pp. 215–226, 2017.

[27] M. Lui, R. McEwen, and M. Mullally, "Immersive virtual reality for supporting complex scientific knowledge: Augmenting our understanding with physiological monitoring," *British Journal of Educational Technology*, vol. 51, no. 6, pp. 2181–2199, 2020.

[28] M. Barnett, "Using virtual reality computer models to support student understanding of astronomical concepts," *Journal of computers in Mathematics and Science Teaching*, vol. 24, no. 4, pp. 333–356, 2005.

[29] E. Hu-Au and J. J. Lee, "Virtual reality in education: a tool for learning in the experience age," *International Journal of Innovation in Education*, vol. 4, no. 4, pp. 215–226, 2017.

[30] J. Scholz and A. N. Smith, "Augmented reality: Designing immersive experiences that maximize consumer engagement," *Business horizons*, vol. 59, no. 2, pp. 149–161, 2016.

[31] S. Poeschl, "Virtual reality training for public speakingâa quest-vr framework validation," *Frontiers in ICT*, vol. 4, p. 13, 2017.

[32] J. O. Bailey and J. N. Bailenson, "Considering virtual reality in childrenâs lives," *Journal of Children and Media*, vol. 11, no. 1, pp. 107–113, 2017.

[33] S. Wang, Z. Mao, C. Zeng, H. Gong, S. Li, and B. Chen, "A new method of virtual reality based on unity3d," in *2010 18th international conference on Geoinformatics*. IEEE, 2010, pp. 1–5.

[34] System Requirements Lab, "Oculus quest 2 system requirements," https://www.systemrequirementslab.com/cyri/requirements/oculus-quest-2/20359, accessed: June 1, 2024.

[35] Unity Asset Store, "Realistic grass & flowers pack — 2d nature — unity asset store," https://assetstore.unity.com/packages/2d/textures-materials/nature/realistic-grass-flowers-pack-191866, November 7 2022, accessed: June 2, 2024.

[36] B. Foundation, "Blender," https://www.blender.org/, 2024, accessed: May 25, 2024.

[37] Adobe, "Mixamo," https://www.mixamo.com/#, 2019, accessed: June 5, 2024.

[38] Y. Han, Y. Zhang, and M. M. Soares, "The usability assessment of meta quest2 and recommendations for improving," in *International Conference on Human-Computer Interaction*. Springer, 2023, pp. 184–193.