

Challenges and Implications of Virtual Reality in History Education: A Systematic Review

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Abstract: Virtual Reality (VR) has emerged as a promising tool for history education, offering immersive and interactive learning experiences. However, its implementation in educational settings presents several challenges that remain under-explored. This systematic review, conducted using the Preferred Reporting Items for Systematic reviews and Meta-Analyses (PRISMA) methodology, aims to identify the main technical, usability, economic, psychological, social, and ethical challenges associated with the use of VR in history teaching. A literature search was performed in the Scopus (Elsevier) database, retrieving 2794 studies, from which a final selection of 14 papers was made based on predefined eligibility criteria. The findings indicate that interoperability issues, high hardware and software requirements, and navigation difficulties hinder VR integration. Moreover, usability concerns, including complex interfaces and cognitive overload, affect both students and educators, emphasizing the need for specialized teacher training. Economic barriers, such as the high cost of VR equipment and software, limit accessibility in resource-constrained institutions. Additionally, psychological and social challenges, including user discomfort, confusion between reality and fiction, and ethical concerns, were identified. These findings highlight the necessity of addressing these limitations to optimize VR's pedagogical potential in history education. Future research should focus on developing cost-effective solutions, enhancing usability, and designing comprehensive training programs to facilitate the effective adoption of VR in educational contexts.

Keywords: virtual reality; systematic review; history education; history didactics; technology



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1. Introduction

Students from different educational stages have identified Social Sciences as one of the most challenging academic areas in terms of comprehension and assimilation. This difficulty is largely attributed to a teaching methodology that fails to adequately address the complexity of the content [1]. Instruction often relies heavily on the rote memorization of dates, names, and facts through lengthy and monotonous presentations [2]. The study of VanSledright (2011) argues that history instruction follows an excessively traditional approach, emphasizing memorization and repetition rather than fostering a critical and in-depth understanding of historical events and processes [3].

In recent years, research in Social Sciences education, as in other fields, has increasingly highlighted the importance of integrating technology into the classroom [4,5]. Consequently, the use of technological tools associated with Information and Communication Technologies (ICT) has gained considerable prominence over the past decades. These

tools not only enhance teaching and learning but also foster the development of new learning environments, pedagogical approaches, and interactive methodologies, thereby improving accessibility to heritage settings and expanding cultural engagement among broader segments of the population [6]. The effective integration of heritage education with emerging technologies has the potential to significantly transform history teaching [7]. The integration of technology into society has led to the emergence of a wide range of new pedagogical possibilities within the field of education, making its incorporation an undeniable reality. The study of Huang et al. (2016) [8] emphasizes that this integration has generated an entirely new landscape, not only for research but also for pedagogical innovation within the educational domain.

Among the many emerging technologies, Virtual Reality (VR) and Augmented Reality (AR) stand out, having been highlighted in several prominent international reports, such as The NMC/CoSN Horizon Report K-12 [9,10] and the Edutrends report by the Educational Innovation Observatory of the Monterrey Institute of Technology [11,12]. These reports position VR and AR as some of the most promising technological trends for educational contexts in the short to medium term. The growing interest in these technologies is evident from the increasing number of publications [13–16], reviews [17–19], and meta-analyses [20–23] that explore their practical applications in recent years.

In the field of history, educators face daily challenges in engaging students with the subject matter. The methodologies and resources currently employed have undergone significant transformations in recent years, particularly with the integration of new technologies into educational environments [24]. In this context, VR and AR technologies are being specifically developed for museums and heritage sites, offering innovative ways to explore and interact with historical elements [25]. The adoption of these technologies represents a key tool, enabling students to access digital scenarios and spaces that would otherwise be inaccessible [26]. These spaces blend the real world with virtual contexts, providing essential information for deeper exploration of topics or allowing students to observe digitally recreated objects and environments [27]. These innovative tools foster interactive and immersive learning environments, facilitating a more profound understanding of historical concepts.

VR and AR offer distinct digital experiences that can complement each other. Despite sharing certain characteristics, VR and AR are often conflated. AR enhances the real environment by adding virtual content elements [28]. Rather than replacing the real world, AR complements it with virtual information [29], establishing a spatial connection between virtual data and the physical environment. In contrast, VR provides a fully immersive experience within a computer-generated digital environment, allowing users to engage with an interactive three-dimensional world and experience a range of sensations and emotions [20]. The key distinction between these two technologies is that AR overlays virtual information onto the real world, while VR creates a completely digital, independent, and self-contained environment. It is important to note that, currently, Mixed Reality (MR) experiences are also being developed. MR integrates both VR and AR, harnessing the strengths of each technology to their fullest potential. This integration enables the inclusion of virtual objects within real-world educational environments, utilizing technological tools that enhance contextualization in the learning process [14].

1.1. VR in Education

Academic research has documented numerous contributions and benefits of VR-based instruction. The recent proliferation of consumer VR hardware has made a wide range of experiences, locations, and environments more accessible than ever before [30]. This technology has proven effective in enhancing learning by enabling students to connect

theoretical knowledge with practical experiences within a virtual environment. According to Villena-Taranilla et al. (2022) [20], learning in a virtual world not only facilitates the comprehension of complex concepts but also enriches the educational experience by making it more interactive and engaging. Similarly, Salzman et al. (1999) [31] explained how this technology promotes complex learning, both in teaching methodologies and academic outcomes. Their study highlights how immersive experiences improve the understanding of challenging subjects by providing dynamic and interactive learning opportunities, thereby optimizing educational processes.

The teaching of history is particularly well-positioned to benefit from this technology [32] as it allows students to explore historical sites and environments that would otherwise be inaccessible in person [26]. In this context, VR technology offers unrestricted access to both real and digitally reconstructed spaces, eliminating the need for physical travel and providing continuous availability. This facilitates greater interaction, enabling engagement from any location and at any time [33]. The publication of Sacristán and Waeder (2016) compare VR to a time machine, highlighting its ability to virtually recreate any space and place it within any historical period [34].

1.2. Rationale

To fully understand the impact of VR technology on the educational process, further research is required to validate or challenge their potential benefits [35]. This presents a key future challenge: conducting additional studies to gain a deeper understanding of how history students and educators engage with these technologies [36]. The current scientific literature on the use of VR in education, particularly in the teaching of history, has tended to focus on its potential benefits and innovative experiences, neglecting the systematic analysis of the challenges, limitations, and barriers associated with its implementation [37]. This lack of critical studies hinders a comprehensive understanding of the phenomenon and limits the development of robust and sustainable pedagogical strategies. In this context, the aim of the present article is to conduct a systematic literature review to identify, synthesize, and critically examine these challenges from two perspectives: technical (infrastructure, accessibility, maintenance) and pedagogical (instructional design, teacher training, classroom management). Through this analysis, we aim to offer a comprehensive view of the identified issues, identify current trends in the educational integration of Virtual Reality, and provide a critical synthesis that will guide future research directions, thus contributing to the design of more grounded and effective educational proposals.

Therefore, there is a pressing need to identify key elements and challenges that may influence the implementation of these technologies. However, current research on VR tends to focus on the analysis of specific applications and motivational aspects [38,39], often neglecting or overlooking broader educational applications and the potential challenges associated with their use. This limitation creates a knowledge gap and a research bias, making it difficult to gain a comprehensive understanding of the pedagogical potential that these technologies can offer in fields such as history and heritage education.

For technology integration in education to have a meaningful impact, it is essential to understand how to maximize its potential and apply it effectively to enhance the teaching and learning of history [40]. Therefore, conducting studies that address existing gaps and critically analyze the challenges posed by these technologies is crucial to overcoming their limitations.

1.3. Research Questions and Purpose

This review aims to identify the most common challenges associated with the application of VR in history learning environments. Through a comprehensive analysis of the recent literature, this study seeks to address the following research questions:

- RQ1** What are the most prevalent technical, usability, and economic challenges faced by educators when integrating VR into history instruction?
- RQ2** What psychological, social, and ethical issues emerge from the use of these technologies in history education?
- RQ3** Do history educators require specialized training to effectively use VR technologies?

The purpose of this review is to contribute to the field of VR by addressing gaps identified in prior studies and reviews. Specifically, the main objective is to highlight the challenges these technologies present in history and heritage education, offering a more comprehensive perspective on their implementation.

This work is arranged as follows: in Section 2, we describe the methodology used for conducting the systematic review, including the criteria for article selection, search strategy, and analysis process. Section 3 provides a detailed synthesis and discussion of the findings, categorizing the studies based on key themes and identifying the challenges and limitations of using VR in history education. Finally, Section 4 concludes the paper by summarizing the key insights and offering recommendations for further investigation in this area.

2. Methods

This study entailed a comprehensive research process aimed at collecting, analyzing, and synthesizing empirical evidence related to the research questions formulated in advance. To achieve this, a systematic review of the relevant scientific literature was conducted [41]. The study report was specifically developed in accordance with the guidelines of the *Preferred Reporting Items for Systematic Reviews and Meta-Analyses* (PRISMA) [42].

The study selection was carried out in a multi-stage process in which potentially eligible studies retrieved from a database search were screened by two independent researchers to obtain details regarding the key characteristics of the included studies. Any discrepancies were resolved through discussion, mediated by a third researcher to reach a consensus. Figure 1 illustrates the flow diagram of the data retrieved through the different stages of this systematic review, detailing the number of records identified, included, and excluded. In the following, we describe in detail the methodology (according to PRISMA guidelines in Supplementary Materials) in order to facilitate transparency and complete reporting of the systematic review.

2.1. Eligibility Criteria

To ensure a consistent selection process, we applied specific inclusion criteria. According to our research scope, studies were included in the review if they met the following criteria:

1. They were published in peer-reviewed scientific journals. To ensure the reliability and quality of the research, conference papers, book chapters, and other non-journal publications were excluded, as they do not necessarily undergo rigorous peer review process (cr01).
2. The full texts were accessible online or through university library systems. If there was any doubt regarding a study, the full article was reviewed before making a final decision on its inclusion or exclusion (cr02).
3. They employed VR (cr03).

4. They were research studies within the field of history education (cr04).
5. The studies addressed or mentioned challenges, limitations, difficulties, deficiencies, drawbacks, or similar concepts regarding the use of VR (cr05).

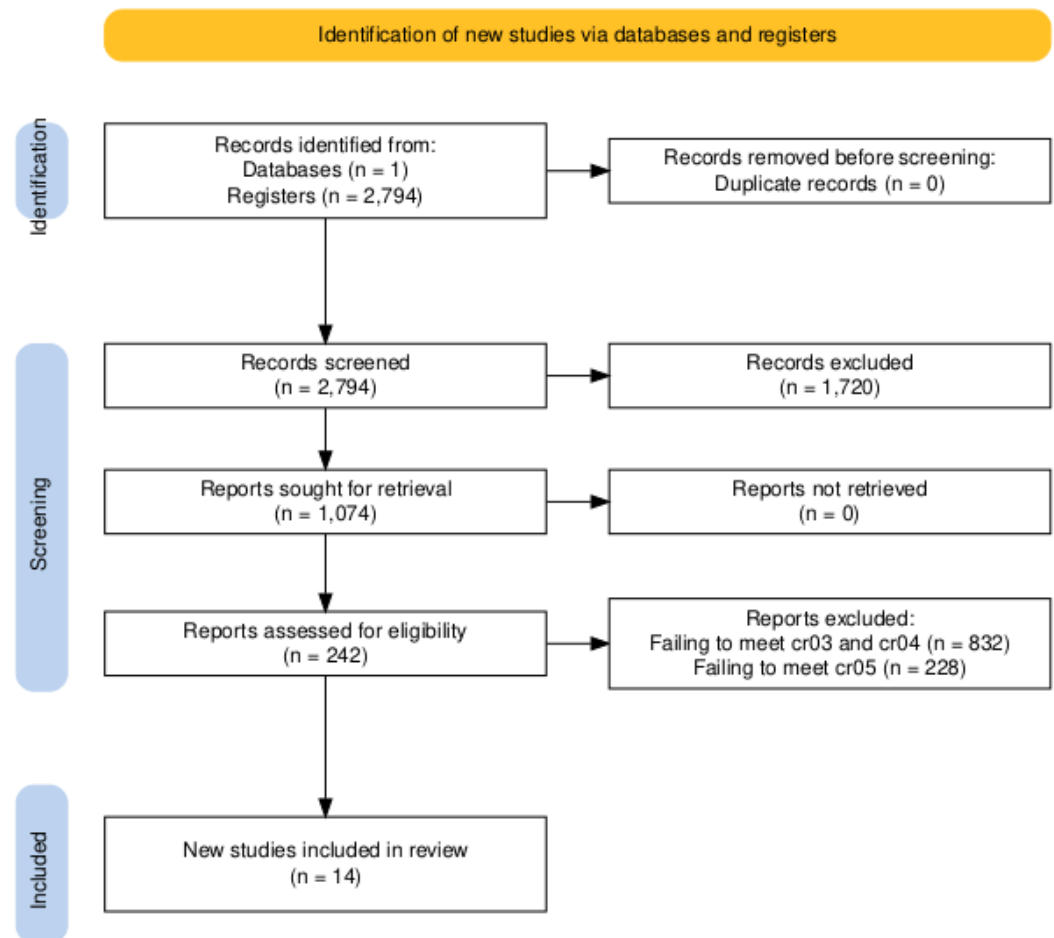


Figure 1. Flowchart of the study selection process.

2.2. Information Source and Search Strategy

A bibliographic search was conducted in July 2024 using the Scopus (Elsevier) database. To develop the search string, unpublished studies were excluded to ensure that all selected references had undergone peer review. The search string used was “Virtual Reality” AND “History” in titles and abstracts, with no time restrictions, resulting in a broad selection of studies spanning over thirty years. Specifically, this search retrieved 2794 studies. No duplicate records were identified in the database survey output. No automation tools were employed in any stage of the process.

Although this systematic review followed a rigorous protocol based on the PRISMA guidelines, one acknowledged limitation is the specificity of the search string used in the search equation. This strategy, designed to maximize the relevance of the selected studies, may have excluded valuable research employing alternative terms such as “immersive learning”, “heritage education”, or “virtual reality in pedagogy”. Future reviews could benefit from expanding the search strategy to encompass a broader range of terminology, allowing for the inclusion of a wider diversity of approaches and experiences related to the educational use of Virtual Reality in historical contexts.

2.3. Selection Process and Data Collection

A double screening was carried out with the potentially eligible studies. For each study, researchers collected the following information in a data format: title, authors, abstract, date of publication, doi, document type, and source title. At all stages, any discrepancies were resolved through discussion, mediated by a third researcher to reach a consensus.

In a first stage, according to the first eligibility criterion (cr01), the two researchers screened the studies to check if they were published in peer-reviewed scientific journals. Of the potentially eligible studies, 1720 were excluded by document type, as they were published as conference papers, reviews, book chapters, books, conference reviews, editorials, notes, letters, short surveys or retracted papers. Hence, the sample of articles sought to retrieval consisted of 1079 articles, all of which were successfully retrieved (in accordance to eligibility criterion cr02).

By reviewing titles and keywords from the collected data, the two independent researchers examined the studies and identified papers related to hands-on experiences with VR (cr03) and research related to the field of history education (cr04). After this selection, a sample of 242 full-text documents were chosen to assess their eligibility.

In the final stage, researchers ensured that the articles met the later established eligibility criteria (c05). At this point, we look for the outcomes of interest measured in the studies, or whether they are ineligible because the results for the outcomes of interest were not reported. To this end, the researchers revised the abstracts (and full text, if necessary) of the 242 studies. A total of 228 articles were excluded for not addressing challenges, limitations, difficulties, deficiencies, drawbacks, or similar concepts regarding the use of VR (cr05). Finally, 14 studies were incorporated into the review.

2.4. Data Items and Synthesis Methods

An inductive analysis was conducted with the aim of identifying the data items, building upon an initial preliminary classification extracted from the selected papers. This classification, structured around the research questions, was developed by the two researchers in different iterations to reach a consensus. By tabulating the characteristics of each study and comparing them against these predefined categories, we ensured a structured approach to synthesis selection. This method allowed us to identify recurring themes and patterns, aligning each study with the most relevant analytical framework. The data items (categories) analyzed in this report were as follows:

- Ethical considerations: Issues related to privacy, informed consent, and the responsible use of VR in educational contexts.
- Psychological and social impact: Effects of VR on students' perception, motivation, and social interaction in learning history.
- Usability challenges (difficulty of use): Technical or cognitive barriers that hinder effective use of VR by teachers and students.
- Pedagogical aspects: Teaching strategies and methodological approaches that enhance the use of VR for history education.
- Technical issues (motion and visualization): Technical problems such as latency, graphics quality, or motion sickness that affect the user experience.
- Economic aspects (development and production costs): Costs associated with designing, implementing, and maintaining VR experiences for history education.
- Social and cultural acceptance: Students' and teachers' perception and willingness to integrate VR into history learning.
- Social interaction in virtual environments: Communication and collaboration dynamics among users in history learning experiences within virtual environments.

3. Results and Discussion

The analysis of studies examining the implementation of VR in history education highlights several recurring challenges. In the following, we present the results organized according to the categories identified, aligned with the previously described synthesis categories. Table 1 summarizes the information described here.

Table 1. Characteristics of the studies included in the review.

Study	Implied Categories
Gómez-Galán (2016) [43]	Ethical considerations Psychological and social impact
Bonnett (2004) [44]	Usability challenges Pedagogical aspects
Christopoulos et al. (2024) [38]	Technical issues Usability challenges Pedagogical aspects
Caron (2023) [45]	Technical issues Economic aspects
Corrales et al. (2024) [7]	Psychological and social impact Social and cultural acceptance
Forsyth (2024) [30]	Technical issues
Bárbara and Haahr (2023) [46]	Usability challenges
Parong and Mayer (2021) [47]	Psychological and social impact
Puggioni et al. (2021) [48]	Pedagogical aspects Pedagogical aspects
Lim D. (2019) [49]	Social interaction in virtual environments Pedagogical aspects
Ramsey (2017) [50]	Technical issues
Harley et al. (2016) [51]	Technical issues
Allison (2008) [52]	Psychological and social impact Pedagogical aspects
Green (2007) [53]	Economic aspects

3.1. Technical Issues

From a technical standpoint, the primary limitations are related to the lack of interoperability between platforms and the absence of open standards that would facilitate the efficient use of VR technologies. These issues are further exacerbated by the substantial hardware and software requirements needed to ensure proper functionality, which in turn impacts both accessibility and sustainability in educational settings [44,45,51]. Additionally, problems with visualization and navigation within virtual environments have been identified, which can result in disorientation and frustration for users [38]. Based on the findings, the primary technical issues identified were related to internet access, including downtime, delays, connectivity problems, and disruptions. Additionally, the energy consumption of devices was identified as another significant challenge.

3.2. Usability Challenges

Regarding usability, several studies indicate that VR interfaces are often complex and unintuitive, which makes them challenging to use, particularly for individuals with no prior experience. This issue poses a significant barrier not only for students but also

for educators, who require specialized training to effectively incorporate these tools into their teaching practices [44,52]. Furthermore, some studies suggest that the cognitive load associated with interacting with these technologies, in addition to physiological discomfort (such as dizziness and disorientation), may reduce the effectiveness of immersive learning experiences [38].

It was found that VR applications were difficult to navigate due to non-intuitive and poorly designed interfaces, complex controls, and ergonomic issues, such as discomfort caused by the weight of the devices. The user experience can be negatively impacted by a lack of familiarity with these technologies. Additionally, motion sickness emerged as one of the most frequently reported difficulties, particularly during extended usage sessions, which can affect both the comfort and the continuity of learning within VR environments. This limitation may reduce the effectiveness of immersive experiences and necessitate adjustments in the design of educational activities to mitigate its adverse effects.

3.3. Psychological and Social Impact

From a psychological and social perspective, several challenges, including anxiety, frustration, and even fear, have been identified in certain usage contexts, particularly when virtual environments are not designed to be accessible or user-friendly [7,43]. Moreover, concerns have been raised about the potential for younger students to confuse reality with fiction, which raises ethical questions regarding the design and implementation of these technologies [43].

3.4. Economic Aspect

Economic factors also constitute a significant barrier, as the high costs associated with the development and acquisition of VR devices and software limit their implementation in educational institutions with constrained financial resources. This challenge is particularly relevant for schools and museums, where these technologies could have a substantial impact on learning, but their adoption remains restricted due to budgetary constraints [45,53]. It is clear that high costs have been a persistent issue since the early 2000s. This financial barrier has hindered museums, schools, and institutions from participating in certain projects due to the substantial licensing fees associated with the use of VR.

3.5. Pedagogical Aspects

Finally, from a pedagogical perspective, studies indicate a limited curricular integration of VR, which hinders its adoption as a regular educational tool. In addition, there is a pressing need for specialized teacher training, as most current teacher education programs do not typically include VR technology management [48,52].

Another challenge associated with the integration of these technologies is the need for enhanced teacher training. The review underscores the critical nature of this issue. These findings are consistent with those of other studies, which highlight similar gaps in the initial training of history teachers concerning the use of digital resources [54].

3.6. Rest of Categories

The following categories were not analyzed in depth due to their low occurrence in the reviewed articles, which may compromise the robustness of the findings given the limited number of studies addressing these topics. Specifically, ethical considerations (issues related to privacy, informed consent, and the responsible use of VR in educational contexts), social and cultural acceptance (students' and teachers' perception and willingness to integrate VR into history learning), and social interaction in virtual environments (communication and collaboration dynamics among users in history learning experiences) were only marginally present in the selected literature. While these aspects are undoubtedly

relevant to the broader discussion on VR in education, the scarcity of studies exploring them prevents drawing meaningful conclusions. Future research should further investigate these dimensions to provide a more comprehensive understanding of their role in the effective implementation of VR in history education.

4. Conclusions

This study has identified several challenges that hinder the implementation of VR in history education, highlighting a substantial research gap that requires further attention. While VR has shown considerable potential in education, its adoption remains constrained by various obstacles that impede its effective integration into learning environments.

The primary research question (RQ1) of this review was to examine the challenges and limitations associated with the implementation of VR in history instruction. Among the main obstacles are technical issues, including a lack of interoperability between systems, format incompatibilities, and the high hardware and software requirements. These limitations not only impede accessibility in educational settings with limited resources but also present significant barriers to maintenance and updates [30,45,51]. In this context, standardizing platforms and developing more accessible technological solutions could help alleviate these challenges and promote broader adoption of VR.

Furthermore, usability barriers affecting both students and teachers have been identified. Factors such as the complexity of interfaces, navigation challenges, and physiological discomfort—such as disorientation and cognitive overload—can limit the effectiveness of immersive experiences in the classroom [38]. Therefore, the development of more intuitive and accessible virtual environments, alongside the optimization of user–system interaction, is essential to maximize the educational benefits of VR.

From an economic perspective, the high costs of implementation continue to be a significant barrier. The investment required for the development and acquisition of VR equipment, along with ongoing maintenance and update expenses, limits its adoption in educational and heritage institutions with constrained budgets [45,53]. To address this challenge, it is essential to explore funding models and foster collaborations between academic and technological entities to facilitate sustainable access to these technologies.

Overall, these findings highlight multiple challenges that must be addressed to ensure the effective integration of VR in history education. This analysis underscores the need to develop more accessible and intuitive technologies, as well as to implement educational strategies that promote their efficient and sustainable use.

The second research question (RQ2) of this study was related to the psychological, social, and ethical issues of the use of VR in history education. From a psychological and social perspective, the findings indicate that some students experience frustration, anxiety, or even fear when interacting with virtual environments, which may adversely affect their learning process [7,43]. Furthermore, there is a concern that younger students may struggle to differentiate between reality and fiction, raising ethical questions regarding the design of virtual scenarios and their potential impact on students' cognitive development [43].

Finally, the third research question (RQ3) was related to the specialized training for history educators on the use of VR. Regarding pedagogical barriers, the findings indicate that the absence of a curricular integration of VR limits its adoption as a regular educational tool. Furthermore, the need for specialized teacher training is emphasized, as many educators lack the necessary skills to design and manage VR-based learning experiences [48,52]. Effective teacher training and the development of VR-adapted teaching resources are critical for ensuring the successful implementation of VR in the classroom.

From an ethical perspective, although the reviewed literature addresses these issues marginally, several relevant challenges associated with the use of VR in educational con-

texts have been identified, particularly with younger students. Some studies caution about the risk of confusion between reality and fiction in young learners, which could have implications for their cognitive and emotional development. Additionally, the importance of establishing informed consent protocols tailored to minors and their legal guardians is emphasized, ensuring proper protection of user rights. Furthermore, the need to design virtual environments that are accessible, inclusive, and emotionally safe is crucial to minimize potential adverse effects, such as anxiety or frustration. While these ethical concerns are not the central focus of the studies analyzed, their identification underscores the importance of integrating them as cross-cutting issues in future research and educational developments based on VR.

In the end, this study identifies a research gap concerning the use of VR in history education. To date, most studies have concentrated on the potential advantages of VR or specific applications, often neglecting a more in-depth analysis of the challenges associated with its implementation [38,39]. This lack of systematic investigation into its limitations contributes to a knowledge gap that hinders a comprehensive understanding of its pedagogical impact and the development of effective strategies to optimize its use.

Therefore, more extensive and detailed research is necessary, not only to validate or challenge VR's educational potential, but also to identify practical solutions to the challenges identified. Understanding how students and teachers interact with this technology, the difficulties they encounter, and the strategies that can be implemented to enhance its effectiveness remains a critical area that warrants further investigation. Moreover, future research could be enriched by adopting theoretical frameworks such as TAM, UTAUT, or TPACK, which would allow for a more systematic analysis of the factors influencing the acceptance, integration, and effective use of Virtual Reality in history education.

In conclusion, while VR presents an innovative tool with significant potential for history education, its effective integration remains contingent upon overcoming substantial technical, economic, psychological, and pedagogical barriers. Addressing these challenges will require a multidisciplinary approach that integrates technological development, educational research, and teacher training, with the aim of transforming VR into an accessible and effective resource for historical learning. Based on the findings of this systematic review, the need to continue advancing in several strategic directions is highlighted. Among them, the importance of developing VR-based educational content that ensures not only its technical quality but also its historical accuracy and pedagogical value stands out; designing specific teacher training programs in immersive technologies for curricular integration; optimizing the usability and accessibility of VR platforms in order to expand their adoption in diverse contexts; and incorporating robust theoretical frameworks such as TAM, UTAUT, or TPACK in future studies to more systematically analyze the factors that influence the acceptance and educational effectiveness of these technologies. Furthermore, future research could comparatively analyze VR and AR in the context of history education, considering their different levels of immersion and their specific pedagogical implications. These future research directions are essential to consolidating the role of VR as a transformative tool in history education.

Study Implications and Educational Practices

The impact of these technologies on the educational process remains a topic of ongoing debate. Therefore, to validate or challenge the advantages of VR use, further research in the field of education is necessary, as existing studies are limited or lack conclusive results [35]. This need also extends to investigating the factors that influence or may impact its usability.

In this context, given the lack of comprehensive studies in this area, our analysis is particularly valuable. As Oumoumen et al. (2024) emphasize, identifying and understanding

the challenges associated with these technologies can enhance their effectiveness, efficiency, and appeal [55]. Thus, our findings are highly relevant for guiding future research and designing learning experiences that incorporate these technologies, aligning with one of the fundamental objectives of this study.

Based on the findings of this review, several practical recommendations are proposed to overcome the main challenges identified in the integration of VR in history education. First, it is suggested to promote the development of open standards to facilitate interoperability between platforms and devices. Additionally, designing specific teacher training programs for the pedagogical use of VR is considered a priority, along with improving the usability of applications through intuitive and ergonomic interfaces. It is also recommended to encourage the creation and adoption of low-cost solutions that allow access in educational contexts with limited resources. Finally, the progressive integration of VR experiences into school curricula is advised, using teaching strategies adapted to the characteristics of historical learning. These actions, grounded in the challenges identified, can significantly contribute to a more effective, equitable, and sustainable implementation of Virtual Reality in educational settings.

Supplementary Materials: The PRISMA checklist can be downloaded at <https://www.mdpi.com/article/10.3390/app15105589/s1>. Reference [56] cited in Supplementary Materials.

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References

1. Licerias, A. *Tratamiento de las Dificultades de Aprendizaje en Ciencias Sociales*; Grupo Editorial Universitario: Granada, España, 2000.
2. Carrasco, C.J.G.; Martínez, P.M.; Medina, J.R.; Sánchez, J.J.M. Perceptions on the procedures and techniques for assessing history and defining teaching profiles. Teacher training in Spain and the United Kingdom. *Educ. Stud.* **2021**, *47*, 472–490. <https://doi.org/10.1080/03055698.2019.1707069>.
3. VanSledright, B.A. *The Challenge of Rethinking History Education. On practice, Theories, and Policy*; Routledge: Abingdon, UK, 2011. <https://doi.org/10.4324/9780203844847>.
4. Miralles, P.; Gómez, C.J.; Arias, L. Social sciences teaching and information processing. An experience using WebQuests in primary education teacher training. *RUSC Univ. Knowl. Soc. J.* **2013**, *10*, 98. <https://doi.org/10.7238/rusc.v10i2.1536>.
5. Miralles, P.; Gómez, C.J.; Monteagudo, J. Percepciones sobre el uso de recursos TIC y «MASS-MEDIA» Para la enseñanza de la historia. Un estudio comparativo en futuros docentes de España-Inglaterre. *Educ. XX1* **2019**, *22*, 187–211. <https://doi.org/10.5944/educxx1.21377>.
6. Ibañez-Etxeberria, A.; Gómez-Carrasco, C.J.; Fontal, O.; García-Ceballos, S. Virtual environments and augmented reality applied to heritage education. An evaluative study. *Appl. Sci.* **2020**, *10*, 2352. <https://doi.org/10.3390/app10072352>.
7. Corrales, M.; Rodríguez, F.; Merchán, M.J.; Merchán, P.; Pérez, E. Comparative Analysis between Virtual Visits and Pedagogical Outings to Heritage Sites: An Application in the Teaching of History. *Heritage* **2024**, *7*, 366–379. <https://doi.org/10.3390/heritage7010018>.
8. Huang, T.C.; Chen, C.C.; Chou, Y.W. Animating eco-education: To see, feel, and discover in an augmented reality-based experiential learning environment. *Comput. Educ.* **2016**, *96*, 72–82. <https://doi.org/10.1016/j.compedu.2016.02.008>.
9. Freeman, A.; Adams Becker, S.; Cummins, M.; Davis, A.; Hall Giesinger, C. *NMC/CoSN Horizon Report: 2017 K-12 Edition*; Technical Report; The New Media Consortium: Austin, TX, USA, 2017.

10. Johnson, L.; Becker, S.A.; Cummins, M.; Estrada, V.; Freeman, A.; Hall, C. *NMC Horizon Report: 2016 Higher Education Edition*; Technical Report; The New Media Consortium: Austin, TX, USA, 2016.
11. Tecnológico de Monterrey. *Reporte EduTrends. Radar de Innovación Educativa 2015*; Technical Report; Tecnológico de Monterrey: Monterrey, Mexico, 2015.
12. Tecnológico de Monterrey. *Reporte EduTrends. Realidad Aumentada y Virtual*; Technical Report; Tecnológico de Monterrey: Monterrey, Mexico, 2017.
13. Doerner, R.; Steinicke, F. Perceptual Aspects of VR. In *Virtual and Augmented Reality (VR/AR)*; Springer: Cham, Switzerland, 2022; pp. 39–70.
14. Cabero Almenara, J.; Puente, A.P. La Realidad Aumentada: Tecnología emergente para la sociedad del aprendizaje. *Aula Rev. Humanidades Cienc. Soc.* **2020**, *66*, 35–51. <https://doi.org/10.33413/aulahcs.2020.66i2.138>.
15. Cabero Almenara, J.; Barroso, J. Los escenarios tecnológicos en Realidad Aumentada (RA): posibilidades educativas en estudios universitarios. *Aula Abierta* **2018**, *47*, 327–336.
16. Altomari, A.G.P. Realidad virtual y realidad aumentada en la educación, una instantánea nacional e internacional. *Econ. Creat.* **2017**, *7*, 34–65. <https://doi.org/10.46840/ec.2017.07.03>.
17. Timotheou, S.; Miliou, O.; Dimitriadis, Y.; Sobrino, S.V.; Giannoutsou, N.; Cachia, R.; Monés, A.M.; Ioannou, A. Impacts of digital technologies on education and factors influencing schools' digital capacity and transformation: A literature review. *Educ. Inf. Technol.* **2023**, *28*, 6695–6726. <https://doi.org/10.1007/s10639-022-11431-8>.
18. Caldera, B.R. Realidad aumentada en educación primaria: Revisión sistemática. *EduTec Rev. Electrónica Tecnol. Educ.* **2021**, 169–185.
19. Pellas, N.; Mystakidis, S.; Kazanidis, I. Immersive Virtual Reality in K-12 and Higher Education: A systematic review of the last decade scientific literature. *Virtual Real.* **2021**, *25*, 835–861. <https://doi.org/10.1007/s10055-020-00489-9>.
20. Villena Taranilla, R.; Cózar-Gutiérrez, R.; González-Calero, J.A.; López Cirugeda, I. Strolling through a city of the Roman Empire: An analysis of the potential of virtual reality to teach history in Primary Education. *Interact. Learn. Environ.* **2022**, *30*, 608–618. <https://doi.org/10.1080/10494820.2019.1674886>.
21. Gómez García, G.; Rodríguez Jiménez, C.; Marín Marín, J.A. La trascendencia de la Realidad Aumentada en la motivación estudiantil. Una revisión sistemática y meta-análisis. *Alteridad Rev. Educ.* **2020**, *15*, 36–46.
22. Di Natale, A.F.; Repetto, C.; Riva, G.; Villani, D. Immersive virtual reality in K-12 and higher education: A 10-year systematic review of empirical research. *Br. J. Educ. Technol.* **2020**, *51*, 2006–2033. <https://doi.org/10.1111/bjet.13030>.
23. Merchant, Z.; Goetz, E.T.; Cifuentes, L.; Keeney-Kennicutt, W.; Davis, T.J. Effectiveness of virtual reality-based instruction on students' learning outcomes in K-12 and higher education: A meta-analysis. *Comput. Educ.* **2014**, *70*, 29–40. <https://doi.org/10.1016/j.compedu.2013.07.033>.
24. Carrasco-Rodríguez, A. Reinventando la enseñanza de la Historia Moderna en Secundaria: La utilización de ChatGPT para potenciar el aprendizaje y la innovación docente. *Estud. HistóRico Hist. Mod.* **2023**, *45*, 101–145. <https://doi.org/10.14201/shhmo2023451101146>.
25. Challenor, J.; Ma, M. Augmented Reality in Holocaust museums and memorials. In *Springer Handbook of Augmented Reality*; Springer International Publishing: Cham, Switzerland, 2023; pp. 413–432. https://doi.org/10.1007/978-3-030-67822-7_17.
26. Fontal, O.; Ibañez-Etxeberria, A. Research on heritage education. Evolution and current state through analysis of high impact indicators. *Rev. Educ.* **2017**, *375*, 184–214. <https://doi.org/10.4438/1988-592X-RE-2016-375-340>.
27. Correa Gorospe, J.M.; Ibañez Etxeberria, A. Museos, tecnología e innovación educativa: Aprendizaje de patrimonio y arqueología en territorio menosca. *REICE Rev. Iberoam. Sobre Calidad Efic. Cambio Educ.* **2005**, *3*, 880–894.
28. Azuma, R. A Survey of Augmented Reality. *Presence Teleoperators Virtual Environ.* **1997**, *6*, 355–385.
29. Basogain, X.; Olabe, M.; Espinosa, K.; Rouèche, C.; Olabe, J.C. *Realidad Aumentada en la Educación: Una Tecnología Emergente*; Escuela Superior de Ingeniería de Bilbao, EHU: Bilbao, Spain, 2007.
30. Forsyth, H. Building a virtual Roman city: Teaching history through video game design. *J. Class. Teach.* **2023**, *24*, 16–25. <https://doi.org/10.1017/S2058631022000277>.
31. Salzman, M.C.; Dede, C.; Loftin, R.B.; Chen, J. A model for understanding How virtual Reality Aids complex Conceptual learning. *Presence Teleoperators Virtual Environ.* **1999**, *8*, 293–316. <https://doi.org/10.1162/105474699566242>.
32. Villena-Taranilla, R.; Cózar-Gutiérrez, R.; González-Calero, J.A.; Diago, P.D. An extended technology acceptance model on immersive virtual reality use with primary school students. *Technol. Pedagog. Educ.* **2023**, *32*, 367–388. <https://doi.org/10.1080/1475939X.2023.2196281>.
33. Redondo, J.D. Patrimonio universitario, patrimonio virtual. *Educ. Futur. Rev. Investig. Apl. Exp. Educ.* **2012**, 121–137.
34. Sacristán, A.; Waelder, P. Realidad Virtual + Internet 3D. 2016. Available online: <https://www.artfutura.org/v3/realidad-virtual-internet-3d/> (accessed on 17 March 2025).
35. Cabero Almenara, J.; Fernández Robles, B. Las tecnologías digitales emergentes entran en la Universidad: RA y RV. *RIED Rev. Iberoam. Educ. Distancia* **2018**, *21*, 119–138. <https://doi.org/10.5944/ried.21.2.20094>.

36. Junior, O.R.; Suelves, D.M.; Gómez, S.L.; Rodríguez, J.R. Digital Resources for Teaching and Learning History. A Research Review. *Panta Rei Rev. Digit. Hist. Didáctica Hist.* **2024**, *18*, 199–226.
37. Villena-Taranilla, R.; Diago, P.D.; Colomer Rubio, J.C. Virtual Reality as a Pedagogical Tool: Motivation and Perception in Teacher Training for Social Sciences and History in Primary Education. *Educ. Sci.* **2025**, *15*, 493. <https://doi.org/10.3390/educsci15040493>.
38. Christopoulos, A.; Styliou, M.; Ntalas, N.; Stylios, C. The Impact of Immersive Virtual Reality on Knowledge Acquisition and Adolescent Perceptions in Cultural Education. *Information* **2024**, *15*, 261. <https://doi.org/10.3390/info15050261>.
39. Abd Majid, F.; Mohd Shamsudin, N. Identifying Factors Affecting Acceptance of Virtual Reality in Classrooms Based on Technology Acceptance Model (TAM). *Asian J. Univ. Educ.* **2019**, *15*, 51–60. <https://doi.org/10.24191/ajue.v15i2.7556>.
40. Haydn, T. Supporting beginning teachers' use of ICT in the history classroom. In *Mentoring History Teachers in the Secondary School*; Routledge: Abingdon, UK, 2023; pp. 176–193.
41. Zawacki-Richter, O.; Kerres, M.; Bedenlier, S.; Bond, M.; Buntins, K. *Systematic Reviews in Educational Research: Methodology, Perspectives and Application*; Springer: Berlin/Heidelberg, Germany, 2020. <https://doi.org/10.1007/978-3-658-27602-7>.
42. Moher, D.; Liberati, A.; Tetzlaff, J.; Altman, D.G. Preferred reporting Items for systematic reviews and meta-analyses: The PRISMA statement. *PLoS Med.* **2009**, *6*, e1000097. <https://doi.org/10.1371/journal.pmed.1000097>.
43. Gómez-Galán, J. Learning historical and chronological time: Practical applications. *Eur. J. Sci. Theol.* **2016**, *12*, 5–16.
44. Bonnett, J. New technologies, new formalisms for historians: The 3D virtual buildings. *Lit. Linguist. Comput.* **2004**, *19*, 273–287.
45. Caron, M. Storia, oggetti, web. Collezioni e strumenti digitali per la digital public history. *Um. Digit.* **2023**, *16*, 79–95. <http://doi.org/10.6092/issn.2532-8816/16630>.
46. Barbara, J.; Haahr, M. What Really Happened Here? Dealing with Uncertainty in the Book of Distance: A Critical Historiography Perspective. In *Proceedings of the International Conference on Interactive Digital Storytelling*, Kobe, Japan, 11–15 November 2023; Springer Nature: Cham, Switzerland, 2023; pp. 129–136.
47. Parong, J.; Mayer, R.E. Learning about history in immersive virtual reality: Does immersion facilitate learning? *Educ. Technol. Res. Dev.* **2021**, *69*, 1433–1451.
48. Puggioni, M.; Frontoni, E.; Paolanti, M.; Pierdicca, R. ScoolAR: An educational platform to improve students' learning through virtual reality. *IEEE Access* **2021**, *9*, 21059–21070.
49. Lim, D. Advanced Technology of the Fourth Industrial Revolution and Korean Ancient History—Study on the use of artificial intelligence to decipher Wooden Tablets and the restoration of ancient historical remains using virtual reality and augmented reality. *Int. J. Korean Hist.* **2019**, *24*, 13–45.
50. Ramsey, E. Virtual Wolverhampton: Recreating the historic city in virtual reality. *ArchNet-IJAR Int. J. Archit. Res.* **2017**, *11*, 42–57.
51. Harley, J.M.; Poitras, E.G.; Jarrell, A.; Duffy, M.C.; Lajoie, S.P. Comparing virtual and location-based augmented reality mobile learning: Emotions and learning outcomes. *Educ. Technol. Res. Dev.* **2016**, *64*, 359–388.
52. Allison, J. History educators and the challenge of immersive pasts: A critical review of virtual reality 'tools' and history pedagogy. *Learn. Media Technol.* **2008**, *33*, 343–352.
53. Green, L.J. Cultural heritage, archives & citizenship: Reflections on using Virtual Reality for presenting knowledge diversity in the public sphere. *Crit. Arts J. South-North Cult. Stud.* **2007**, *21*, 308–320.
54. Gómez-Carrasco, C.; Rodríguez-Medina, J.; Chaparro, A.; Alonso, S. Recursos digitales y enfoques de enseñanza en la formación inicial del profesorado de Historia. *Educ. XXI* **2022**, *25*, 143–170. <https://doi.org/10.5944/educxx1.30483>.
55. Oumoumen, K.; Aboubane, F.; Younes, E.C.H. Automation of Historical Buildings: Historical Building Information Modeling (HBIM) based Virtual Reality (VR). In *Proceedings of the Mediterranean Architectural Heritage: RIPAM10, 2024*; Volume 40, p. 319. <https://doi.org/10.21741/9781644903117-34>.
56. Page, M.J.; McKenzie, J.E.; Bossuyt, P.M.; Boutron, I.; Hoffmann, T.C.; Mulrow, C.D.; Shamseer, L.; Tetzlaff, J.M.; Akl, E.A.; Brennan, S.E.; et al. The PRISMA 2020 statement: An updated guideline for reporting systematic reviews. *BMJ* **2021**, *372*, n71.

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