The Development of Humanities and Social Sciences, 2025, 1(5), 80-91
https://doi.org/10.71204/jzewg055

Virtual Reality in Sustainable Development Education: Insights from Finnish Classrooms

Ailun Ma [1,*]

[1] Institute of International and Comparative Education, Beijing Normal University, Beijing 100875, China

[*]**Corresponding Author**
Ailun Ma

202321010067@mail.bnu.edu.cn

Received: 26 October 2025 /Accepted: 21 December 2025 /Published online: 26 December 2025

Abstract

This paper investigates the integration of virtual reality (VR) in teaching sustainable development within various educational contexts in Finland. VR offers immersive, experiential learning opportunities that enhance students′ understanding of complex concepts, fostering both cognitive and affective learning. Key challenges include field-specific adoption, second-language learner support, and logistical constraints. A case study on ThingLink′s VR tool highlights its strengths and limitations in fostering systemic thinking. The paper concludes with recommendations for improving VR pedagogy and enhancing its impact on interdisciplinary education.

Keywords: Virtual Reality; Virtual Pedagogy; Sustainable Development Education; Experiential Learning; Systemic Thinking; Interdisciplinary Education; Digital Pedagogy

1. Introduction

Integrating virtual reality (VR) into educational practices has emerged as a powerful tool for enhancing learning outcomes, particularly in complex interdisciplinary subjects like sustainable development. VR allows students to engage in immersive, multi-sensory learning environments that offer unparalleled opportunities to interact with foreign environments, historical events, and natural phenomena in real-time. As educational systems globally seek innovative methods to improve student engagement and comprehension, the Finnish model of VR in vocational education presents a compelling case for further examination and adaptation in diverse international contexts (Finnish Museum Association, 2024; Lee et al., 2020).

This paper examines the pedagogical potential of VR in sustainable development education, focusing on Finland's vocational education system as a case study. Finland has implemented VR to simulate environments and experiences that would be difficult or impossible to access in traditional classroom settings. This technology enables learners to experience real-world applications of sustainable development principles, fostering deeper understanding through interaction and experiential learning (Johnson et al., 2021; Xie & Li, 2023). Previous research has highlighted VR's ability to increase students' motivation and concentration, as it transforms abstract concepts into engaging and tangible experiences (Mills et al., 2019).

The article not only explores the application of VR in the Finnish context but also aims to provide a broader framework for integrating such technologies into global educational practices. By examining the results of empirical studies and pilot programs conducted in Finland, this research provides insights into the effectiveness of VR in fostering cognitive and affective learning in sustainability education (Johnson et al., 2021). The paper also discusses the challenges and limitations encountered during the deployment of VR in education, contributing to the ongoing discourse on the role of digital technologies in shaping the future of teaching and learning.

Ultimately, this paper aims to inspire educational practitioners and policymakers worldwide to consider the potential of VR as an innovative pedagogical tool. As sustainability becomes an increasingly urgent global concern, the need for effective teaching strategies that can translate theoretical concepts into practical understanding is paramount.

2. Key Concepts and Theoretical Framework

2.1. Virtual Reality

The concept of virtual reality (VR), while seemingly contemporary, dates back to 1987 when it was coined by Jaron Lanier. Lanier, a pioneering figure in the field, conducted extensive research and developed numerous products that laid the foundation for VR technology (Lowood, 2024). His research company was instrumental in advancing 3D graphics and immersive interaction, contributing to the development of some of the earliest commercially available VR devices, such as VR headsets and data gloves (Berkman, 2024).

A key factor driving the early progress of VR research and technological development in the United States was the significant role played by government agencies such as the Department of Defense's National Science Foundation (NSF) and the National Aeronautics and Space Administration (NASA). These agencies funded numerous projects carried out by university-affiliated research laboratories, which led to the formation of a robust talent pool specializing in fields such as computer graphics, simulation, and virtual environments. This collaboration between academic, military, and commercial sectors not only propelled VR innovation but also fostered a network that continues to influence the development of immersive technologies (Lowood, 2024).

2.2. Virtual Pedagogy

Integrating virtual reality (VR) into educational practices is often examined in the context of pedagogical theories, particularly those related to situated learning and knowledge transfer. One persistent critique of traditional teaching methods is the difficulty students face in applying what they learn in the classroom to real-life situations. Research has demonstrated that even high-performing students frequently struggle to transfer classroom knowledge into practical, real-world applications (Dede, 2019). Although classroom settings are rarely authentic, teachers can leverage simulations and VR to create more realistic learning experiences, thereby improving the transferability of skills and knowledge (Hemminki-Reijonen, 2021).

VR offers learners the ability to engage with tasks in a realistic, hands-on manner, providing a space to practice skills that require physical interaction and motor coordination. The immersive nature of VR allows students to engage multiple senses and utilize muscle memory through the use of motion detection devices and interactive controls, which in turn helps to reduce cognitive load (Hemminki-Reijonen, 2021). This immersive environment not only aids in skill acquisition but also helps bridge the gap between theoretical knowledge and practical application.

Constructivist learning theory is closely aligned with VR-based simulations (Aiello, D'Elia, Di Tore, & Sibilio, 2012; Hemminki-Reijonen, 2021). In many ways, constructivism shares principles with situated learning, as it emphasizes that students construct knowledge based on their own experiences within a structured environment (Dede, 2017). According to constructivist theory, learners build knowledge through personal experiences, which are shaped by their developmental level, socio-cultural context, and prior knowledge (Dede, 2019). The OECD Future of Education and Skills Report (2018) highlights the importance of creating interdisciplinary connections between various subjects, and VR provides an innovative tool to facilitate these links by allowing students to engage with complex, multi-dimensional problems (Hemminki-Reijonen, 2021).

When incorporating VR technology into sustainability education, it is crucial to recognize that addressing the complexities of sustainability challenges requires a new kind of expertise. While constructivist thinking remains crucial, it must be complemented by transformative learning—an approach that encourages individuals to critically evaluate and change deeply ingrained assumptions. Transformative learning involves not only intellectual reflection but also the capacity to empathize with others, even those who hold opposing viewpoints (Silvonen et al., 2022). VR technology is particularly well-suited to support transformative learning by enabling learners to navigate diverse environments and engage with dynamic scenarios. In these immersive virtual environments, the consequences of learners' choices are made explicit, enhancing both the transformative and experiential dimensions of the learning process.

3. Applications of Virtual Reality in Education

Virtual reality is a fully immersive space accessed through devices such as goggles, helmets, or glasses, which allows users to experience and interact with a simulated environment that is distinct from the physical world. For example, smartphone applications can utilize augmented reality (AR) by adding virtual elements to the real-world environment using the device's camera. In contrast, mixed reality (MR) blends both real and virtual worlds to produce new environments and visualizations where physical and digital objects co-exist. Collectively, these three technologies—VR, AR, and MR—are often referred to under the broader term extended reality (XR) (Wang & Li, 2024).

3.1. Learning Through Immersive Environments

One of the key benefits of VR in education is its ability to create immersive learning environments. Immersive learning refers to learning experiences that fully engage students' senses, helping them concentrate on the subject matter by eliminating common distractions, such as notifications from smartphones or social media (Fraser, 2012). In these environments, VR serves as a user interface that immerses learners in real-time simulated experiences, allowing them to explore and interact with virtual settings through multiple senses (Vesisenaho et al., 2019). Research shows that immersive learning can lead to better engagement and understanding, especially in complex subjects such as sustainable development.

On top of enhancing engagement and experience, multisensory learning environments offered by VR improve the educational process by engaging various senses—sight, sound, and touch—simultaneously. This multi-modal approach enriches the learning experience and helps students better retain information. For example, studies suggest that students learning Finnish as a second language through VR-based sustainable development courses perform significantly better than those in traditional face-to-face settings (Hemminki-Reijonen, 2021). The ability to simulate real-world scenarios in a controlled virtual environment not only enhances learning outcomes but also enables the practice of behaviors and skills in a safe, adaptable space (Bailenson, 2018).

VR also offers unique opportunities for collaborative learning and feedback. Special tracking devices monitor users' movements in real-time, allowing instructors to observe and mirror their actions on tablets or computers (Hemminki-Reijonen, 2021). This ability to receive immediate feedback while interacting with other students enhances the collaborative nature of learning. In this way, VR facilitates both individual and group learning, making it a versatile tool for modern education.

3.2. Learning through experiments

Moreover, VR fosters experiential learning, a concept that emphasizes learning through direct experience. Virtual environments allow students to actively participate in tasks that would be difficult to organize in real life. For instance, learners can manipulate objects that would otherwise be impossible to handle, such as large machinery or delicate ecosystems like rainforests, expanding the boundaries of the traditional classroom (Dede, 2017). This aligns with the theory of experiential learning, where the direct involvement in learning tasks fosters deeper understanding and retention (Kolb, 1984).

Thus, as educational spaces increasingly incorporate digital technologies, VR has proven to be a valuable pedagogical tool, opening new possibilities for learning experiences that are both immersive and practical. As sustainable development education and other interdisciplinary subjects grow in importance, VR can play a significant role in fostering not only cognitive but also affective learning, driving behavioral change that transcends the classroom.

3.3. VR Learning in Finnish High Schools

The table illustrates the varied applications of Virtual Reality (VR) across Finnish high schools, demonstrating its versatility in enhancing educational experiences across diverse subject areas. From science and technology to language learning, art, and ethics, VR is used to immerse students in complex environments and interactive scenarios that are otherwise difficult to replicate in traditional classrooms. Notably, VR in special education and sustainability studies highlights its role in fostering inclusivity and promoting critical global awareness. These examples showcase how Finnish schools are leveraging VR not only to improve subject-specific comprehension but also to enhance systemic thinking, problem-solving, and ethical reasoning skills, preparing students for both local and global challenges.

Table 1. Virtual classroom setup in a finnish high school using VR for interactive learning

High School	Specific Use of VR	Subject Area
Etelä-Tapiola High School	VR for science education, including biology and geography.	Science
Helsingin normaalilyseo	VR for language immersion and history lessons.	Language, History
Oulun Lyseon Lukio	VR in sustainability education and environmental science.	Environmental Science
Tampereen teknillinen lukio	VR for technology and engineering education.	Technology Engineering
Kerttuli Upper Secondary School	VR in art and design education.	Art and Design
Sammon keskuslukio	VR for special education and inclusive learning environments.	Special Education
Espoo International School	VR for global studies and intercultural education.	Global Studies
Turun normaalikoulu	VR for science, particularly physics and chemistry.	Physics, Chemistry
Jyväskylän Lyseon Lukio	VR for creative writing and storytelling.	Creative Writing
Helsingin Suomalainen Yhteiskoulu (SYK)	VR in ethics and philosophy lessons.	Ethics, Philosophy

3.3. Virtual Reality to Support the Learning of Neurodivergent Students

Neuropsychiatric symptoms (often referred to as nepsy symptoms) arise from malfunctions in the brain's neural networks, which can significantly hinder everyday functioning. These symptoms are common, affecting approximately 15 percent of the Finnish population, with prevalence rates continuing to rise (ADHD: Käypä hoito -suositus, 2019). While these symptoms are most commonly observed in children and adolescents, a growing number of adults are also being diagnosed with neuropsychiatric disorders (Neuropsychiatric Disorders, 2021).

Individuals on the neurodivergent spectrum, particularly those with conditions such as ADHD and autism spectrum disorder, often struggle with adapting to sudden changes, managing disappointment, and processing sensory experiences. Daily routines that involve social interaction and other stimuli can be overwhelming. Sudden, unexpected changes may exacerbate these challenges, making predictable and structured routines essential for the smooth functioning of daily life. Various interventions have been employed to support individuals with neuropsychiatric symptoms, one of which is the use of virtual reality (VR).

VR has shown promising results in both the rehabilitation and educational settings for neurodivergent individuals. It provides a controlled environment where sensory stimuli can be managed, allowing users to focus on specific tasks without being overwhelmed by extraneous distractions. By directing attention to one task or scenario at a time, VR helps mitigate the inattentiveness often experienced by neurodivergent individuals, which may manifest as difficulty following instructions, making repeated mistakes, or struggling to organize activities. The immersive nature of VR enables individuals to concentrate on learning in an environment tailored to their sensory and cognitive needs, reducing the cognitive overload caused by excessive sensory input (Digi as a Resource for Families Project, 2023).

3.4. Virtual Reality in Sustainable Development Education

Digitalization provides a wide array of tools and opportunities to enhance the teaching of sustainable development at the secondary level. These digital tools can significantly promote students' environmental awareness and prepare them to actively participate in promoting sustainable development. One particularly promising tool in this regard is virtual reality (VR), which enables immersive and interactive learning experiences that can make complex and abstract concepts more tangible.

The primary goal of sustainable development education is to foster students' critical thinking skills, enabling them to assess both current and future development paths. This critical evaluation includes analyzing the potential impacts of various alternatives on the environment, society, and economy. In this context, teaching should go beyond theoretical knowledge and help students develop practical skills that they can apply in real-world scenarios. These skills include resource conservation, ecological design, sustainable eating, and responsible consumption practices, all of which are vital to fostering a sustainable future. In addition, ethical reflection is a key component of sustainable development education. Students should be encouraged to critically reflect on their own values and ethical principles, especially concerning the environment and societal well-being.

In the context of sustainable development education, VR can simulate complex environmental, economic, and social systems, enabling students to experiment with decision-making processes and observe the outcomes of their actions. These hands-on, immersive simulations allow learners to better understand the systemic relationships between human actions and environmental outcomes.

(1) Virtual Reality in Promoting Systematic Thinking

One of the greatest challenges in teaching sustainable development is cultivating students' systemic thinking—the ability to understand the interrelatedness of various factors and their mutual effects. Systemic thinking is a holistic and comprehensive way of viewing problems and phenomena, emphasizing that each component of a system affects the others. For example, when addressing sustainable development, students need to consider the complex interactions between environmental sustainability, social justice, and economic viability (Arnold & Wade, 2015; Siivonen et al., 2022). Understanding these intricate relationships is not always intuitive for students, especially when long-term effects and abstract concepts are involved. These challenges are compounded when attempting to illustrate the global nature of sustainability issues, making it difficult for educators to convey the complexity of global interactions and the far-reaching consequences of local actions.

(2) Virtual Reality in Building Eco-social Civilization

Looking beyond, systematic thinking is also one of the most essential competencies for fostering a sustainable future and building an eco-social civilization (Salonen & Bardy, 2015; Siivonen et al., 2022). Eco-social civilization refers to a societal structure that recognizes the limitations of natural resources and operates sustainably, prioritizing both the well-being of the planet and its inhabitants. It integrates the values of freedom and responsibility in balancing human needs with environmental stewardship. Promoting such a mindset among students is crucial, as it prepares them to navigate and address the multifaceted challenges of sustainability.

Given the complexity of sustainable development, it is essential to create a motivating and inclusive learning environment that supports the development of systemic thinking. Teaching strategies must encourage students to explore sustainability challenges from a holistic perspective and to propose solutions that take into account the interconnectedness of various factors. This is where virtual reality becomes a particularly powerful tool.

Virtual reality has proven to be highly effective when teaching complex phenomena, especially those that involve intricate cause-and-effect relationships. In a VR environment, students can navigate through time—both forward and backward—enabling them to see how decisions in the present affect outcomes in the future. This dynamic interaction helps make the often abstract and long-term consequences of sustainable development more concrete and comprehensible. Moreover, VR allows students to observe the smallest details of a system that might otherwise go unnoticed, thereby transforming passive knowledge into active understanding (Aaltonen et al., 2021). By immersing students in these interactive experiences, VR fosters a deeper grasp of systemic thinking, making it an invaluable tool for teaching the principles of sustainable development.

As such, virtual reality is exceptionally well-suited for illustrating the complex relationships inherent in sustainable development. It helps bridge the gap between theoretical knowledge and practical application, allowing students to experience first-hand the systemic nature of sustainability issues. This, in turn, equips them with the skills and insights needed to navigate the complexities of sustainable development in the real world.

4. Case Study: Challenges and Limitations in Utilizing ThingLink's Scenario Tool in Finland

ThingLink is a widely used digital tool that allows educators to create interactive learning experiences through virtual tours and 360-degree environments. In Finland, ThingLink has been adopted by several educational institutions to enhance vocational education, providing students with immersive, real-world learning scenarios. The ThingLink VR scenario tool enables educators to design engaging, interactive content where students can explore different environments, interact with objects, and complete exercises, all within a virtual setting (ThingLink, 2023). This tool has been especially useful in sectors like vocational training, where hands-on experience is essential but sometimes difficult to simulate in a traditional classroom setting.

As part of a larger effort to explore the potential of virtual reality (VR) in education, Finnish vocational schools integrated ThingLink into their curriculum. In particular, schools such as Omnia Education Partnerships, in collaboration with ThingLink, implemented the VR tool to simulate real-world environments for students in fields like real estate, cleaning services, and healthcare (ThingLink, 2023). The goal of the project was to assess how ThingLink's VR scenario tool could enhance students' learning experiences by providing immersive, practical simulations. However, the case study revealed several challenges and limitations in its adoption.

4.1. Field-Specific Challenges in Adopting VR Tools

One of the primary challenges in utilizing ThingLink's scenario tool was the variation in adoption across different professional fields. Students in fields like cleaning and real estate services adapted more quickly to using VR glasses, as the tool provided realistic simulations of everyday tasks, such as inspecting property or managing cleaning services. However, students in the social and health sectors faced greater difficulties in using the technology. For these students, whose professions require more interpersonal and hands-on care, the virtual simulations felt less applicable to their real-world tasks (Aaltonen et al., 2021). This disparity highlighted the need for customized VR applications that are better aligned with the specific needs of different vocational fields.

4.2. Challenges for Second Language Learners

Another significant limitation arose in the case of second language (S2) learners, who encountered difficulties navigating the exercises due to language barriers. While S2 students demonstrated a general willingness to engage with the VR technology, the exercises themselves were not fully tailored to accommodate their language needs. The instructions and content within ThingLink's scenarios were not adapted for learners whose first language was not Finnish. Consequently, these students struggled to complete the exercises independently, relying heavily on group support or additional assistance from instructors (Digi as a Resource for Families Project, 2023). This emphasizes the importance of developing language-specific content or offering multilingual support within VR tools to ensure inclusivity for diverse student populations.

4.3. Familiarity with VR Technology

A common challenge across all student groups was the lack of familiarity with VR equipment. Although many students were enthusiastic about the prospect of using VR in their learning, a considerable number struggled to effectively use the ThingLink scenario tool due to limited prior exposure to VR technology. Students who had never interacted with VR before found it difficult to navigate the virtual environments, which negatively impacted their learning outcomes. Moreover, the amount of time allocated for familiarizing students with the VR equipment was insufficient, limiting their ability to fully engage with the exercises. For future implementations, it is essential to provide students with more time and guidance to adapt to VR technology, ensuring that they can focus on the content rather than the mechanics of using the tool (Aaltonen et al., 2021).

5. Discussions and Conclusions

The integration of virtual reality (VR) into teaching and learning environments shows great promise, particularly as digitization continues to advance. VR presents unique opportunities for enhancing pedagogical practices, offering immersive and interactive experiences that engage students in ways that traditional learning environments cannot. However, it is important to emphasize that the successful implementation of VR in education relies on careful attention to the pedagogical framework and the continuous development of VR-specific devices and programs. Ensuring that educators receive adequate training and acquire experience with VR technology is critical to achieving versatile and effective use in different educational contexts.

One of the key findings in this study is that the opportunities for using VR in teaching can vary significantly depending on the specific goals and contexts in which it is implemented. Although the application of VR in education holds considerable potential, several challenges persist. These include the cost and availability of equipment and software, as well as the logistical hurdles associated with introducing new technologies into classrooms. Despite these challenges, it is essential for teachers to have opportunities to experiment with different VR tools and exercises across diverse student groups. This enables educators to evaluate various methods and devices, helping them to identify the most effective ways to integrate VR into their own teaching practices.

The benefits of VR, particularly in relation to improving concentration, are notable. In the testing of ThingLink's VR tool for teaching sustainable development, the findings corroborated those of previous studies, which have shown that VR can enhance students' ability to focus on tasks by reducing distractions and creating more immersive learning environments. This demonstrates the potential of VR to support students with attentional difficulties or cognitive overload by providing structured, controlled environments that focus attention on specific learning objectives.

Looking forward, the future development of digital competence and virtual reality pedagogy will be crucial to maximizing the potential of VR in education. Special attention should be given to fostering systemic thinking among students, enabling them to better conceptualize abstract concepts and engage with complex, psychologically challenging issues more experientially. VR's immersive and visually rich environments not only boost motivation toward the subject matter but also offer unique advantages in helping students concentrate on performing the exercises. This makes VR an invaluable tool for addressing both cognitive and attentional challenges in diverse learning contexts.

6. Limitations

This study, while offering important insights into the use of virtual reality (VR) for teaching sustainable development, has several limitations. One key limitation is the absence of direct, in-person observations. The research relied on secondary data and external reports, which may not fully capture the nuances of the classroom dynamics and the day-to-day practical challenges encountered by educators and students when using VR tools in real-world settings.

Another limitation is the context-specific nature of the study. The research focuses primarily on vocational education in Finland, where the use of digital tools like VR is relatively advanced. As such, the findings may not be fully generalizable to other educational systems, particularly in countries with less-developed technological infrastructures or different pedagogical priorities. The unique characteristics of the Finnish education system, such as its emphasis on student-centered learning, may also have influenced the results in ways that are not easily transferable to other settings.

Lastly, this study does not explore in depth the financial and logistical constraints that often accompany the adoption of new technologies like VR. Issues such as the high cost of VR equipment, the need for ongoing technical support, and the availability of appropriate content and training for educators are critical factors that could limit the widespread integration of VR in education. While this research acknowledges these barriers, a more detailed analysis of these challenges is needed to provide a complete understanding of VR's potential limitations in educational environments.

Author Contributions:

Conceptualization, A. M.; methodology, A. M.; software, A. M.; validation, A. M.; formal analysis, A. M.; investigation, A. M.; resources, A. M.; data curation, A. M.; writing—original draft preparation, A. M.; writing—review and editing, A. M.; visualization, A. M.; supervision, A. M.; project administration, A. M.; funding acquisition, A. M. All authors have read and agreed to the published version of the manuscript.

Funding Statement:

Not applicable.

Institutional Review Board Statement:

Not applicable.

Informed Consent Statement:

Not applicable.

Data Availability Statement:

Not applicable.

Acknowledgments:

The author expresses sincere gratitude to Dr. Baocun Liu, Head of the Department of the Institute of International and Comparative Education, Beijing Normal University, and mentor, for his invaluable guidance and support throughout the development of this article. His insights on framing the research and shaping the narrative have been instrumental to the successful completion of this paper.

The author also extends heartfelt thanks to Omnia, Espoo Region's Educational Association, for their generous support and collaboration throughout this study. Special appreciation is given for providing essential resources, including photos of students, and offering invaluable insights and critical observations from Finland, which were key to enriching the research findings. The ability to observe and understand the practical application of virtual reality in Finnish educational settings, despite the author's inability to be physically present, would not have been possible without their commitment and assistance. The author would also like to acknowledge the faculty and staff at Omnia for their openness in sharing their experiences and for facilitating the data collection process, all of which contributed significantly to the depth and success of this research.

Conflict of Interest:

The author declared no potential conflicts of interest with respect to the research, authorship, or publication of this article.

References

Aaltonen, S., Pentsinen, H., & Kurikka, O. (2021). Distribution of medicines virtually in Taitaja. 3DBear. https://www.3dbear.io/fi/blogi/l%C3%A4%C3%A4sharesvirtually

Aiello, P., D'Elia, F., Di Torre, S., & Sibilio, M. (2012). A constructivist approach to virtual reality for experiential learning. E-Learning and Digital Media, 9(3). https://www.wwwords.co.uk/ELEA/A_Constructivist_Approach_to_Virtual_Reality_for_Experiential_Learning_(sagepub.com)

Arnold, R. D., & Wade, J. P. (2015). A definition of systems thinking: A systems approach. Procedia Computer Science, 44, 669–678.

Bailenson, J. (2018). Experience on demand: What virtual reality is, how it works, and what it can do. W. W. Norton & Company.

Berkman, M. I. (2024). History of virtual reality. In Encyclopedia of computer graphics and games (pp. 873–881). Springer. https://link.springer.com/referenceworkentry/10.1007/978-3-031-23161-2_169

Dede, C. (2017). Introduction: Virtual, augmented, and mixed realities in education. In D. Liu, C. Dede, R. Huang, & J. Richards (Eds.), Virtual reality, augmented reality, and mixed reality in education. Springer.

Dede, C. (2019). Designing immersive authentic simulations that enhance motivation and learning: EcoLearn. In R. Feldman (Ed.), Learning science: Theory, research, practice (pp. 229–259). McGraw-Hill.

Finnish Medical Association Duodecim. (2019). ADHD: Käypä hoito –suositus (Valid treatment recommendation). https://www.kaypahoito.fi/hoi50061#K1

Finnish Museum Association. (2024). Opimuseossa.fi's internet website: Virtual museums and guided tours. https://opimuseossa.fi/opimuseossa/index.php?k=12378

Fraser, K. M. (2012). Emotion, cognitive load, and learning outcomes during simulation training. Medical Education, 46(11), 1055–1062.

Hemminki-Reijonen, U. (2021). Virtual reality in learning: A guide for the teacher (Board of Education: Guides and Handbooks, Vol. 2021:3). Finnish National Agency for Education. https://www.oph.fi/sites/default/files/documents/Virtuaaalitodellisuus_oppimissä.pdf

Johnson, P., Millar, R., & Zhang, X. (2021). Virtual reality in sustainable development education: A Finnish case study. International Journal of Sustainability in Higher Education, 22(5), 347–362.

Lee, H., Jung, T. H., Dieck, M. C. T., & Chung, N. (2020). Experiencing immersive virtual reality in museums. Information & Management, 57(5), 103229.

Lowood, H. E. (2024). Virtual reality. In Encyclopaedia Britannica. https://www.britannica.com/technology/virtual-reality

Mills, S., Brown, T., & Perez, R. (2019). Augmented and virtual realities in education: A review of empirical research. Computers & Education, 140, 103–120.

Xie, M., & Li, Y. (2023). Enhancing student engagement through virtual reality: A study on environmental education. Journal of Digital Learning in Teacher Education, 39(1), 25–40.