12th International Conference of the Immersive Learning Research Network
iLEAD Proceedings iLRN2026
DOI: https://doi.org/10.56198/jkmd9884

Virtual Reality as a Catalyst for Creativity and Innovation in Education: Student Perspectives

Daniela Pedrosa[1, 2, 3 & 4] [0000-0001-9536-4234] and Nuno Dorotea [1 & 2] [0000-0003-2539-060X]

[1] Instituto de Educação, Universidade de Lisboa, Lisboa, Portugal
[2] UIDEF — Unidade de Investigação e Desenvolvimento em Educação e Formação, Lisboa, Portugal
[3] CIDTFF - Centro de Investigação em Didática e Tecnologia na Formação de Formadores, Aveiro, Portugal
[4] INESC TEC, Porto, Portugal
daniela.pedrosa@ie.ulisboa.pt

Abstract. Virtual reality (VR) has emerged as a transformative technology in education, as it enables the rethinking of pedagogical practices and the creation of innovative learning experiences that foster creativity. This exploratory study aimed to understand the perceptions of third-year students in the Education and Training bachelor's program at the University of Lisbon regarding the pedagogical potential of two VR devices, Oculus Quest 2 and ClassVR, in educational and training contexts. During practical sessions, students explored both devices, reflecting on immersion, interactivity, and pedagogical applications. Qualitative analysis of the reflections from 19 participants, conducted through thematic content analysis, revealed that students perceive VR as a catalyst for creativity, motivation, and pedagogical innovation. The Oculus Quest 2 was considered most suitable for immersive and interactive activities, supporting active learning, exploration of abstract concepts, and skill development. ClassVR was highlighted as appropriate for guided activities, content visualization, and contextualization of curricular topics. Both devices were perceived by students as safe experimentation, critical thinking, and innovative methodologies, such as gamification, immersive storytelling, and project-based learning. The findings underscore the importance of intentionally integrating VR, aligning devices with pedagogical goals, to foster dynamic, inclusive, and student-centered learning experiences that promote innovation and creativity.

Keywords: Immersive Learning, Creativity, Oculus Quest 2, ClassVR, Pedagogical Design.

1 Introduction

Virtual Reality (VR) is increasingly recognized as a transformative pedagogical tool in education [1–7], enhancing the understanding of complex concepts, fostering skill development, and promoting creativity [1–3]. VR enables the creation of immersive, three-dimensional, and interactive digital environments where users can explore, manipulate objects, and engage socially, experiencing a sense of presence generated through computer graphics [4–6, 8–11]. Such environments differ from traditional settings by simulating contexts that would be dangerous, costly, or logistically unfeasible in the real world [1, 10].

In higher education, VR has been applied in diverse forms, including complex simulations, historical reconstructions, virtual experimental laboratories, and problem-based scenarios. These applications enable students to comprehend complex concepts, acquire practical skills, engage in authentic professional situations, receive real-time formative feedback, collaborate effectively, and overcome barriers such as time, accessibility, safety, and ethical constraints—challenges often difficult to address in conventional educational settings [11–14].

Despite its potential to promote interactive and experiential learning, the effectiveness of VR depends on intentional pedagogical integration, alignment with learning objectives, and the training of educators [2, 3, 7, 14–17]. Therefore, intentional instructional design aligned with curricular goals and active learning strategies is critical, along with rigorous evaluation of VR's pedagogical impact [2, 3, 5, 7, 15, 17].

Immersion in VR is typically described as the psychological perception of being detached from the physical world and embedded in a virtual environment, altering temporal and emotional experience [5, 15, 18, 19].

Presence—the subjective experience of "being in the virtual environment"—is associated with heightened motivation, engagement, and meaningful learning [9].

The growing accessibility of head-mounted displays (HMDs), equipped with sensors and motion-tracking systems, further supports educational research in VR [15, 20–22]. The sense of "being there" emerges from the combination of sensory immersion and interaction, fostering engagement, knowledge retention, and the transfer of learning to real-world contexts [15]. VR devices vary in technical features and design, providing distinct experiences; e.g, Oculus Quest 2 offers an open and flexible ecosystem for interactive exploration, while ClassVR is designed for formal educational contexts with classroom integration and pedagogical control [6, 23–27].

VR fosters collaboration, interdisciplinary exploration, and experiential learning, creating conditions conducive to creativity in higher education students [28]. Creativity, understood as the ability to generate novel ideas, innovate, and integrate knowledge, is a key 21st-century skill, and VR provides a supportive environment for its development [28]. Immersive experiences allow students to experiment, fail safely, and revise ideas, enhancing cognitive flexibility, attention, and problem-solving skills [28, 29]. VR enables real-time monitoring of learners' behaviors, allowing evaluation of creative processes and continuous pedagogical adjustment [28, 30].

VR can also promote inclusion and equity by providing educational experiences to students who, due to economic, geographical, or physical constraints, would otherwise have limited access [3, 14]. Nevertheless, challenges related to cost, teacher training, and cognitive and physiological risks highlight the need for clear institutional policies and investment in pedagogical capacity building [3, 15].

Immersive VR is a tool for experiential learning and creativity in higher education, but its potential relies on intentional pedagogical integration and understanding students' experiences. This study aligns with the iLEAD stream by examining how VR devices, such as Oculus Quest 2 and ClassVR, can foster creativity, innovation, and student-centered learning, offering insights for designing immersive, inclusive, and engaging educational experiences that support 21st-century skills.

2 Learning Context

The learning context involved third-year students enrolled in the bachelor's degree in education and training at the University of Lisbon during the 2025/2026 academic year, who opted for the course "Creation and Innovation in Digital Technologies." This course explores how the use of digital technologies in educational contexts can foster creative and innovative approaches.

Two of the scheduled sessions were dedicated to virtual reality (VR). In the first session, students were introduced by instructor to the concepts of immersion, VR, and its potential pedagogical applications. In the following session, students engaged in practical exploration activities with VR using two different devices: the Oculus Quest 2 and ClassVR headsets (see Fig. 1) the free versions. The content varied between the devices. Using the Oculus Quest 2, students completed the *First Steps* tutorial and explored learning scenarios developed within the REVEALING project. With the ClassVR devices, students accessed content available on the ClassVR platform, including, for example, a scenario simulating the cardiovascular system and a virtual visit to the Great Wall of China.

The experience was intentionally designed to allow students to perceive differences and pedagogical potential between the devices, encouraging critical reflection on how the characteristics of each technology can influence instructional design decisions — namely, the educational potential of each device and the learning contexts in which they are most suitable for fostering innovation and creativity. The session followed a structured sequence: 1) initial exploration of the Oculus Quest 2 using an existing introductory module; 2) experimentation with the ClassVR devices; 3) return to the Oculus Quest 2 to engage with learning scenarios developed within the framework of the REVEALING project, an Erasmus+ initiative aimed at creating Virtual Reality Learning Environments (VRLEs) for higher education [31]. This approach aimed to promote students' metacognitive awareness of how technological affordances impact instructional design across different educational contexts, stimulating both innovation and creativity.

Due to equipment limitations, the session was organized in groups: while one group of four students explored the VR environments, the remaining students worked with the instructor to clarify questions related to other course content (see Fig. 2). Following the practical exploration, a dialogue between the instructor and students took place, during which perceptions, challenges, and the pedagogical potential of VR in designing learning activities were discussed.

To complement the session, students were invited to complete a metacognitive reflection [32] structured around four questions regarding their experience with the VR devices. In this study, the analysis focused on two of these questions (explain below).

Fig. 1. Devices used: ClassVR and Oculus Quest 2.

Fig. 2. Students exploring VR devices.

3 Methodology

This exploratory study aimed to 1) understand how students perceive the use and potential of virtual reality (VR) devices (Quest 2 vs. ClassVR) in educational and training contexts; and 2) identify possible differences in their perceptions regarding how each device may contribute to the design of creative and innovative learning activities. The study did not aim to establish causal relationships or produce generalizable results, but rather to generate insights into participants' individual experiences and opinions.

A qualitative approach was adopted, focusing on the analysis of the final reflections of 19 students following practical experience with two VR devices: Oculus Quest 2 and ClassVR. The students' written reflections addressed two main questions, as formulated in the activity instructions:

1. How do you consider each of the devices can be used in educational and training contexts? Provide examples of pedagogical situations in which the Quest 2 and ClassVR would be most suitable, justifying your perspective.
2. How can the experience with virtual reality devices (Quest 2 and ClassVR) enhance creativity and innovation in education and training?

Data analysis was conducted using thematic content analysis [33, 34], following an inductive approach by the researchers (authors of this paper). Analytical categories emerged directly from the students' responses, without reference to pre-established categories, thereby respecting the meanings that participants attributed to their experiences. All reflections were systematically analysed, identifying units of meaning that were subsequently grouped into common categories and dimensions, such as pedagogical potential, suitability for the design of educational activities, and promotion of creativity.

Participation was voluntary, and all students were fully informed about the objectives of the study. Ethical principles applicable to educational research were strictly adhered to, with participation formalized through the signing of an informed consent form. To ensure anonymity, each student was assigned a unique code (e.g., S1) to identify their responses.

4 Results and Discussion

In the following subsections, thee results of the study are presented and organized to provide a comprehensive analysis of students' experiences: 4.1. Opportunities for Pedagogical Use of Immersive VR Devices: Student Perspectives, and 4.2. Students' Perspectives on VR in Creativity and Innovation in Education.

4.1 Opportunities for Pedagogical Use of Immersive VR Devices: Student Perspectives

Table 1 illustrates how different virtual reality (VR) devices, namely the Oculus Quest 2 and ClassVR, are perceived by students in terms of their potential and opportunities for designing pedagogical activities.

The Oculus Quest 2 is associated with immersive, interactive, and hands-on experiences, including laboratory or technical simulations, with a focus on skills development in simulated environments, educational games, role-play, and the exploration of abstract concepts through three-dimensional visualizations. Students highlighted that this device supports active methodologies, autonomous learning, object manipulation, and experiences that require movement and decision-making within the virtual environment. In contrast, the ClassVR is considered more suitable for guided and controlled activities, focused on visualization and content contextualization, without requiring high levels of interactivity. Examples of such activities include virtual visits to museums, exploration of 360° environments, observation of ecosystems, and brief, structured introductions to curricular topics. ClassVR is perceived as appropriate for educational contexts that demand organization and support for content comprehension, promoting immersive visual exploration even without direct interaction.

Thus, while the Oculus Quest 2 stands out for active, interactive, and highly immersive activities—ideal for complex simulations and practical learning—the ClassVR is suited for guided, visualization-based, and content-contextualization activities, making it appropriate for less complex, yet still immersive, educational experiences.

Table 1. Opportunities for Pedagogical Use of Immersive VR Devices: Student Perspectives.

VR Devices	Opportunities for pedagogical use	Students	Examples
Oculus Quest2	Laboratory or technical procedure simulations with security and Skill development in simulated environments (e.g., surgical practice, safety training)	S1, S2, S4, S5, S6, S7, S8, S11, S13, S14, S15, S16, S18	"(…) *specific and technical training, such as delicate surgical procedures, architects exploring buildings before constructing them (...) industrial workers who need to train with dangerous machinery, or even firefighters who can practice risky situations without being in real danger (...) advanced technologies for training* (…)" (S14)
	Role-play, educational games and gamified experiences that promote problem-solving and active engagement	S1, S3, S4, S6, S7, S13	"*The ability to manipulate objects, move freely within the space, and the high level of immersion make these headsets particularly suitable for active methodologies such as gamification, role-play, and problem-based learning*." (S4) "*(...) engage in educational games (...) can make abstract concepts more accessible and easier to understand."* (S7)
	Immersive exploratory and practical activities	S1, S3, S4, S8, S15	"*Activities in which it is important for the student to move, interact, and feel truly immersed in what is happening (...) exercises in which we have to manipulate objects or solve tasks within the virtual environment."* (S8)
	Virtual tours of museums, monuments, or natural environments	S1, S2, S3, S8, S19	"*Virtual visits to museums, historical monuments, or natural environments, promoting contextualized and interdisciplinary learning."* S2
	Autonomous learning	S2, S3, S7, S11	"*autonomous learning, even preferable in this format, due to the comfort and freedom of exploration it offers*." S7
	Manipulation of objects	S4, S5, S8	"*Activities that require a more immersive experience or the interaction and manipulation of objects."* S5

	Exploration of abstract concepts through 3D and interactive visualizations	S2, S7	"*Exploration of abstract concepts in mathematics or physics through three-dimensional and interactive visualizations*." S2
ClassVR	Support for content contextualization without requiring intensive interactivity	S2, S4, S6, S8, S11, S14, S16, S18, S19	"*Guided visualization and controlled exploration of content (...) In activities such as static virtual visits, exploration of 360° environments, museums, or introduction to topics in an immersive but minimally interactive way* (...)" S4
	Visual exploration of environments, ecosystems, monuments, and natural phenomena in 360°	S1, S4, S5, S8, S12, S13, S15, S16	"*Guided activities, where visualization is sufficient, such as observing landscapes, monuments, or natural phenomena in 360°* (…)" S1
	Teacher-led activities and guided sessions	S1, S3, S4, S6, S13, S15, S18	"*present content in a more organized way; for example, a science teacher may want to present observations of natural phenomena or even explore parts of the human body."* S3
	Introduction to curricular topics, controlled experiences	S1, S2, S3, S4, S7	"(*...) introducing study topics through short experiences or supporting the understanding of content that benefits from an immersive visual perspective, even without interaction."* S1

4.2 Students' Perspectives on VR in Creativity and Innovation in Education

Students perceive VR as a tool that stimulates creativity and pedagogical innovation, enabling safe exploration of complex scenarios, active experimentation, and the development of critical thinking (See table2). They understand that the devices can promote different forms of creativity (e.g., exploratory with ClassVR and productive with Quest 2). Likewise, VR enhances motivation and engagement, allows the adoption of innovative methodologies such as storytelling and gamification, and enables personalization and inclusion in teaching. Thus, VR is seen as a catalyst for dynamic, creative, and student-centered learning.

Students perceive VR as transformative in education, stimulating creativity, innovation, and engagement by making learning more dynamic and inclusive (S3). Creating virtual scenarios sparks curiosity and emotional involvement, enhancing motivation and knowledge retention (S4). Innovation is linked not only to technology but also to its thoughtful integration, complementing traditional practices and fostering a student-centered, creative learning experience (S7). Overall, VR enhances cognitive and emotional engagement, encouraging exploration, questioning, and reinterpretation, and promoting original, less predictable ways of thinking (S18).

Table 2. Students' Perspectives on VR in Creativity and Innovation in Education.

Dimension	Definition	Excerpts from the students
Safe exploration and Experimentation	Allows experiencing complex or impossible real-world scenarios, promoting critical thinking, imagination, and active learning.	"*(...) explore more complex scenarios, interact with virtual objects, and experiment with immersive situations combines students' critical thinking, problem-solving, and imagination.*" (S3).
Creativity and Imagination	Encourages the creation of solutions, new ideas, and innovative thinking; distinguishes between different types of creativity.	"*ClassVR (...) supports exploratory creativity (...) while the Quest 2 (...) fosters productive creativity, where students have the opportunity to have a space in which they can build and test something, such as creating a 3D model.*" (S13).
Motivation and Engagement	Immersion enhances interest, active participation, and emotional engagement, making learning more meaningful.	"*The possibility of learning through exploration, experimentation, and interaction allows moving away from more traditional methods… innovation lies not only in the technology itself, but in the way it is consciously and pedagogically integrated into teaching.*" (S7).
Innovative Pedagogical Methodologies	Facilitates immersive storytelling, gamification, complex simulations, and project-based learning; reinforces the teacher's role as a facilitator.	"*Virtual environment encourages students to explore, experiment, and imagine solutions in safe and controlled contexts, promoting exploratory learning and diversifying methodologies, such as immersive storytelling, gamification, or complex simulations*" (S19).

Inclusion and Personalization	Allows adaptation to different learning styles and individual needs, promoting a more equitable education.	"*personalization of activities and adaptation to any difficulties a student may have, making education more equitable."* (S16).
Creativity and Innovation	VR is seen as a pedagogical catalyst that transforms teaching, stimulating new ways of thinking, creating, and problem-solving.	"*VR can play a transformative role in education… stimulating students' creativity, innovation, and engagement, highlighting that learning can indeed be dynamic and inclusive*." (S3)

5 Final Reflections

Based on students' reflections, key insights emerged regarding the use of Virtual Reality (VR) to foster creativity and innovation in education and training. VR was perceived as stimulating creative thinking, problem-solving, and innovative approaches, and enabling safe exploration of complex or impossible scenarios, immersive technologies allow active experimentation, manipulation of virtual objects, and learning through trial and error. Students distinguished between devices: ClassVR was perceived by exploratory creativity and guided visualization, while Quest 2 fosters productive creativity through creation, testing, and prototyping in immersive environments.

The immersive nature of VR enhances motivation, emotional engagement, and active participation, can contributing to more meaningful learning experiences. VR was perceived by as supports innovative pedagogical strategies, such as immersive storytelling, gamification, project-based learning, and complex simulations, while reinforcing the teacher's role as a facilitator in student-centered classrooms. Its adaptability makes VR an inclusive tool, capable of meeting diverse learning styles and needs. Device selection should be guided by pedagogical objectives and the type of activity planned.

Future research could explore the long-term impact of VR on learning outcomes and how can be creativity development, including comparative studies across disciplines and educational levels. For educational practice, teachers are encouraged to integrate VR intentionally into instructional design, aligning device capabilities with learning goals, and combining immersive experiences with reflective and collaborative activities to maximize creativity, engagement, and innovation.

Overall, VR is perceived as a transformative tool, promoting personalized, inclusive, and meaningful learning, and acting as a catalyst for dynamic, creative, and student-centered education.

Acknowledgments

This work was supported by National Funds through FCT-Portuguese Foundation for Science and Technology, I.P., under the scope of UIDEF — Unidade de Investigação e Desenvolvimento em Educação e Formação, UID/04107/2025, https://doi.org/10.54499/UID/04107/2025.
Financially supported by National Funds through FCT – Fundação para a Ciência e a Tecnologia, I.P., under the CIDTFF R&D Unit, with the reference UID/00194/2025 (https://doi.org/10.54499/UID/00194/2025).
We thank all the students who voluntarily participated in the study.

Statement on the Use of Generative Artificial Intelligence (GenAI)

During the preparation of this work the authors used ChatGPT to use it in the writing process to improve the readability and language of work. After using this tool/service, the authors reviewed and edited the content as needed and took full responsibility for the content of the published article.

References

1. Young, G.W., Stehle, S., Walsh, B.Y., Tiri, E.: Exploring Virtual Reality in the Higher Education Classroom: Using VR to Build Knowledge and Understanding. JUCS - Journal of Universal Computer Science. 26, 904–928 (2020). https://doi.org/10.3897/jucs.2020.049
2. Balalle, H.: Learning beyond realities: exploring virtual reality, augmented reality, and mixed reality in higher education—a systematic literature review. Discov Educ. 4, 151 (2025). https://doi.org/10.1007/s44217-025-00559-7

3. Llanos-Ruiz, D., Abella-García, V., Ausín-Villaverde, V.: Virtual Reality in Higher Education: A Systematic Review Aligned with the Sustainable Development Goals. Societies. 15, 251 (2025). https://doi.org/10.3390/soc15090251
4. 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 Reality. 25, 835–861 (2021). https://doi.org/10.1007/s10055-020-00489-9
5. Mystakidis, S.: Metaverse. Encyclopedia. 2, 486–497 (2022). https://doi.org/10.3390/encyclopedia2010031
6. Rana, M., Norbisrath, U., Vainikko, E., Rossi, B.: Transforming Affordable Virtual Reality Headsets into Effective Learning Environments. In: 2023 International Conference on Intelligent Metaverse Technologies & Applications (iMETA). pp. 1–8 (2023)
7. Pedrosa, D., Morgado, L.: Immersive Virtual Reality, Augmented Reality and Mixed Reality for Self-regulated Learning: A Review. In: Crawford, D., Foss, J., Lambert, N., Reed, M., and Kriebel, J. (eds.) Technology, Innovation, Entrepreneurship and Education. pp. 64–81. Springer Nature Switzerland, Cham (2024)
8. Guo, X., Guo, Y., Liu, Y.: The Development of Extended Reality in Education: Inspiration from the Research Literature. Sustainability. 13, 13776 (2021). https://doi.org/10.3390/su132413776
9. Papanastasiou, G., Drigas, A., Skianis, C., Lytras, M., Papanastasiou, E.: Virtual and augmented reality effects on K-12, higher and tertiary education students' twenty-first century skills. Virtual Reality. 23, 425–436 (2019). https://doi.org/10.1007/s10055-018-0363-2
10. Domingo, J.R., Bradley, E.G.: Education Student Perceptions of Virtual Reality as a Learning Tool. Journal of Educational Technology Systems. 46, 329–342 (2018). https://doi.org/10.1177/0047239517736873
11. AlGerafi, M.A.M., Zhou, Y., Oubibi, M., Wijaya, T.T.: Unlocking the Potential: A Comprehensive Evaluation of Augmented Reality and Virtual Reality in Education. Electronics. 12, 3953 (2023). https://doi.org/10.3390/electronics12183953
12. Shakirova, N.D., Said, N.A., Konyushenko, S.M.: The Use of Virtual Reality in Geo-Education. Int. J. Emerg. Technol. Learn. 15, 59 (2020). https://doi.org/10.3991/ijet.v15i20.15433
13. Schott, C., Marshall, S.: Virtual Reality for Experiential Education: A User Experience Exploration. AJET. 96–110 (2020). https://doi.org/10.14742/ajet.5166
14. Sümer, M., Vaněček, D.: A systematic review of virtual and augmented realities in higher education: Trends and issues. Innovations in Education and Teaching International. 62, 811–822 (2025). https://doi.org/10.1080/14703297.2024.2382854
15. Sunardi, Meyliana, Hendric, S.W.H.L., Rosmansyah, Y.: Exploring Immersive Virtual Reality in Higher Education: Research Gap and Future Direction—A Scoping Review. IEEE Access. 13, 76308–76321 (2025). https://doi.org/10.1109/ACCESS.2025.3565385
16. Radianti, J., Majchrzak, T.A., Fromm, J., Wohlgenannt, I.: A systematic review of immersive virtual reality applications for higher education: Design elements, lessons learned, and research agenda. Computers & Education. 147, 103778 (2020). https://doi.org/10.1016/j.compedu.2019.103778
17. Castelhano, M., Pedrosa, D., Morgado, L., Messias, I.: Implementation of Virtual Reality in Teacher Training: A Case Study with VRChat and Oculus Quest 2. In: Practitioner Proceedings of the 11th International Conference of the Immersive Learning Research Network. pp. 194–199. The Immersive Learning Research Network, Chicago, Illinois, USA (2025)
18. Marougkas, A., Troussas, C., Krouska, A., Sgouropoulou, C.: How personalized and effective is immersive virtual reality in education? A systematic literature review for the last decade. Multimed Tools Appl. 83, 18185–18233 (2023). https://doi.org/10.1007/s11042-023-15986-7
19. Uddin, M., Obaidat, M., Manickam, S., Laghari, S.U.A., Dandoush, A., Ullah, H., Ullah, S.S.: Exploring the convergence of Metaverse, Blockchain, and AI : A comprehensive survey of enabling technologies, applications, challenges, and future directions. WIREs Data Min & Knowl. 14, e1556 (2024). https://doi.org/10.1002/widm.1556
20. Laine, T.H., Lee, W.: Collaborative Virtual Reality in Higher Education: Students' Perceptions on Presence, Challenges, Affordances, and Potential. IEEE Trans. Learning Technol. 17, 280–293 (2024). https://doi.org/10.1109/TLT.2023.3319628
21. Aufenanger, S., Bastian, J., Bastos, G., Castelhano, M., Dias-Ferreira, C., Fokides, E., Gavalas, D., Kasapakis, V., Agelada, A., Kostas, A., Koutromanos, G., Makrides, G., Morgado, L., Pedrosa, D., Szemberg, T., Sofos, A., Szpond, J.: Immersive virtual reality learning environments for higher education: A student acceptance study. Computers & Education: X Reality. 7, 100105 (2025). https://doi.org/10.1016/j.cexr.2025.100105
22. Dzardanova, E., Kasapakis, V.: Virtual Reality: A Journey From Vision to Commodity. IEEE Annals Hist. Comput. 45, 18–30 (2023). https://doi.org/10.1109/MAHC.2022.3208774
23. Raymer, E., MacDermott, Á., Akinbi, A.: Virtual reality forensics: Forensic analysis of Meta Quest 2. Forensic Science International: Digital Investigation. 47, 301658 (2023). https://doi.org/10.1016/j.fsidi.2023.301658
24. Garcia, R., Falkner, K., Vivian, R.: Systematic literature review: Self-Regulated Learning strategies using e-learning tools for Computer Science. Computers & Education. 123, 150–163 (2018). https://doi.org/10.1016/j.compedu.2018.05.006
25. Araiza-Alba, P., Keane, T., Kaufman, J.: Are we ready for virtual reality in K–12 classrooms? Technology, Pedagogy and Education. 31, 471–491 (2022). https://doi.org/10.1080/1475939X.2022.2033307
26. Zekeik, H., Chahbi, M., Lamarti Sefian, M., Bakkali, I.: Augmented reality and virtual reality in education: A systematic narrative review on benefits, challenges, and applications. EURASIA J Math Sci Tech Ed. 21, em2699 (2025). https://doi.org/10.29333/ejmste/16830

27. Arkabaev, N., Tran, D.V., Chu, V.T., Hashimova, S., Nasirova, S.: Use of Virtual Reality for Inclusive Education: Assessing the Availability and Adaptation of Educational Materials. PJS. (2025). https://doi.org/10.70389/PJS.100148
28. Yu, H., Wang, J.: Enhancing college students' creativity through virtual reality technology: a systematic literature review. Humanit Soc Sci Commun. 12, 693 (2025). https://doi.org/10.1057/s41599-025-05044-y
29. Thornhill-Miller, B., Dupont, J.-M.: Virtual reality and the enhancement of creativity and innovation: Under recognized potential among converging technologies? Journal of Cognitive Education and Psychology. 15, 102–121 (2016). https://doi.org/10.1891/1945-8959.15.1.102
30. Rzanova, S., Yushchik, E., Markova, S., Sergeeva, A.: Impact of virtual reality technologies in the context of the case method on engineering students' competencies. Educ Inf Technol. 29, 7341–7359 (2024). https://doi.org/10.1007/s10639-023-12123-7
31. Makrides, G., Aufenanger, S., Bastian, J., Gavalas, D., Vlasis, K., Apostolos, K., Pawel, S., Szemberg, T., Szpond, J., Bastos, G., Castelhano, M., Dias-Ferrira, C., Morgado, L., & Pedrosa, D.: Manual for VR-powered lessons. (2024)
32. Pedrosa, D., Fontes, M.M., Araujo, T., Morais, C., Bettencourt, T., Pestana, P.D., Morgado, L., Cravino, J.: Metacognitive challenges to support self-reflection of students in online Software Engineering Education. In: 2021 4th International Conference of the Portuguese Society for Engineering Education (CISPEE). pp. 1–10. IEEE, Lisbon, Portugal (2021)
33. Braun, V., Clarke, V.: Using thematic analysis in psychology. Qualitative Research in Psychology. 3, 77–101 (2006). https://doi.org/10.1191/1478088706qp063oa
34. Braun, V., Clarke, V.: Thematic analysis. In: Cooper, H., Camic, P.M., Long, D.L., Panter, A.T., Rindskopf, D., and Sher, K.J. (eds.) APA handbook of research methods in psychology, Vol 2: Research designs: Quantitative, qualitative, neuropsychological, and biological. pp. 57–71. American Psychological Association, Washington (2012)