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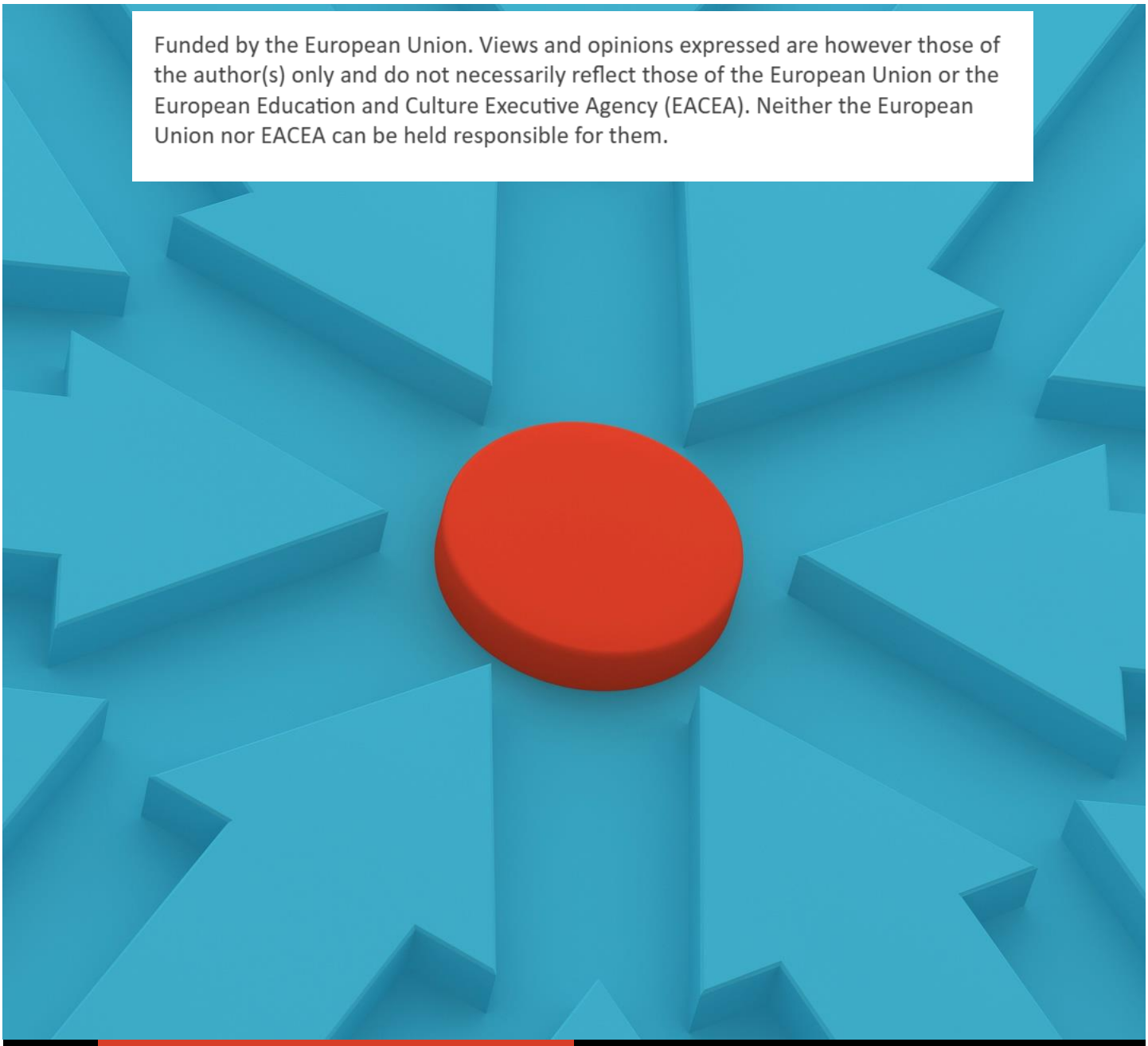

Virtual Lab in Schools

A guide under the EcoSteam Project

ERASMUS PROJECT - ECOSTEAM - 2023-1-SE01-KA220-SCH-000158067

Created and developed by InteractIdeas (2024) – www.interactideas.pt

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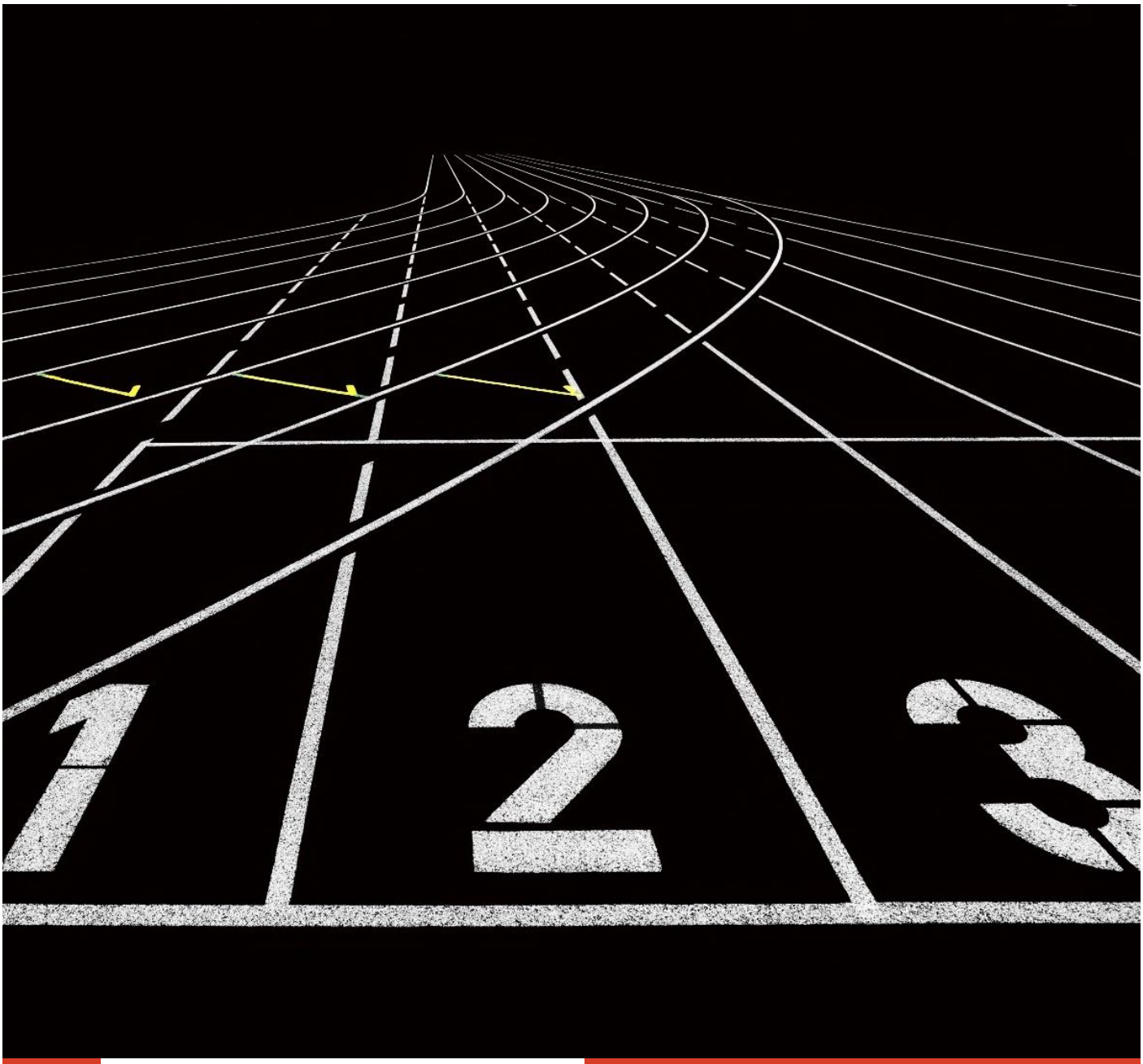

CONCEPT NOTE

The "Eco STEAM VR Learning Platform" is an Erasmus+ KA2 framework that blends immersive Virtual Reality (VR) experiences with Generative AI (G-AI) tools to enhance STEAM (Science, Technology, Engineering, Arts, Mathematics) education in a comprehensive and transformative manner align with environmental sustainability

For further information, resources, and to explore their offerings, you can visit the Eco STEAM VR Learning Framework website

https://interactideas.pt/vrlearning/index.html

For further information, about the project main goal, activities and results you can visit Eco STEAM Erasmus Project website

https://ecosteamaivr.eu/

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Content

Concept note 2
Introduction to the Virtual Lab 6
Purpose and Concept of a Virtual Lab 8
Essential Equipment for a Virtual Lab 10
Setting Up the Virtual Lab 12
Using the Virtual Lab 16
Safety Precautions 20
Maintenance and Technical Support 22
Conclusion 24

Figures

Figure 1 – Enhancing Learning through VR and AI.....9
Figure 2 – List of equipment for the EcoSTEAM Virtual Lab.....11
Figure 3 – Keys elements for the ECOSteam Virtual Lab.....15
Figure 4 – Main topics to be consider under the use of the Virtual Lab 19
Figure 5 – Safety measures regarding the Virtual Lab.....21
Figure 6 – Virtual Lab Maintenance Strategy.....23

INTRODUCTION TO THE VIRTUAL LAB

The Virtual Lab is a dedicated and versatile space within the school, designed to empower teachers and students to explore, create, and immerse themselves in Virtual Reality (VR) experiences as part of the Eco STEAM project.

This lab can be established in diverse settings throughout the school, ***whether it is a repurposed classroom, a section of the library, a computer lab, or any adaptable room*** that can support both virtual and augmented reality activities. The flexibility of these settings ensures that schools of all types, regardless of their existing infrastructure, can incorporate this transformative learning space regarding the goals and purposed of the EcoSteam Erasmus+ KA2 project.

Moreover, this lab guide and setup aims to serve as a model for all schools across Europe and globally, aligning closely with the European Union's objectives regarding the Green Transition. By developing Eco STEAM VR activities, the Virtual Lab seeks to inspire and promote environmentally conscious practices that prepare students for a sustainable future. This guide highlights the importance of creating safe, impactful educational environments where students can actively engage with and understand the pressing issues of climate change. The initiative supports schools in equipping their students with the knowledge and skills necessary to contribute meaningfully to the green transition, fostering ecological awareness and a commitment to sustainable development.

The primary objective is to ensure that the lab is not only accessible and adaptable but also optimized to maximize the educational impact of VR and AR experiences.
By integrating these innovative tools, the Virtual Lab aims to foster ecological awareness, critical thinking, creativity, problem-solving abilities, and collaborative learning, which are all essential components of a comprehensive modern education. Furthermore, the lab aims to bridge the gap between digital literacy and environmental consciousness, ensuring students become well-rounded learners equipped for the challenges of the future.

The Virtual Lab integrates VR technology with generative AI tools, under the VR Learning EcoSTEAM platform developed under the scope of this project, creating an enriched learning environment where abstract concepts transform into tangible, interactive experiences. This combination allows students to visualize complex ideas, engage dynamically with subjects, and experience learning in a way that is both effective and enjoyable.

By interacting directly with 3D models and experiences, and AI-generated content to support the development of rich and contextualize learning experiences, students are given opportunities to deepen their understanding of otherwise challenging topics through experiential learning.

Additionally, the Virtual Lab could serve as a hub for innovation and experimentation, where students can collaborate on projects that seamlessly combine ecological and STEAM concepts with real-world applications. This environment encourages creativity, allowing learners to apply their knowledge practically, and to explore the intersections between technology, science, and ecological stewardship.

This guide provides a comprehensive walkthrough of the essential equipment, setup requirements, step-by-step installation instructions, detailed usage practices, and critical safety measures needed to establish a fully functional Virtual Lab.

The aim is to ensure that the lab promotes educational excellence while prioritizing student safety and well-being throughout every stage of their immersive learning journey.

PURPOSE AND CONCEPT OF A VIRTUAL LAB

The Virtual Lab provides students with opportunities to explore STEAM (Science, Technology, Engineering, Arts, Mathematics) concepts using interactive VR simulations and experiences that transform traditional learning into something far more dynamic. By combining VR tools such as Google Cardboard and Oculus Headsets students can visualize and interact with topics in a truly immersive, practical way that engages multiple senses and enhances understanding.

This not only makes abstract concepts more concrete but also significantly promotes experiential learning, encouraging students to become active participants in their own education rather than passive recipients. The immersive nature of VR allows students to experience subjects in a more profound way, fostering a deeper connection to the content that traditional methods often struggle to achieve.

The Virtual Lab allows for deeper exploration through hands-on projects, simulations, and collaborative problem-solving sessions, making learning more impactful and enjoyable. Students can use VR to walk through historical moments, explore biological processes, build and test 3D models, or even experiment with ecological systems—all from within the classroom. These activities make complex ideas accessible, turning abstract theories into real, interactive experiences that are memorable and engaging.

The overarching aim is to provide an innovative educational space that promotes ecological sustainability through interactive technologies, thereby bridging the gap between theoretical learning and practical application. This space supports not just the understanding of STEAM concepts but also integrates ecological awareness by demonstrating the interconnectedness of human actions and the environment. By emphasizing sustainability through technology, students gain insights into how science and engineering can be used to solve pressing environmental challenges.

This approach nurtures students' curiosity and motivates them to delve deeper into both STEAM and ecological issues, helping them build skills that will be crucial for their future academic and career pursuits.

The Virtual Lab encourages students to think critically about the world around them and consider how they can contribute to sustainable solutions, ultimately aligning their learning with global sustainability goals and the green transition.

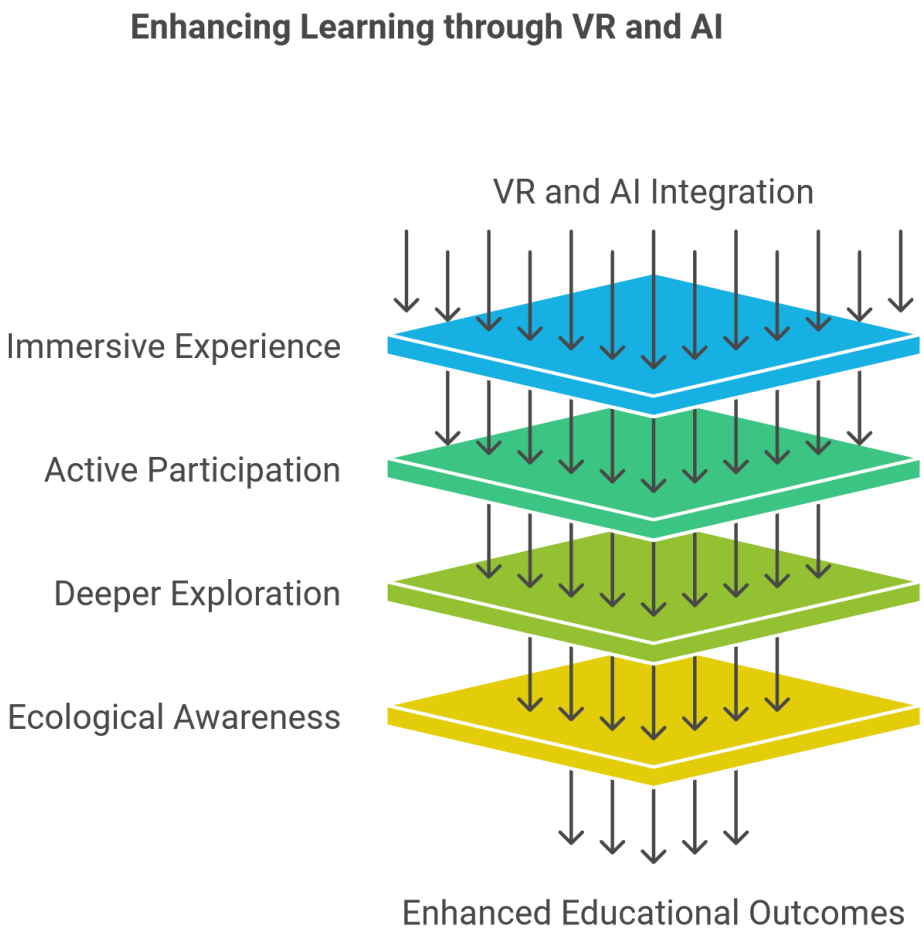

Figure 1 – Enhancing Learning through VR and AI

ESSENTIAL EQUIPMENT FOR A VIRTUAL LAB

To set up a Virtual Lab for the Eco STEAM project, the following equipment is a list of equipment that should be consider, along with some optional but highly recommended items to enhance the overall experience and ensure an optimal, engaging, and immersive learning environment.

The list of equipment forms the core infrastructure required for running Virtual Reality (VR) and Augmented Reality (AR) experiences, while the optional items help create a comfortable, safe, and accessible space that maximizes the potential of these innovative tools. It is important to note that having a well-equipped lab not only supports effective VR and AR interactions but also contributes to the safety and sustainability of the learning environment.

Below, we provide a detailed list of both the essential and recommended components needed to establish a comprehensive Virtual Lab that can be utilized for diverse Eco STEAM educational activities.

- **Google Cardboards**: Cost-effective VR viewers that can be used with smartphones, allowing students to participate in VR experiences.
- **Oculus Headsets**: High-quality VR headsets for a more immersive experience, enabling students to interact with virtual environments in a detailed and realistic way.
- **Smartphones and Tablets**: Required to use with Google Cardboards and to facilitate some augmented reality (AR) experiences.
- **High-Performance Computer**: Essential for managing VR content, generating lesson plans using the AI tools provided by the Eco STEAM project, and accessing platforms like CoSpaces.
- **Comfortable Seating and Space for Movement**: Students may need space to move around for some VR experiences, so ergonomic chairs and an open area are recommended.
- **Internet Connection**: Reliable Wi-Fi is necessary to access online VR and AI tools, download lesson plans, and share VR projects with others.

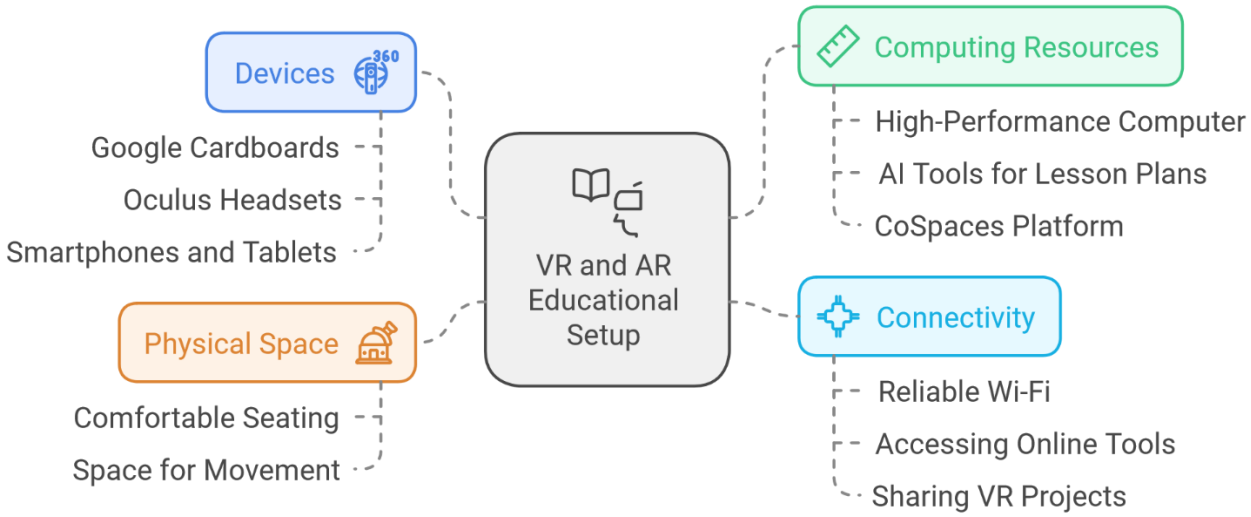

Figure 2 – List of equipment for the EcoSTEAM Virtual Lab

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SETTING UP THE VIRTUAL LAB

Setting up a Virtual Lab in a school is an exciting and transformative step towards reimagining traditional learning environments into dynamic and interactive spaces that foster engagement and hands-on exploration. The Virtual Lab serves as a specialized room designed for immersive educational activities using Virtual Reality (VR) and Augmented Reality (AR), enabling students to interact with concepts in entirely new ways that bridge the gap between theoretical understanding and practical application under the scope of the EcoSTEAM Erasmus+ KA2 project.

This lab will enable both teachers and students to explore ecological and STEAM (Science, Technology, Engineering, Arts, Mathematics) topics in innovative and interdisciplinary ways, providing them with practical, experiential learning opportunities that truly bring these subjects to life. Students can delve into eco processes, visualize 3D models, experience historical events as if they were present, and explore ecological systems—all within an immersive virtual environment.

To ensure a successful setup, it involves careful and strategic planning of space, selection of equipment, and strict adherence to safety guidelines.
This comprehensive planning makes the lab not only accessible but also highly functional and conducive to active, hands-on exploration and creativity.

Below, we provide a detailed, step-by-step guide on how to effectively prepare and configure your Virtual Lab, ensuring that it meets the diverse needs of all learners, including those with different learning styles, while maximizing the benefits of VR technology. The goal is to create a versatile environment that can accommodate a variety of educational activities, from individual exploration to collaborative group projects, and from teacher-led demonstrations to student-driven inquiry-based learning.

By following these detailed steps, schools can effectively set up a Virtual Lab that meets both educational and safety standards, thereby providing a state-of-the-art learning environment where students can explore, create, and innovate.

The proper preparation of space, equipment, and technology is crucial to ensure that the Virtual Lab offers a rich, engaging, and secure experience for students as they explore VR and AR technologies.

Such an environment not only fosters excitement about learning but also builds foundational skills in problem-solving, critical thinking, creativity, and collaboration—all essential skills for the future workforce.

Furthermore, the Virtual Lab becomes a central hub for educational excellence, supporting a wide range of activities that can be tailored to align with specific curriculum goals, while also fostering environmental awareness and encouraging students to become active participants in their own education journey. This aligns directly with the main goals of the EcoSTEAM Erasmus project and contributes to the European Union's objectives for the Green Transition.

By providing rich educational experiences that emphasize ecological sustainability and hands-on STEAM learning, the Virtual Lab helps prepare students to be the artisans of a new, greener world. Through engaging with immersive technologies, students are empowered to develop skills and a mindset that promote environmental stewardship, making them key contributors to a sustainable future and leaders in the green transformation efforts spearheaded by the EU.

These are the main elements that should be consider when setting up the ECOSteam school virtual lab.

- **Room Requirements:**
    - Choose a room that has adequate floor space to allow for safe movement during VR activities. The area should be free of obstacles, with a flat and even floor, to minimize the risk of accidents while students are engaged in immersive experiences. Ideally, the room should be large enough to accommodate all necessary equipment while still providing space for students to move around comfortably.

- **Lighting:**
    - Proper lighting is essential for an optimal VR experience. The room should have dimmable lighting options, as excessive or harsh light can interfere with VR sensors and create glare on headset lenses. Dimmable lights allow teachers to create the ideal lighting conditions based on the type of activity. Installing blackout curtains is also recommended to control natural light, which can be adjusted as needed to reduce distractions and improve headset tracking.

- **Furniture:**
    - Use comfortable and ergonomic seating such as stools or chairs for seated VR activities to ensure students remain comfortable during longer sessions. Additionally, provide tables for storing VR headsets, controllers, and tablets when they are not in use. The furniture should be lightweight and easy to move, allowing for quick reconfiguration of the space depending on the activity planned.

- **Safe Boundaries:**
    - Mark safe zones on the floor using colored tape, mats, or floor decals to indicate the areas designated for VR use. This will help students understand the boundaries for safe movement during immersive sessions, preventing accidental collisions with walls or other objects. These safe zones should be clearly defined and visible to all participants, ensuring that everyone understands where they can safely move while wearing a headset.

- **Technology Setup:**
    - Install and test all VR equipment, ensuring that the Oculus headsets are charged and ready for use and that Google Cardboards are compatible with the smartphones provided. Connect the high-performance computer to the internet and test it to ensure it can handle the VR content and AI lesson planning tools seamlessly. Make sure that all software and drivers are updated to the latest versions before initial use to avoid any compatibility issues during lab sessions.

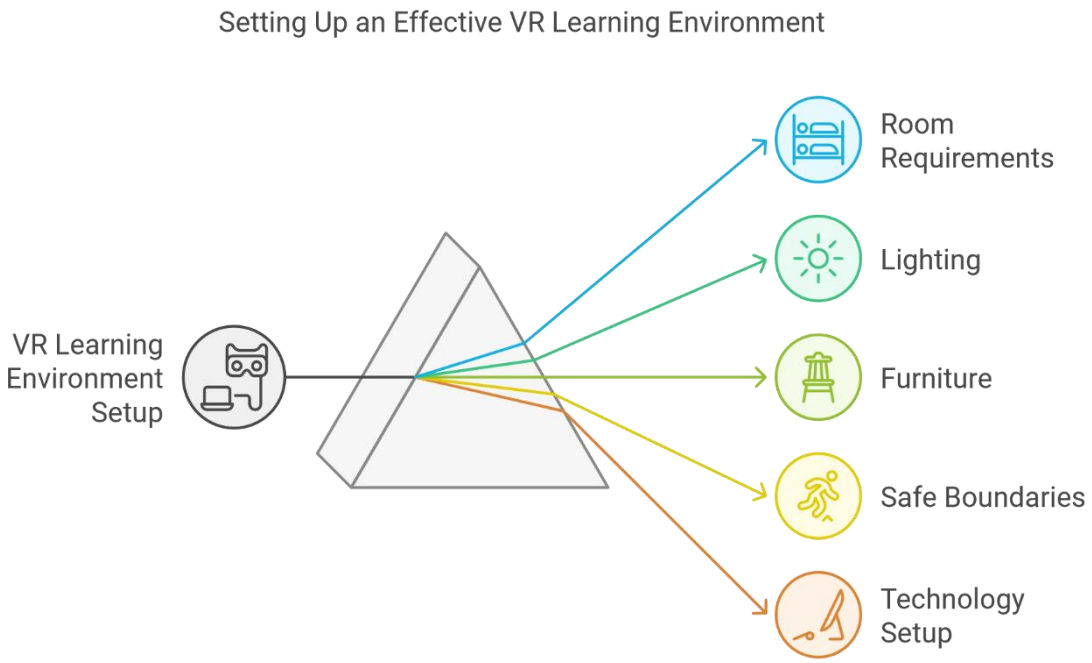

Figure 3 – Keys elements for the ECOSteam Virtual Lab

USING THE VIRTUAL LAB

The Virtual Lab serves as a dynamic tool to significantly enhance student engagement and learning in ecological and STEAM subjects through immersive Virtual Reality (VR) experiences. It goes beyond conventional classroom learning by offering an environment where students can actively participate in and drive their own learning journeys.

By equipping educators with the necessary training and resources, facilitating equitable access to the lab, and integrating AI-powered lesson planning, the Virtual Lab transforms traditional education into a collaborative, hands-on, and interactive journey.
Teachers are provided with ongoing professional development (*teachers received training under the development of this project to equipped them with the necessary skills to develop activities using the virtual lab*) to ensure they are confident in using the equipment, creating lesson plans, and managing VR-based learning activities, which in turn enriches the learning experience for students.

The Virtual Lab aims to level the playing field by providing equitable access, ensuring that students from various backgrounds have the opportunity to engage with cutting-edge technology. By utilizing AI-powered tools, educators can create lesson plans that are tailored to the needs of their students, personalizing learning to make it more relevant and engaging for different learning styles.
Through platforms like CoSpaces, students can explore 3D ecological systems, design their own virtual scenarios, and tackle real-world environmental challenges in a way that combines creativity, critical thinking, and teamwork.

With VR, students are not just passive recipients of information; they become immersed in experiences that foster a deeper understanding of complex concepts. For example, students can virtually step into an ecosystem to observe plant and animal interactions, or they can simulate engineering challenges to find sustainable solutions.
These experiences encourage students to think critically about global issues, apply their knowledge in a practical context, and develop an appreciation for interdisciplinary problem-solving.

The Virtual Lab is more than just a space for learning; it is a space for innovation, where students are encouraged to experiment, make mistakes, and learn through doing. Collaborative projects within the lab help students develop essential teamwork skills, as they are often tasked with working together to create VR simulations or solve complex challenges.
This not only helps them learn the academic content but also builds soft skills such as communication, leadership, and resilience—skills that are crucial for future success in both academic and professional settings.

Moreover, the Virtual Lab supports the development of a growth mindset, empowering students to take ownership of their learning and feel more confident in exploring new ideas and technologies. By giving students the tools to create and innovate, the lab helps them become proactive learners and future leaders who are well-equipped to address the pressing environmental issues of our time.

The hands-on experiences gained through VR are instrumental in fostering a sense of environmental stewardship, encouraging students to become artisans of a greener world, capable of making informed decisions that contribute to sustainable development.

Ultimately, the Virtual Lab integrates technology, creativity, and ecological awareness in a way that makes learning not only more effective but also more meaningful. It helps students build the critical skills needed for the 21st century, inspiring them to be innovative problem-solvers and active contributors to society. By combining VR, AI, and STEAM education, the Virtual Lab creates a holistic educational experience that is capable of nurturing the next generation of thinkers, creators, and leaders.

These are the main topic that must be addressed regarding the use of the ECOSteam Virtual Lab by teachers and students.

- **Teacher Training:**
    - Teachers must be trained in the use of VR equipment and educational platforms like CoSpaces. The Eco STEAM project provides professional development

resources to help educators become proficient with integrating VR tools into their lesson plans. This training ensures that teachers are confident in managing VR activities, troubleshooting issues, and guiding students effectively during immersive learning experiences.

- **Scheduling Lab Time:**
  - Establish a clear schedule to allocate lab time for different classes and ensure equitable access for all students. This could involve creating a calendar for lab bookings, with designated time slots for each class. Scheduling prevents conflicts and ensures that all students have the opportunity to benefit from the Virtual Lab experiences. It is also important to consider having extra sessions for students who may require additional time to fully grasp the concepts.

- **VR Content Development:**
  - Use AI tools such as the AI Lesson Plan Generator to create customized VR lesson plans that cater to different ecological and STEAM topics. These lesson plans should align with curriculum objectives and provide students with engaging, interactive ways to explore complex subjects. Platforms like CoSpaces can be used to design and implement virtual scenarios that align with specific educational goals, helping students visualize abstract concepts and apply their knowledge in practical, hands-on contexts.

- **Collaborative Projects:**
  - Encourage students to work in small groups to create VR content and complete projects within the Virtual Lab. Collaborative projects are a great way to foster teamwork and problem-solving skills, as students learn to communicate effectively, delegate tasks, and work towards a common goal. Example projects could include designing a virtual ecosystem, creating a VR simulation of a historical event, or using AI tools to solve an environmental challenge, all of which promote creativity and critical thinking.

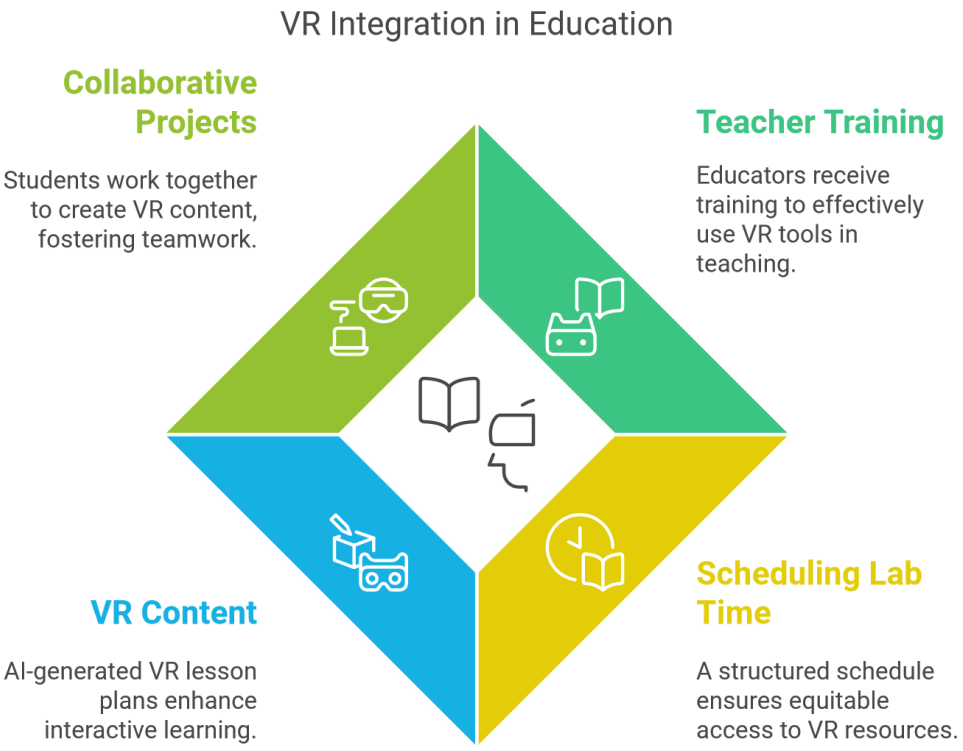

Figure 4 – Main topics to be consider under the use of the Virtual Lab

SAFETY PRECAUTIONS

Safety is of utmost importance when setting up and using a Virtual Lab, especially when dealing with immersive technologies like Virtual Reality (VR). The goal of these precautions is to ensure that students and educators can explore and interact with VR in a secure and comfortable manner, minimizing risks while maximizing the educational benefits. VR and AR activities are highly immersive, which can sometimes lead to disorientation or a lack of awareness of one's surroundings.

By establishing clear safety guidelines and practices, schools can create a safe and supportive environment where students feel comfortable using the technology. Below, we provide comprehensive safety measures that should be followed to ensure an optimal experience for all participants.

- **Supervision:**
  - Ensure that a trained teacher or supervisor is always present while students are using VR equipment. The supervisor should be familiar with VR safety guidelines and able to assist students with equipment, monitor their behavior, and provide immediate help in case of any issues. Proper supervision is crucial for preventing accidents and addressing any discomfort students may feel during immersive experiences.

- **Clear Space:**
  - Maintain a clutter-free environment to reduce the risk of tripping or bumping into objects while students are wearing VR headsets. This includes ensuring that cables are secured, furniture is arranged neatly along the perimeter, and that all equipment is stored properly when not in use. A clear and organized space helps reduce the risk of injuries and keeps the lab environment safe for all participants.

- **Breaks:**
  - Limit VR sessions to 15-20 minutes to prevent motion sickness or eye strain. Encourage students to take regular breaks between sessions to avoid fatigue. During these breaks, students should be encouraged to move around, drink water,

and rest their eyes to alleviate any physical discomfort that might arise from prolonged VR use.

- **Hygiene:**
  - Use sanitary wipes to clean headsets, controllers, and any other shared equipment between uses to maintain hygiene, especially if the headsets are shared among multiple students. Consider using disposable face covers or washable headset covers to ensure that headsets remain clean and comfortable for each user. Maintaining good hygiene practices helps prevent the spread of germs and keeps the equipment in good condition.

- **Guidelines for Students:**
  - Brief students on safe VR practices before each session. This includes reminding them to move slowly, be aware of their surroundings, and immediately stop if they feel dizzy or uncomfortable. Establishing clear rules about safe behavior in the VR environment helps prevent accidents and ensures that all participants have a positive and productive learning experience.

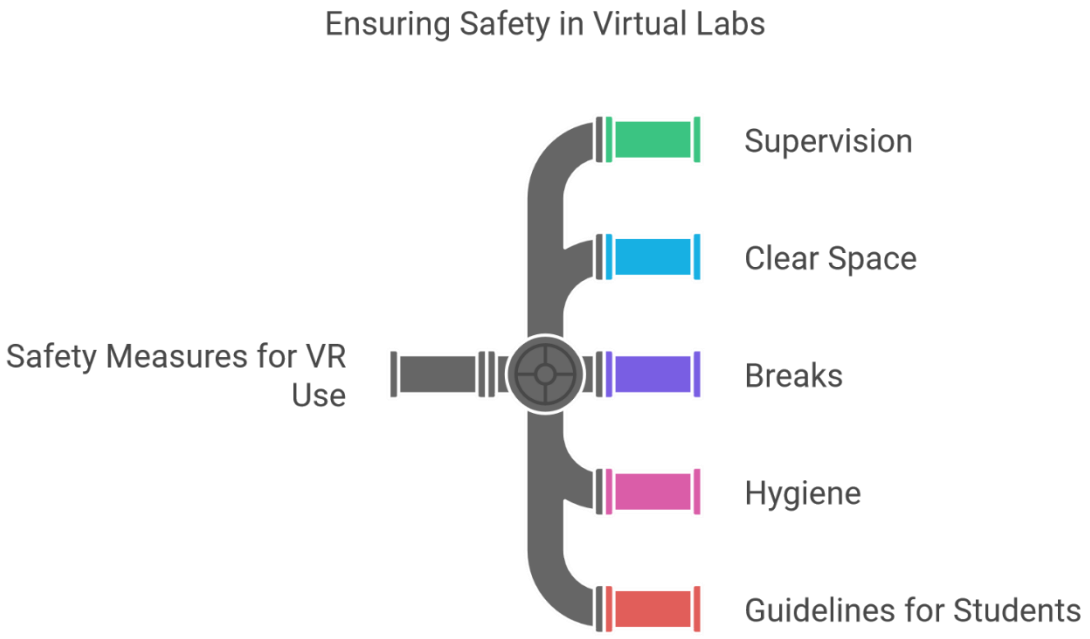

Figure 5 – Safety measures regarding the Virtual Lab

MAINTENANCE AND TECHNICAL SUPPORT

Effective maintenance and technical support are crucial to ensuring the long-term success and smooth operation of the Virtual Lab. Since the lab relies on specific technology, both hardware and software, it is essential to establish a comprehensive maintenance strategy to keep everything running optimally.

The goal is to minimize downtime and ensure that the equipment remains functional and accessible for students and educators whenever needed.
Proper technical support helps educators feel more comfortable using the technology and reduces the likelihood of disruptions during learning sessions.

Below are some guidelines and best practices for maintaining the lab and ensuring the availability of technical support whenever issues arise.

- **Regular Equipment Checks:**
    - Inspect VR headsets, Google Cardboards, controllers, and all other equipment on a regular basis to check for signs of wear and tear. Ensure that all devices are functioning correctly before each use, and replace any damaged components as needed. Regular checks help prevent unexpected equipment failures during a session and keep everything running smoothly.

- **Software Updates:**
    - Keep all software, including VR platforms, AI tools, and device firmware, up to date. Software updates often include important security patches, compatibility improvements, and new features that enhance the VR experience. Schedule regular times for updates to ensure minimal disruption to lab activities and test the updates to verify that they work as expected before student use.

- **Technical Assistance:**

- Designate a point of contact, such as a tech-savvy teacher or an IT staff member, for troubleshooting any technical issues that may arise during VR sessions. This person should be familiar with the Virtual Lab setup, including both hardware and software, and be able to address common issues such as connectivity problems, software glitches, or equipment malfunctions. Having a designated technical expert ensures that problems are resolved quickly, reducing downtime and minimizing disruptions to the learning experience.

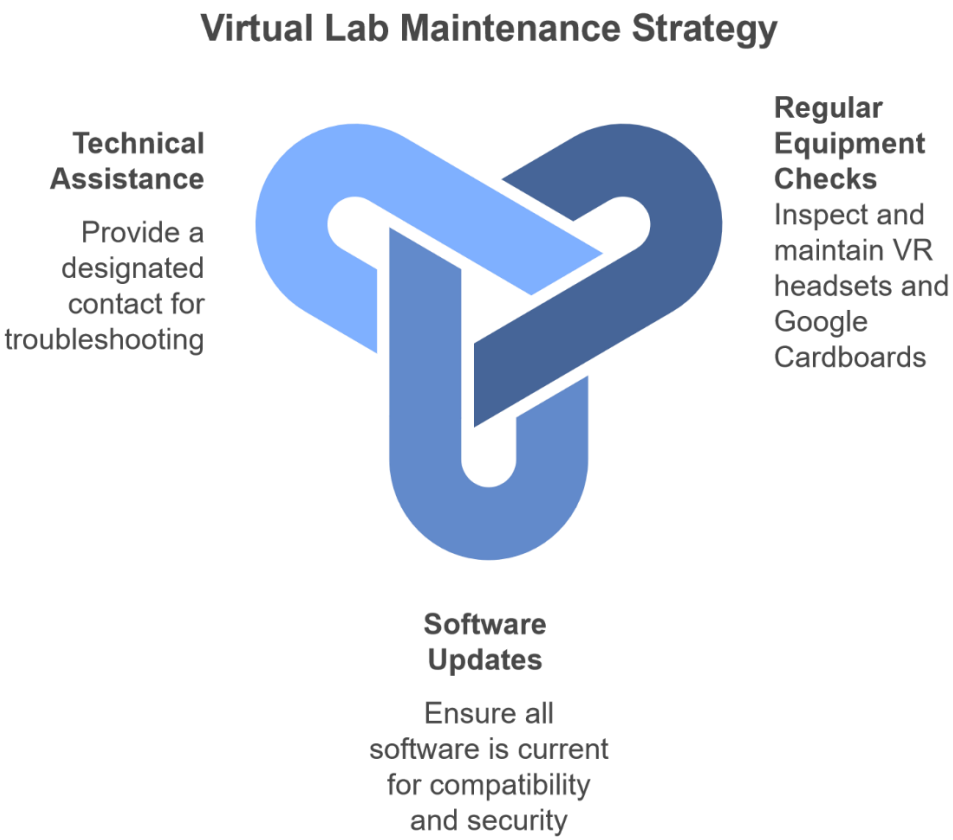

Figure 6 – Virtual Lab Maintenance Strategy

CONCLUSION

The Virtual Lab is an exciting addition to schools participating in the Eco STEAM project, representing a significant leap forward in how we integrate advanced technologies into educational settings.

By setting up this space with the right equipment, providing adequate teacher training, and implementing stringent safety measures, schools can offer students a unique and highly interactive way to engage with ecological and STEAM content that goes far beyond traditional classroom instruction.

This Virtual Lab should not be seen as an initiative confined to the Eco STEAM project. Instead, it serves as a starting point for schools to solidify these approaches and activities as a permanent part of their educational strategies. It is also an exemplary model for schools across the European Union and globally, showcasing how technology can drive meaningful learning experiences and address pressing global challenges.

Aligned with several UN Sustainable Development Goals (SDGs), such as Quality Education (Goal 4), Climate Action (Goal 13), and Partnerships for the Goals (Goal 17), this Virtual Lab prepares the next generation to face challenges like climate change and environmental degradation. By fostering critical skills and awareness, this initiative positions students to become proactive global citizens who can innovate and lead efforts toward a sustainable and equitable future.

The Virtual Lab acts as a dynamic environment where theoretical knowledge comes to life through practical exploration, allowing students to fully immerse themselves in subjects that are typically abstract or difficult to visualize. This immersive experience fosters not only greater understanding but also curiosity and enthusiasm for learning.

The Virtual Lab will not only enhance students' learning experiences but also inspire creativity, critical thinking, collaboration, and a profound interest in sustainability. Through the use of VR, students are able to step into scenarios that simulate real-world ecosystems, historical events,

and scientific phenomena. These experiences help them understand the broader implications of what they are studying and make connections between different areas of knowledge.

This environment is designed to inspire innovative thinking, helping students develop new ideas and encouraging them to see themselves as problem solvers and contributors to future technological and ecological advancements.

Through hands-on VR experiences, students will be better prepared to tackle real-world challenges and contribute positively to a sustainable future. These experiences equip them with essential skills such as problem-solving, adaptability, and collaborative teamwork—skills that are increasingly important in today's rapidly evolving world.

Moreover, by incorporating ecological themes and sustainability into their VR projects, students gain a deeper appreciation for environmental stewardship and are motivated to think critically about how they can positively impact their communities and the planet.

In this way, the Virtual Lab becomes not just a learning space but also a catalyst for change, empowering students to take ownership of their learning journey and become proactive, informed citizens who are ready to address the challenges of tomorrow.