Interreg CENTRAL EUROPE

Co-funded by the European Union

VReduMED

Transferable VR-Based Solutions for Care Education

Implementation Models, Educational Approaches and Practical Pathways for Adoption

Table of Contents

1. IDEATION AND WORKING PROCESS 5

1.1. Stakeholder Ideation 5

1.2. Consortium Ideation 6

1.3. Contribution of Pilot Actions 7
1.3.1. Pilot activity 1: VReduMED lab infrastructure 7
1.3.2. Pilot activity 2: VR-based workshops 7
1.3.3. Pilot activity 3: Co-creation hackathon 8

2. JOINTLY DEVELOPED SOLUTIONS 9

2.1. Solution 1 - Mobile VR Labs 9
2.1.1. Structural design of the solution 9
2.1.2. Test methodology and validation logic 10
2.1.3. Tested implementations in Czechia, Germany and Hungary 10
2.1.4. Operational workflow and mobile lending model 11
2.1.5. Main lessons learned 11
2.1.6. Transfer potential and implementation pathway 12
2.1.7. Implementation checklist for adopters 12
2.1.8. Strategic relevance of the solution 12
2.1.9. Typical deployment scenarios 13
2.1.10. Governance, maintenance and quality assurance 13
2.1.11. Sustainability and long-term perspective 13
2.1.12. Example institutional pathway from first contact to routine use 14

2.2. Solution 2 - Innovation Workshops in VR 15
2.2.1. Why VR is chosen as a workshop medium 15
2.2.2. Preparatory phase and conceptual design 15
2.2.3. Recommended workshop architecture 16

2.3. Conducting the workshop 16
2.3.1. Benefits and value of the format 17
2.3.2. Limits, safeguards and conditions for success 17
2.3.3. Facilitator role and local support structures 17
2.3.4. Recommended implementation pathway 18
2.3.5. Practical use cases 18

2.3.6. Designing tasks and prompts for immersive ideation 18
2.3.7. Inclusion, accessibility and participant confidence 18
2.3.8. Sustainability and reuse 19
2.3.9. Example pathway from preparation to follow-up 19
2.3.10. Institutional roles, resource planning and risk management 19

2.4. Solution 3 - VR in Care Education 20
2.4.1. Educational logic and overall focus 20
2.4.2. Project-developed applications as core content 21
2.4.3. Good-practice applications and broadening the educational scope 21
2.4.4. Diversity of implementation 21
2.4.5. The German lending model as an integration pathway 22
2.4.6. Quantitative and qualitative findings 22
2.4.7. Low-threshold 360-degree scenario development 22
2.4.8. Didactic recommendations 23
2.4.9. Curricular and institutional integration 23
2.4.10. Organizational and operational implementation 24
2.4.11. Transfer value and future use 24
2.4.12. Practical pathway for new adopters 24
2.4.13. Sustainability, continuation and scale-up 25
2.4.14. Example adoption pathway for a care education institution 25

3. LOW THRESHOLD VR PROTOTYPING FOR CARE EDUCATION 26

3.1. Technical Solutions 26
3.1.1. PaneoVR 26

3.2. Developed 360° VR scenarios 27
3.2.1. Scenario 1: Hand disinfection 27
3.2.2. Scenario 2: Pain management 28
3.2.3. Scenario 3: Manual Blood pressure measurement 28

3.3. Sustainability & Long-term perspective 29

4. CONCLUSION 30

Executive Summary

This output document presents practical and transferable approaches for using Virtual Reality (VR) in care education and related innovation contexts. Developed within the VReduMED project, it brings together tested solutions, implementation models and educational recommendations that show how immersive technologies can be introduced in a realistic, structured and meaningful way. The document is intended for a broad public audience, including educational institutions, healthcare training providers, innovation organisations and other stakeholders interested in future-oriented learning and collaboration.

The document is built around four complementary components that reflect different stages of VR adoption and use. First, Mobile VR Labs provide a practical model for creating accessible VR infrastructure through manageable equipment setups, mobility options and support workflows. This solution demonstrates how institutions can establish reliable access to VR without requiring highly specialised permanent facilities from the outset.

Second, Innovation Workshops in Virtual Reality show how immersive environments can support collaborative idea generation, transnational exchange and shared visual work. The document outlines how such workshops can be planned, facilitated and followed up effectively, highlighting that VR is most valuable when used as a purposeful collaboration format rather than as a novelty in itself.

Third, VR in Care Education focuses on the educational use of immersive applications in nursing and healthcare training. Based on testing in real educational and healthcare settings, this part of the document shows how VR can support learning in areas such as emergency response, patient safety, observation skills and spatial understanding. At the same time, it makes clear that educational value does not result from the technology alone, but from its didactic integration, its alignment with learning objectives and its fit within existing teaching structures.

Fourth, low-threshold VR prototyping for care education demonstrates how 360-degree learning scenarios can be created with accessible authoring tools. This shows that immersive educational content does not always require complex 3D production or specialised programming. Instead, institutions can develop and adapt their own scenario-based materials in a resource-sensitive and locally relevant way.

Taken together, these four components form a coherent pathway from first access to VR, through collaborative experimentation, to direct educational application and local content creation. Rather than promoting technology for its own sake, the document provides realistic guidance on how VR can be used where it adds clear value — educationally, organisationally and strategically. In this sense, the output serves as a practical reference for institutions and stakeholders seeking transferable pathways into immersive learning and innovation

A. Objective of this output

The objective of this output is to provide a practical and publicly accessible reference for organisations that want to explore, test and implement Virtual Reality (VR) in care education and related innovation contexts. It brings together the project's validated approaches and translates them into a structured and transferable orientation framework for institutions seeking realistic pathways into immersive learning and collaboration.

Rather than presenting VR as a technology showcase, this document focuses on where and how immersive approaches can create concrete educational and organisational value. It highlights implementation conditions, methodological principles and practical examples that help institutions make informed decisions about the meaningful use of VR in teaching, training and cross-sector cooperation.

More specifically, this output aims to:

- describe a transferable model for mobile VR labs that supports accessible infrastructure, regional access and manageable entry routes into immersive technologies.
- provide practical guidance for planning, facilitating and following up innovation workshops in VR as a format for collaborative ideation and transnational exchange.
- show how VR applications can be integrated into care education in a didactically grounded, organisationally feasible and educationally meaningful way.
- illustrate how low-threshold 360-degree scenarios can support local prototyping, content development and the adaptation of immersive learning materials to specific teaching contexts.
- support the adoption, transfer and further development of VR-based approaches across education, training, healthcare-related learning environments and cross-sector collaboration.

Overall, the output is designed to help stakeholders move from initial interest in VR toward informed and sustainable use. Its purpose is not only to present project results, but also to offer orientation for future implementation, adaptation and scale-up in diverse institutional settings.

1. Ideation and Working Process

This chapter describes how the project consortium developed the three solutions presented later in this document. It outlines the steps taken to gather ideas, select the most promising ones and explore suitable methods for creating immersive learning scenarios. The chapter also highlights how the project team combined stakeholder perspectives, partner collaboration and practical development work to form a coherent working process.

1.1. Stakeholder Ideation

Across all project regions, open innovation workshops brought healthcare institutions and MedTech/VR companies to explore where immersive learning could add value in education and training. In total, 10 workshops engaged 158 participants with a balanced VR background (roughly half with prior VR experience), and produced 38 ideas that span procedure training, emergencies, communication, environment simulations, rehabilitation and curriculum use cases.

Key takeaways that directly informed concept selection and scenario design:

- **Didactic quality first:** Stakeholders asked for scenarios that deliver clear learning value, provide immediate feedback, and reflect current clinical standards; routine skills that are already easy to teach offline should stay offline.
- **Short, repeatable formats**: Shorter modules with variations, to support iterative practice.
- **Clarity and usability**: Clear instructions, simple interactions, and visible affordances reduce frustration; onboarding is essential because many learners are new to VR.

These inputs provided the thematic baseline for the partners, for the hands-on scenario creation approach described in the following sections and are also incorporated in the VReduMED Handbook, targeting regional care education and the VReduMED Roadmap.

Figure 1: Open innovation workshops brought healthcare institutions and MedTech/VR companies together to explore where immersive learning could add value in education and training (photo: VReduMED)

1.2. Consortium Ideation

Following the regional stakeholder workshops, the project partners held two joint innovation workshops to develop and prioritise partner-driven ideas for future cross-border cooperation. These sessions brought together representatives from all participating organisations and focused on identifying topics with strong educational relevance and realistic development potential.

During the first workshop, partners generated a wide range of ideas using structured group work. Individual ideas were collected, clustered and discussed before being placed in a joint prioritisation matrix. Each participant then rated the ideas using a points-based system.

In the second workshop, the highest-rated ideas were further developed in small transnational groups. Each group expanded one of the shortlisted topics by defining its purpose, potential users, scope, added value and first implementation steps. This process resulted in the creation of concise concept drafts, which covered topics such as:

- AI-based communication assistance in healthcare,
- VR-supported stress management for nurses,
- VR for physical therapy and rehabilitation, and
- an educational VR game for children promoting health awareness

From this refined set, the partners jointly selected the themes that were considered most promising contributing to the solutions in terms of educational impact, feasibility and cross-regional relevance. These selected concepts were then included in the project's Sustainability Plan, ensuring that they will be pursued further beyond the project's lifetime. The consortium intends to explore opportunities for upscaling, for example through follow-up cooperation, additional funding schemes and broader adoption in education and training environments. These three selected concepts are described in the next chapter.

Figure 2: The VReduMED consortium conducted internal open innovation sessions, to generate project concepts based on the findings. (photo: VReduMED)

1.3. Contribution of Pilot Actions

The pilot activities played an important role in supporting the development process. Each activity tested different aspects of cross-regional collaboration and helped determine how VR can be used effectively in joint development work.

1.3.1. Pilot activity 1: VReduMED lab infrastructure

Pilot activity 1 examined whether the participating VReduMED laboratories and mobile setups were technically ready for joint use across regions. The tests assessed available equipment, required physical space and network performance at all sites. The results showed that all labs provided stable conditions for VR applications, including reliable connectivity and suitable room layouts for safe use. This pilot confirmed that the technical environment needed for collaborative VR work is in place, ensuring that later development and co-creation activities could be carried out effectively.

Figure 3: Participants testing VR equipment and room-scale setup in one of the VReduMED labs during the infrastructure pilot activity. (photo: VReduMED)

1.3.2. Pilot activity 2: VR-based workshops

In the next step, the project explored whether collaborative workshops could be conducted directly inside virtual environments. The tests showed that VR-based workshops work well when participants receive proper onboarding, when group sizes remain manageable and when sessions are structured in shorter blocks with breaks. These findings helped define the practical requirements for using VR as a tool for cross-regional co-creation.

Figure 4: Virtual collaboration setting in which participants explored shared VR workshop methods inside a MeetinVR environment. (photo: VReduMED)

1.3.3. Pilot activity 3: Co-creation hackathon

The third pilot activity tested how interdisciplinary teams can design educational ideas from concept to prototypes. During a two-day hackathon, participants from nursing and informatics worked together to create short training scenarios. They could either build on ideas from the earlier stakeholder workshops or develop new scenarios based on their own experience. The pilot showed that interdisciplinary groups can quickly create meaningful VR learning content and demonstrated how collaborative development formats support the overall concept-creation process.

Figure 5: Participants collaborating during the two-day hackathon, working in teams to design and develop 360° VR learning scenarios in healthcare education. (photo: Sensorik Bayern)

2. Jointly Developed Solutions

2.1. Solution 1 - Mobile VR Labs

The first VReduMED solution is a validated model for establishing and operating mobile or regionally anchored Virtual Reality laboratories (VR Labs) for care education and cross-sector innovation. The model emerged from project's infrastructure pilot (Pilot 1), which tested the technical setup of the project's laboratories, their mobility, their connectivity and their capacity to support collaborative VR use across partner regions. The central question of the pilot was not whether VR devices could be installed somewhere in principle, but whether a lab concept could be developed that is robust enough for regular use, flexible enough for transfer activities and realistic enough for institutions that need manageable entry routes into immersive technologies.

This solution is important because access to VR in education often fails at the implementation stage rather than at the level of motivation. Institutions may be interested in immersive learning, but still face uncertainties about hardware, room setup, network quality, hygiene, mobility, supervision and support. Pilot 1 addressed exactly these issues. It translated the abstract idea of a VR laboratory into a testable and transferable model with defined requirements, a practical testing methodology and region-specific implementation evidence. The resulting solution can therefore be described as an operational infrastructure model rather than simply as a collection of devices.

2.1.1. Structural design of the solution

The Mobile VR Labs solution consists of several interlocking components. The first component is the hardware layer. The pilot report defines both minimum and recommended technical requirements for VR headsets, specifying standalone devices compatible with the project's applications and collaborative workflows. This matters because the quality of the user experience depends strongly on frame rate, stability and ease of use. The project also recognised that an institutional setup requires more than headsets alone. Laptops or PCs for supplementary tasks, projectors or large displays for casting, spare cables, extension cords, transport cases, power supplies and mobile routers all form part of a usable mobile lab model. By defining these elements explicitly, the project moved from a minimal device perspective to a realistic operational setup.

The second component is the connectivity layer. The pilot defines minimum and recommended bandwidth and latency values and tested them repeatedly in all participating labs. This emphasis is justified because many VR scenarios, especially collaborative ones, are highly sensitive to network instability. Good connectivity affects not only streaming and content loading, but also the continuity of interaction, the stability of the room environment and the overall credibility of the format for first-time users. The project therefore treated network measurement as a central part of the lab concept, not as a secondary technical detail.

The third component is the spatial and safety layer. Pilot 1 defines clear minimum and recommended room requirements for standing VR use and recognised that safe immersive work depends on being able to free sufficient space whenever sessions are carried out. This spatial perspective is highly relevant for educational institutions, which often do not have dedicated VR facilities but need to integrate VR into multi-purpose rooms, classrooms or workshops. The solution therefore accepts flexible room use, provided that safe free space can be created and supervised.

The fourth component is mobility. A key insight of VReduMED is that a laboratory does not need to be permanently fixed in one place in order to create value. Mobility means that institutions without their own specialist room can still benefit from immersive technology through transportable kits, external support and structured lending. In this sense, the solution is also an access strategy for widening participation in VR-based education and testing.

2.1.2. Test methodology and validation logic

Pilot 1 uses a deliberately simple but rigorous testing methodology. First, each laboratory verified the amount of equipment available for project activities, demonstrations, workshops and lending. Second, each site checked whether enough physical space could be provided for safe standing use. Third, each site carried out repeated network measurements, focusing on latency, bandwidth, network jitter and stability. This three-step logic was important because it covered the most common implementation risks: insufficient equipment, unsafe or impractical room conditions, and network environments that look adequate on paper but fail under realistic load.

The methodology also reflected real project conditions. Measurements were carried out at different times and under varying levels of network load in order to mimic ordinary use rather than a one-off ideal test situation. This is a strong feature of the solution because it acknowledges that educational deployment rarely takes place under laboratory-perfect conditions. In everyday practice, users connect during busy periods, devices are moved between rooms or institutions, and wireless conditions fluctuate. A solution model that ignores this would be less transferable.

COMPONENT	ROLE IN THE SOLUTION	TRANSFER IMPLICATION
Hardware layer	Standalone headsets and supporting equipment for immersive use	Defines baseline usability and reliability
Connectivity layer	Stable internet access, Wi-Fi capacity and latency control	Critical for collaborative use and content loading
Spatial layer	Safe room conditions for standing or guided use	Enables classroom and workshop deployment
Mobility layer	Transport cases, routers, power management and cables	Allows lending and external deployment
Support workflow	Onboarding, troubleshooting and structured feedback	Turns equipment into a service model

2.1.3. Tested implementations in Czechia, Germany and Hungary

In Czechia, the VR laboratory at JVTP included three Meta Quest 2 headsets, a laptop, a projector for casting and a 5G router for external events. The available physical space allowed two headsets to be used simultaneously, while a third served as redundancy or as support for external deployment. The site fulfilled the defined criteria overall. Its network tests showed that download and upload performance largely met the recommended levels and that jitter remained very low. At the same time, latency values varied and Wi-Fi load was identified as a relevant critical factor. This is a valuable implementation lesson because it shows that collaborative VR can be technically feasible even when some public speed-test values fluctuate, provided that round-trip times to relevant servers remain acceptable and that the local wireless environment is managed carefully.

The German VR laboratory at OTH Regensburg validated the solution in two ways. First, it showed that a university-based VR lab can exceed the minimum requirements by a considerable margin in terms of device availability, available space and fixed network performance. Second, and even more importantly, it demonstrated the transfer potential of the mobile lab approach. The setup was used not only inside the university, but also in nursing schools, conferences, meetings and numerous external settings. Mobile lending was realised in many institutions for multi-week periods. This turns the lab concept into a practical service model: institutions expressed interest digitally, entered into a binding agreement, received equipment and onboarding support, used the setup independently in teaching, and then reflected on the experience together with the project team. This workflow is one of the strongest pieces of evidence that the Mobile VR Labs solution can support real transfer beyond a project site.

The same German testing also revealed one of the main boundary conditions of the solution: while fixed network infrastructure performed reliably, mobile setup conditions were not consistently stable. In one documented case, the connection quality was so low that the planned testing had to be terminated and replaced by the local existing network structure. This does not weaken the solution. Rather, it clarifies its practical conditions for use. It shows that a mobile lab remains a viable model, but that institutions need pre-checks, backup options and realistic expectations about network dependency.

The Hungarian VR laboratory at Szechenyi Istvan University further strengthened the evidence base. The site combined Meta Quest 2 and Meta Quest 3 devices with a fixed laboratory setup and portable routers for external use. Its network results consistently exceeded the recommended performance levels, with very stable bandwidth, low latency and strong overall reliability. This confirms that the lab concept is not tied to one specific institutional type. It can function effectively in different organisational settings when the basic requirements are met.

2.1.4. Operational workflow and mobile lending model

A major strength of the VReduMED solution lies in the fact that it combines technical standards with an operational workflow. This is especially visible in the German lending model, but the underlying logic is applicable more broadly. A functioning mobile lab requires a clear process: preparation of the equipment, installation of relevant applications, hygiene-ready handling, transport in suitable cases, setup at the receiving institution, first-use onboarding, optional support during the usage period and structured collection of feedback afterwards. Without such a workflow, mobility remains a theoretical feature rather than a usable service.

The multi-week trial periods were especially valuable because they allowed institutions to move beyond one-off demonstration and explore curricular compatibility, scheduling, supervision and user acceptance under real conditions. Teachers could test how long preparation takes, how students react after the initial novelty effect, whether room logistics are manageable, and where support is needed. This kind of insight is exactly what many organisations require before they consider more permanent investment. The Mobile VR Labs solution therefore supports experimentation without forcing institutions to commit too early.

2.1.5. Main lessons learned

Several lessons can be derived from the pilot. First, the amount of equipment matters less than the coherence of the setup. A smaller number of well-prepared devices with good network conditions and a clear support workflow creates more value than a larger but unstable or poorly managed inventory. Second, network quality must be assessed in the actual environment of use, especially when mobile deployment is planned. Third, mobility should be planned organisationally. Transport boxes, power management, router configuration, backup communication channels and user instructions are not optional extras; they are part of the solution itself.

Fourth, the lab concept is particularly useful when it is embedded in a wider educational or innovation ecosystem. The VReduMED labs were not isolated hardware repositories. They acted as regional demonstration and transfer centres, connecting universities, schools, SMEs and healthcare stakeholders. This institutional anchoring increases the sustainability of the model because it turns the lab from an equipment pool into a regional service and exchange structure.

2.1.6. Transfer potential and implementation pathway

The Mobile VR Labs solution is relevant for universities, vocational schools, care education providers, innovation agencies, clusters and public actors that want to make VR accessible in a manageable way. The recommended implementation pathway is staged. Institutions should begin with a needs-based assessment of target groups and use cases, followed by the definition of a core setup with clearly specified hardware, room requirements and support roles. The next step is controlled first use through demonstrations or short workshops. Only after this should lending, wider deployment or interconnected lab activity be expanded. This staged approach mirrors the logic that proved effective in VReduMED and reduces the risk of overbuilding before real demand and conditions are understood.

In summary, the first pilot produced more than technical validation. It resulted in a practical model for creating, operating and transferring mobile VR lab capacity for care education and cross-sector collaboration. The solution is credible because it combines recommendations with tested evidence, technical requirements with organisational workflow, and fixed infrastructure with mobility options adapted to different institutional realities.

2.1.7. Implementation checklist for adopters

Institutions considering adoption can use the following practical checklist as a starting point. First, determine whether the lab is intended mainly for demonstration, repeated classroom use, lending or cross-regional collaboration. This choice affects the number of headsets, router capacity and the level of facilitator support required. Second, assess the available rooms and identify which spaces can be cleared safely for standing VR use. Third, test the network under realistic conditions, not only once and not only through a generic online speed measurement. Fourth, prepare accessories and hygiene procedures so that devices can move between users without creating friction.

Fifth, define who is responsible for setup, troubleshooting, charging, maintenance and feedback collection. Sixth, decide whether the institution wants to establish only a fixed site or also a mobile deployment model. If mobility is planned, transport protection, battery management and router preparation should be treated as core budget items. Seventh, connect the lab concept to actual educational or innovation workflows from the beginning, because infrastructure without use cases risks becoming underutilised.

2.1.8. Strategic relevance of the solution

The strategic importance of the Mobile VR Labs solution lies in its role as an enabling condition for wider adoption. Many organisations interested in immersive learning do not need a large specialist XR centre. They need a realistic first infrastructure layer that can be implemented, tested, adjusted and possibly shared. VReduMED shows that such a layer can exist in the form of regional laboratories combined with mobile service elements. This makes the solution particularly relevant for public programmes, regional ecosystems and networks that seek scalable but resource-sensitive pathways into digital innovation.

2.1.9. Typical deployment scenarios

The Mobile VR Labs solution can be deployed in several ways depending on institutional maturity and strategic goals. A university may use the lab as a regional demonstration and transfer centre, inviting schools, healthcare providers and companies to explore immersive learning formats. A nursing school may use a smaller version of the solution mainly for internal teaching and short supervised sessions. A cluster organisation or innovation agency may operate the equipment more as a mobile demonstrator that supports stakeholder events, conferences and regional networking. These scenarios differ in scale, but they all use the same underlying principles: a coherent hardware set, reliable preparation, clear user support and a defined operational workflow.

A second distinction concerns the temporal model of use. Some institutions will benefit from a permanent room with regular recurring activity. Others may need a travelling setup that can be deployed for campaigns, training days or trial periods. VReduMED demonstrated that both approaches can be valid. The essential point is that the technical and organisational concept remains stable enough for users to experience VR as reliable and manageable rather than improvised.

2.1.10. Governance, maintenance and quality assurance

Any institution adopting the solution should define simple governance routines from the beginning. This includes inventory control, charging routines, software updates, hygiene procedures, damage reporting and a booking or reservation logic where the equipment is shared across teams. These issues may appear minor, but they strongly influence user trust. If the headsets are not charged, if a cable is missing, or if the previous user left the system in an unclear state, the credibility of the format declines quickly.

Quality assurance also benefits from routine documentation. VReduMED's emphasis on repeated network checks, structured feedback and trial-based evaluation suggests that institutions should treat each deployment as a learning opportunity. A short post-session checklist, combined with a simple record of technical issues and user observations, can create a practical knowledge base for improving future use. This turns the lab from a static infrastructure object into a continuously improving service environment.

2.1.11. Sustainability and long-term perspective

From a sustainability perspective, the strongest feature of the Mobile VR Labs solution is that it allows institutions to progress gradually. They can begin with a limited but well-managed setup, test demand and organisational fit, and then expand only where there is evidence of educational or strategic value. This approach is particularly suitable for publicly funded environments in which resource efficiency and demonstrable transfer matter.

The solution also supports long-term sustainability because it can host different forms of activity over time. A lab that initially focuses on demonstrations can later support workshops, application testing, teacher training, scenario development or interregional exchange. This flexibility increases the likelihood that the infrastructure remains relevant after the initial project phase and can be integrated into broader digitalisation or innovation strategies.

2.1.12. Example institutional pathway from first contact to routine use

A typical institutional pathway begins with awareness and curiosity rather than with a fixed procurement plan. An interested school, university or healthcare organisation first encounters the lab through a demonstration event, a regional network activity or a recommendation from another partner. At this stage, the decisive question is not yet which exact devices should be purchased, but whether VR can address a real local need. The institution therefore benefits from seeing a working setup, experiencing a short use case and discussing openly what would be feasible in its own environment.

In a second step, a smaller trial or lending phase allows the institution to move from interest to evidence. Local staff can test whether rooms can be prepared reliably, whether users tolerate the headsets well, whether the network is stable enough and whether facilitation demands remain manageable. Once these operational basics are understood, the institution can decide whether to remain with occasional mobile use, to establish a more regular local setup or to join a regional network structure in which devices and expertise are shared. This pathway is realistic because it avoids premature investment while still creating a structured route toward routine use.

The VReduMED experience suggests that this gradual pathway should be accompanied by dialogue rather than by purely technical handover. Institutions benefit from exchanging experiences with teachers, facilitators and technical support persons who have already worked with the setup. In this way, the lab becomes not only an infrastructure asset, but also a focal point for peer learning and institutional confidence-building.

2.2. Solution 2 - Innovation Workshops in VR

This chapter provides a practical guideline for planning, facilitating and following up innovation workshops in Virtual Reality (VR). It explains under which conditions immersive workshop formats can add value to transnational collaboration in care education, MedTech and digital health innovation. VR is not used as an end in itself. Instead, immersive environments are used where stronger co-presence, shared visual work and spatial interaction can support ideation more effectively than conventional online collaboration tools.

A well-designed VR innovation workshop should lead to concrete shared outcomes. These may include sketched scenarios, prioritised ideas, mapped workflows or clustered needs. To achieve this, the workshop requires careful preparation, a structured agenda, active facilitation, clear task design and reliable follow-up.

2.2.1. Why VR is chosen as a workshop medium

VR is particularly relevant for cross-regional collaboration. Many partnerships depend on digital exchange because regular physical meetings are costly, time-consuming or impractical. Conventional online platforms are effective for presentations and coordination, but they often create limitations for collaborative ideation. Participants remain visually separated, spatial references are weak, and shared sketching or breakout work can feel detached. A shared virtual room can address these limitations by supporting stronger co-presence, better focus and more hands-on collaboration.

Innovation work often benefits from spatial interaction and embodied attention. In a virtual environment, participants are represented as avatars sharing a room rather than as isolated video tiles. They can face one another, move toward breakout areas, gather around work surfaces and use tools integrated into the same environment. This helps create a stronger sense of co-presence, supports hands-on joint work with whiteboards and pens, and reduces the side activities that often distract from focused ideation in browser-based meetings.

2.2.2. Preparatory phase and conceptual design

Before conducting a workshop, facilitators should carry out exploratory internal testing. This includes reviewing possible applications, selecting a platform compatible with the available Meta Quest hardware and assessing how new users can be onboarded efficiently. This preparatory phase is crucial because immersive workshops fail quickly when facilitators do not fully understand the environment. Core functions to test include controller handling, navigation, collaborative drawing, the use of breakout rooms, slide presentation, room layouts and the loading of basic assets. Such tests help define a minimum feature set for live workshops and confirm that a lean environment is preferable, especially when participants have limited prior VR experience.

A structured workshop concept should be developed on the basis of these preparatory findings. Small mixed groups are especially suitable, typically around six participants in total, usually with one or two persons from each organisation. This configuration reduces overlap in speech, makes facilitation easier and supports a more focused form of transnational exchange. A cross-sector mix of care experts, MedTech representatives and VR experts can further strengthen the quality of discussion and idea development.

2.2.3. Recommended workshop architecture

A clear block-based workshop architecture is a defining feature of an effective VR innovation workshop. A recommended sequence consists of an in-person introduction to VR and to the workshop context, a hands-on familiarisation phase in the virtual platform, a short break, an expert input phase, a collaborative innovation session in VR and a feedback phase. This structure matters because effective VR workshops require more than simply placing participants in headsets and expecting collaboration to happen automatically. A staged transition from physical orientation to immersive interaction, and from technical familiarisation to content-related co-creation, helps participants engage with confidence and clarity.

The onboarding architecture is especially important. A useful distinction is between an in-lab introduction and in-VR familiarisation. Participants should first learn how to fit the headset correctly, how to handle the controllers and what to do if they experience discomfort. Only after this should they enter the shared room to practise navigation, whiteboard interaction and basic tool use. In this way, health, safety and usability become part of the workshop design itself, which is particularly important when many participants are first-time users.

A suggested agenda for a VR innovation workshop is outlined below:

WORKSHOP BLOCK	PURPOSE
In-lab introduction	Explain hardware, safety and goals, and adapt the introduction to participants with little or no VR experience.
VR familiarisation	Practise navigation and basic tools while limiting the environment to essential functions.
Expert input	Provide a common frame of reference and stimulus directly inside the VR room.
Innovation session	Enable group ideation in breakout areas, keeping groups small and tasks clear.
Feedback phase	Collect usability-related and content-related reflections in order to support transfer and iteration.

2.3. Conducting the workshop

A successful workshop depends on careful preparation. The host should configure the virtual room in advance, activate only the required core functions, upload presentation materials and generate access codes for participants. In parallel, a backup online call, for example via Microsoft Teams, should be established so that communication can continue if technical issues occur during the immersive session. Participating locations should prepare rooms with enough free space for safe VR use. Headsets should be preinstalled and tested, and external monitor streams should mirror participants' views so that local facilitators can support them if needed.

Once participants enter the virtual room, the workshop flow should combine presentation, interaction and breakout work. Presentation materials can be displayed on a virtual screen so that all participants, regardless of location, can follow the same input. The central innovation session can then assign participants to breakout areas where they work at virtual tables. There, they respond to innovation prompts, select scenarios and sketch ideas using virtual pens and whiteboards. This creates a facilitated co-creation space rather than a conventional online meeting.

2.3.1. Benefits and value of the format

Immersive workshop formats offer several concrete benefits. First, participants often experience a stronger sense of shared presence than in ordinary online meetings. This matters for ideation because participants are more likely to engage actively when they feel they are working together in one room rather than reporting in sequence from separate screens. Second, the workshop environment enables visual and spatial forms of exchange through presentation surfaces, whiteboards and breakout arrangements. Third, participants tend to focus more strongly on the workshop task, which is a significant advantage for transnational sessions where digital fatigue and distraction are common.

An additional benefit lies in the documentation possibilities of the environment. The selected platform can allow screenshots and short video recordings and can preserve room content such as notes and sketches after the session. This creates a practical bridge between live interaction and follow-up work, because facilitators can revisit outcomes, document progress and continue working with the material in later sessions. In this way, the format supports not only synchronous collaboration but also continuity between workshop phases.

2.3.2. Limits, safeguards and conditions for success

Immersive workshops are not universally effective under all conditions. Stable and fast internet connections are essential. If bandwidth is insufficient, the virtual room may collapse and participants may need to switch to a backup communication channel. This underlines the importance of redundancy and realistic technical prechecks. Backup communication channels should therefore be included in workshop planning, and extra time should be allowed for the loading of heavier assets.

Health and comfort are equally important. Even when headsets are generally comfortable, prolonged or uninterrupted VR use can lead to eye fatigue or motion sickness. Continuous VR segments should therefore be limited to about forty-five minutes, with regular breaks built into the agenda. Comfort guidance during onboarding, monitoring participant well-being during the session and allowing participants to pause are all essential parts of the format.

Another important limit concerns cognitive load. Participants need time to learn the available tools, especially pens and whiteboards. Even when most users are able to work effectively after a short practice phase, onboarding cannot be skipped. Instructions should remain concise, tool options should be reduced and facilitation should be active rather than passive. This is one of the main reasons why a lean environment with clearly defined tasks is preferable.

2.3.3. Facilitator role and local support structures

Immersive workshop facilitation is a hybrid role. It includes preparation of the VR environment, management of the agenda, observation of group dynamics, technical support and documentation of outcomes. In many cases, this role should be shared between a central host and local support persons at the participating sites. Mirrored displays allow local facilitators to see what participants are doing and to intervene if headset handling or navigation creates difficulties. This local support architecture is one of the reasons why the format remains accessible to first-time users.

Facilitator preparation should therefore be treated as a central implementation task. Internal trial runs are advisable, as are clearly defined roles for local and central support, prepared backup channels and agreed procedures for how participants can leave and re-enter the VR environment if needed. These may seem like small design decisions, but they distinguish a polished workshop format from a one-off technical experiment.

2.3.4. Recommended implementation pathway

For institutions interested in adopting the format, a staged pathway is more realistic than starting with a complex large-scale VR event. Facilitators should first carry out internal testing and select a stable, easy-to-manage environment. Workshop goals should then be defined very precisely, including the role of presentation, discussion and ideation. A first guided workshop should be conducted with a small mixed group and strong local facilitation. Only afterwards should the format be scaled to additional groups, themes or institutions.

This format is relevant for educational institutions, innovation agencies, cluster organisations, project consortia and public-private partnerships that need stronger digital collaboration formats. It is especially suitable when the aim is not merely to exchange information, but to create shared understanding, visualise ideas and jointly develop scenarios across locations. In this sense, immersive environments can serve as a complementary workshop infrastructure for cross-regional innovation work.

2.3.5. Practical use cases

The format is not limited to one specific workshop theme. It can be adapted for curriculum co-design, stakeholder consultation, interdisciplinary scenario development, international staff exchange and thematic innovation labs. What remains constant is the need for a clearly structured process, careful onboarding and a workshop task that benefits from shared visual and spatial interaction. In these contexts, VR becomes less of a novelty medium and more of an intentional design choice for certain types of collaborative work.

2.3.6. Designing tasks and prompts for immersive ideation

The quality of the workshop depends heavily on the design of the task. Immersive environments can improve co-presence and interaction, but they do not automatically produce good ideas. The task must therefore be concrete enough to orient participants and open enough to invite co-creation. This can be achieved by combining an initial expert input with clear prompts for scenario-based group work. Participants should not be asked to brainstorm in the abstract. Instead, they should work on concrete innovation-related topics in care, education or MedTech and externalise their thinking on shared whiteboards and tables.

A simple design rule follows from this: workshop tasks should produce visible shared output. This may take the form of sketched scenarios, prioritised ideas, mapped workflows or clustered needs. Visible output helps keep participants engaged, supports facilitation during the session and makes follow-up easier because the results can be documented and revisited afterwards.

2.3.7. Inclusion, accessibility and participant confidence

A robust workshop format should accommodate participants with mixed levels of VR experience, because this diversity is likely to be typical in most transfer settings. The design should therefore be inclusive not only across countries and sectors, but also across levels of digital confidence. The staged onboarding model directly supports this by allowing participants to enter the environment gradually, practise basic interaction before the main task begins and ask for local support without interrupting the entire group.

Accessibility in this context does not mean that every participant experiences VR in the same way. Rather, it means that the workshop design provides enough orientation, support and flexibility for different user profiles to participate meaningfully. This includes seating options where needed, pauses, clear language, visual prompts and backup communication channels. These measures make the difference between a workshop that is technically possible and one that is genuinely usable.

2.3.8. Sustainability and reuse

The sustainability of the format lies in its repeatability. Once an organisation builds facilitator competence, tests a stable environment and develops a set of reusable workshop blocks, the format can be redeployed with different groups and topics. This is especially valuable for transnational projects, networks and partnerships that need more than occasional coordination meetings. Over time, the format can become a standing method for joint ideation, reflection and concept development.

In the longer term, the workshop model also has educational value of its own. It familiarises participants with immersive collaboration, demonstrates the opportunities and limits of VR as a working environment and can stimulate further adoption of immersive methods in teaching and innovation processes. In this way, it contributes not only to immediate workshop outcomes, but also to broader institutional learning.

2.3.9. Example pathway from preparation to follow-up

A realistic workshop pathway begins several weeks before the actual session. Facilitators should clarify the purpose of the workshop, select the participant mix and identify whether the format is intended mainly for idea generation, concept refinement or stakeholder exchange. The virtual environment should then be configured accordingly, presentation materials should be prepared and local support persons should be briefed. Shortly before the workshop, participants should receive practical information about timing, onboarding and comfort expectations so that the first contact with the format already reduces uncertainty.

During the session itself, the most important design principle is guided progression. Participants move from introduction to first interaction, from first interaction to content work and from content work to reflection. This progression helps manage both cognitive load and group dynamics. After the workshop, the process should not end with the removal of the headset. Screenshots, whiteboards and facilitator notes should be documented, and the results should be translated into follow-up steps such as a concept draft, a next workshop cycle or a summary for partners who are not present.

The full pathway is what gives the format its real value. The immersive session is the visible centre of the process, but its quality depends on preparation before the event and structured continuation afterwards. Organisations replicating the format should therefore view the workshop as a method cycle rather than a single digital meeting.

2.3.10. Institutional roles, resource planning and risk management

Organisations that want to use the format regularly should define roles and resources explicitly. Someone needs to own the workshop process, someone needs to prepare the virtual environment and someone needs to coordinate local support at participating sites. In smaller organisations, these roles may overlap. In larger networks, they may be distributed across partners. What matters is that responsibilities are visible and that no essential preparation task remains implicit.

Resource planning should include time for rehearsal, onboarding and post-session documentation. Immersive workshop quality depends on preparation effort that is partly invisible to participants. Reliable sessions are rarely spontaneous. They depend on environment checks, agenda design, internal testing and local coordination. Recognising this effort from the outset makes the format more sustainable because it prevents underestimation of facilitator workload.

A simple risk management approach is also advisable. This includes backup communication channels, alternative participation options in case a headset fails, clear procedures if a participant experiences discomfort and realistic time buffers for technical entry. Such measures do not make the workshop less innovative. On the contrary, they stabilise it and increase trust among participants and partner organisations.

2.4. Solution 3 - VR in Care Education

The third VReduMED solution is a model for integrating Virtual Reality into care education. Whereas the first solution focuses on infrastructure and the second on collaborative workshop methodology, this third solution addresses the direct educational use of immersive technology. It is based on Pilot 3, which tested project-developed applications and selected good-practice tools in real educational and healthcare contexts across all partner countries. The resulting solution combines content, didactics, organisational embedding and transfer strategy. A summary can be found in the table below.

EDUCATIONAL COMPONENT	PRIMARY EDUCATIONAL VALUE	IMPLEMENTATION IMPLICATION
CPR application	Infant and child resuscitation in emotionally realistic situations	Best combined with dummy, sensor support and debriefing
Room of Horror	Observation of hazards and patient safety errors	Useful for repeatable safety training
Human Anatomy VR	Spatial visualisation of anatomy and function	Supports visually complex teaching units
360-degree scenarios	Low-threshold scenario-based learning and local adaptation	Can be created with accessible authoring tools
Lending model	Institutional testing under real conditions	Supports gradual adoption before major investment

2.4.1. Educational logic and overall focus

The educational rationale of the solution is based on the idea that VR is especially valuable when it enables learning situations that are difficult to provide in conventional settings. These include emotionally demanding scenarios, safety-critical observation tasks, highly visual or spatial topics and repeatable structured practice under protected conditions. The pilot therefore focused on applications that support practical decision-making, confidence in action, observation skills and embodied understanding rather than on abstract novelty.

The report also makes clear that the project did not assume VR should replace existing teaching. Instead, it investigated where immersive tools add value within broader educational structures. This is a crucial principle. The solution is not an argument for technology-driven substitution, but for didactically grounded integration. In practical terms, this means that learning objectives, teaching sequences, debriefing and institutional embedding remain as important as the application itself.

2.4.2. Project-developed applications as core content

The first core application of the solution is the CPR training application for children and infants. Resuscitation involving children and infants is emotionally demanding and comparatively underrepresented in conventional training, which tends to focus on adult dummies. The VReduMED application addresses this gap by combining an immersive scenario with real haptic interaction. Learners practice on a physical resuscitation dummy while the VR system provides scenario framing and performance feedback. A wrist sensor system measured relevant compression parameters, enabling more objective assessment of action quality within the simulation.

The educational strength of this application lies in the way it combines technical procedure with situational pressure and communication. Learners must not only perform compressions correctly; they must also involve bystanders, initiate emergency calls and organise the retrieval of an AED. In this sense, the application trains both procedural competence and structured action under stress. Public demonstrations during the evaluation phase further confirmed that the scenario remains relevant even for experienced professionals, which supports its transfer potential for both initial education and continuing training.

The second core application is the VRoom of Horror. This application addresses patient safety by placing learners in a virtual environment where they must identify hazards and errors. The error pool was generated with the support of technical experts from nursing education across partner countries and reflects real risk situations from daily care practice. This immersive scenario can be repeated, varied and used to strengthen observation, risk perception and structured situational judgement. Because recognised and unrecognised errors are displayed clearly after each run, the application also supports feedback and reflection.

2.4.3. Good-practice applications and broadening the educational scope

In addition to the project-developed tools, Pilot 3 used selected good-practice applications from the project's wider mapping work. One prominently described example is Human Anatomy VR. Its strength lies in spatial visualisation, the layering and exploration of anatomical structures, and the intuitive user guidance that makes it suitable for heterogeneous learning groups.

The use of applications such as Human Anatomy VR expands the didactic scope of the VR solutions tested within the project. While project-developed applications primarily address action-oriented and safety-related scenarios, Human Anatomy VR specifically supports the spatial understanding of anatomical structures and is therefore particularly suitable for content areas that are strongly visual in nature.

This demonstrates that VR in care education is not only relevant for simulations or error-based scenarios, but also for the clear and intuitive teaching of complex subject matter. For educational institutions, this means that different types of VR applications can be meaningfully combined depending on the learning objective

2.4.4. Diversity of implementation

The educational integration model was tested through a variety of formats in several countries. This diversity of implementation contexts is one of the strengths of the solution. It demonstrates that VR in care education is not tied to a single organisational environment. It can be introduced in schools, universities, hospitals, conferences and regional outreach formats, provided that onboarding and facilitation are adapted to the audience. The use of mirrored displays and local support staff further shows that immersive learning can be opened up to observers and blended with conventional teaching situations.

2.4.5. The German lending model as an integration pathway

The most elaborate implementation pathway within the pilot has been developed at OTH Regensburg. Here, the project combines public demonstration events with a structured six-week lending model for nursing education institutions. This model has a high transfer value because it goes beyond the mere provision of hardware and establishes a structured, scientifically supported testing framework involving educators.

If suitable applications first had to be independently identified, selected, tested, and potentially replaced, providing VR headsets alone would be of limited practical use for educational institutions. An added key value of the model therefore lies in the combination of hardware availability, a didactically grounded set of applications, and expert guidance during implementation in the educational context. This enables institutions to assess whether and how VR scenarios can be meaningfully integrated under real-life conditions as an introduction to topics, as preparation for practical exercises, or as a deeper learning environment. At the same time, the model helps to identify relevant structural conditions and barriers, such as available teaching time, data protection requirements, supervision effort, and curricular alignment.

2.4.6. Quantitative and qualitative findings

The solution provides positive aspects at several levels. Quantitative evaluation data shows the CPR application was rated very positively by care education participants and by respondents overall. Human Anatomy VR also receives very favorable ratings, with the visualization of content being highlighted in particular. Across applications, positive assessments focus on presentation and visualization, interactivity and didactic approach.

The qualitative findings add depth to these results. Interviews across partner countries emphasized recurring structural conditions such as staff shortages, workload, organisational pressure and the need for didactic clarity. VR is particularly useful when it enables standardised, safe and repeatable training or when it can visualise complex procedures and structures in a vivid way. At the same time, the reports repeatedly warn against technology-driven use without clear educational purpose. One of the clearest conclusions is that didactics must come before technology.

2.4.7. Low-threshold 360-degree scenario development

An important complementary element of the solution emerged from the project’s co-creation hackathon. Using PaneoVR, participants created three 360-degree VR scenarios on hygienic hand disinfection, pain management and manual blood pressure measurement. These scenarios are significant because they illustrate a lower-threshold path into immersive content development. Instead of relying on complex 3D modelling and specialist programming, teams used 360-degree images, audio, hotspots, checklists and questions to create structured learning environments linked to real care situations.

For care education institutions, this element of the solution is especially relevant. It demonstrates that immersive educational innovation does not have to depend exclusively on high-end custom development. With suitable authoring tools and pedagogical support, teachers and interdisciplinary teams can create, adapt and maintain their own scenario-based content. This widens the sustainability of the solution because it turns institutions from passive users into potential co-developers of immersive materials.

2.4.8. Didactic recommendations

The use of VR in education should be consistently aligned with clearly defined learning objectives, such as improved confidence in action, more structured decision-making, enhanced risk perception, strengthened observation competence, improved spatial understanding, and visual comprehension. The educational value does not arise from the technology itself, but from its alignment with a specific learning goal and a clearly structured teaching and learning setting.

In this sense, the intended learning outcomes should always be made explicit. Depending on the educational context and scenario design, VR-based learning can contribute to greater confidence in handling professional situations, support more structured and situation-appropriate decision-making, sharpen the perception of risks and critical cues, and foster spatial understanding of environments, processes, or anatomical relations. In addition, the immersive nature of VR can provide a strong basis for reflective learning, particularly when experiences are systematically processed in a guided debriefing.

One-time use often has limited didactic value, as initial sessions are strongly shaped by orientation processes, technical familiarisation, and novelty effects. More sustainable learning outcomes can be achieved when VR applications are used repeatedly and embedded within structured teaching sequences. These typically include preparatory introductions, guided use of the application, and subsequent reflection and evaluation phases.

Structured debriefing is essential in this context. Only through guided reflection can the immersive experience be transformed into reflective and transferable knowledge. This includes both subject-specific interpretation and the joint reflection of actions, perceptions, and potential sources of error. In particular, debriefing can strengthen learners' reflective capacity by helping them critically examine their decisions, recognise alternative courses of action, and connect the virtual experience to future real-world practice.

Another important aspect is the alignment between the application, the target group, and the teaching context. A higher level of technical sophistication does not automatically lead to better learning outcomes. What matters is whether the application is content-relevant, appropriate to the learners' prior knowledge and level of training, and used in a didactically meaningful way.

2.4.9. Curricular and institutional integration

At the curricular level, VR should be understood as a complementary tool rather than a replacement for existing teaching standards. Differences between VR scenarios and local procedures need to be made transparent and used as opportunities for reflection, rather than being treated solely as shortcomings. Adapting VR use to institutional and curricular frameworks supports sustainable implementation.

Curricular integration can be structured through clearly defined teaching units that combine introduction, guided use of VR applications, and structured reflection phases. In this way, VR can be embedded into existing modules as part of broader teaching sequences, rather than being treated as a standalone activity.

Successful curricular and institutional integration also depend on the early involvement of educators. Teachers and trainers need time to become familiar with the devices, the pedagogical role of the applications, and the practical conditions of use. Continuous support during the testing and implementation phase facilitates this process and supports informed decisions about how VR can be integrated into existing teaching structures.

Institutional integration further involves organizational considerations such as scheduling, responsibilities, technical preparation, hygiene, data protection, and supervision requirements. Only when these aspects are taken into account can VR move from an one-off innovation to a sustainable component of established educational structures.

2.4.10. Organizational and operational implementation

On the organizational side, the solution strongly supports flexible implementation models. Comprehensive permanent infrastructure is not always necessary. Mobile, temporary or loan-based formats can provide a resource-sensitive and realistic path to adoption, especially when responsibilities, scheduling and technical preparation are clear. Early involvement of teachers is critical, as is the presence of facilitation and support during first uses.

The solution also makes clear that successful implementation requires attention to routine operational issues: charging devices, managing hygiene, preparing rooms, coordinating time slots, defining supervision arrangements and collecting structured feedback. These tasks are sometimes underestimated, but they are decisive for whether an institution experiences VR as a helpful addition or as an organizational burden.

2.4.11. Transfer value and future use

The transfer value of the “VR in Care Education” solution does not lie primarily in the availability of multiple applications, but in the fact that their use has been tested and reflected under real educational conditions. The key factor is not the technology itself, but the conditions under which it can be meaningfully applied in educational settings. This includes, in particular, the careful selection of appropriate applications, the active involvement of educators, curricular alignment, and suitable organizational and technical frameworks.

The solution should therefore not be understood as a universally applicable model that can be transferred independently of context. Its value lies in providing orientation: it highlights which types of applications appear suitable for specific educational purposes, what kind of support structures are required, and which barriers typically emerge during implementation. These include, for example, time constraints for educators, data protection requirements, supervision effort, technical conditions, and the question of how applications can be integrated into existing teaching formats.

For nursing schools, universities, hospitals, and continuing education providers, the relevance of the solution lies in demonstrating that the use of VR cannot be reduced to the provision of hardware or isolated applications. Educational value only emerges when applications are selected and used in a didactically grounded way, supported by expertise, and meaningfully embedded into teaching structures.

2.4.12. Practical pathway for new adopters

A realistic adoption pathway does not begin with a broad set of applications, but with a small number of carefully selected scenarios for which a clear didactic value can be identified. The starting point should therefore not be the available technology, but the intended learning objectives and the question of which applications are actually suitable to support them. Particularly relevant are scenarios in which VR offers a clear advantage over conventional teaching formats, such as highly visual topics, safety-critical observation tasks, or emotionally demanding situations.

Equally important is the involvement of a limited group of educators who are given the opportunity to familiarize themselves with the applications, their didactic potential, and their practical requirements. This can be followed by a guided initial testing phase with learners, which should be reflected not only in terms of learning outcomes, but also in terms of organizational feasibility. Relevant aspects include scheduling, supervision, technical preparation, hygiene, data protection, and curricular fit.

Only on this basis should decisions be made about whether and how to expand the use of VR. Sustainable adoption does not result from large-scale rollout at an early stage, but from a step-by-step process in which didactic suitability, practical feasibility, and institutional conditions are jointly assessed.

2.4.13. Sustainability, continuation and scale-up

The long-term value of the “VR in Care Education” solution lies in its modularity and flexibility. Institutions are not required to adopt all applications, formats, or development approaches at once. Instead, they can begin with a limited number of use cases, combine these with a manageable number of devices and clearly defined learning objectives, and expand gradually based on experience.

This approach reflects a process-oriented understanding of implementation, in which repeated testing and adaptation precede any broader scaling. Sustainability in this context does not result from the initial introduction of technology, but from its continued didactic use and institutional anchoring over time.

The solution also supports continuation by offering different pathways for further development. Institutions may continue to use selected applications, adapt them to their own teaching contexts, refine their didactic concepts, or develop new scenario-based content using accessible tools. At the same time, the experiences and materials generated can serve as a basis for further collaboration, funding initiatives, or the development of support structures.

In this sense, sustainability is not defined by the persistence of specific tools, but by the ability of institutions to integrate, adapt, and further develop immersive approaches within their own educational practice.

2.4.14. Example adoption pathway for a care education institution

A realistic adoption pathway for a nursing school or training provider begins with the selection of one or two teaching units in which immersive learning can clearly add value. Typical starting points are emotionally demanding emergency situations, observation-based safety training or strongly visual topics that students often find difficult in purely verbal instruction. Once these units have been selected, a small educator team can test the applications, adapt the teaching sequence and prepare learners for first use.

The next stage is a supervised pilot in which the institution not only observes student reactions, but also reflects on timing, room setup, hygiene, supervision and the role of debriefing. This is the point at which the educational and organizational dimensions come together. If the institution experiences the format as useful and manageable, the same structure can then be repeated with additional groups or supplemented with low-threshold local scenario development. The VReduMED experience suggests that this stepwise progression creates stronger and more sustainable adoption than trying to introduce a large set of applications all at once.

3. Low threshold VR prototyping for care education

The following section presents 360° VR learning scenarios that were created during the organised hackathon pilot activity. Each scenario was designed to address a concrete learning need in nursing education and demonstrates how immersive 360° environments can support the acquisition of procedural, communicative, and clinical reasoning skills. The examples illustrate how VR can translate real-world care situations into accessible, safe and repeatable learning experiences.

3.1. Technical Solutions

3.1.1. PaneoVR

PaneoVR was used as the primary authoring tool for creating VR training scenarios. The platform is a web-based toolkit specifically designed for the development of immersive 360° VR learning environments and focuses on easy accessibility and intuitive handling. The web editor allows users to design and structure scenarios visually, without requiring any programming knowledge. Content is created by combining 360° photos or videos with text elements, audio recordings, and interactive components directly within the editor.

All scenario content was produced by the participants themselves. Using 360° cameras, the teams captured authentic practice environments, procedural workflows, and simulated care situations. This approach offers several advantages: greater realism and authenticity, direct content control by subject matter experts, independence from external production providers, and a more cost and resource efficient development process.

Interactive elements such as hotspots, multiple choice questions, navigational markers, and checklists can be added via drag and drop. Scene transitions are easy to configure, ensuring clear structure and intuitive navigation within the VR environment. The finalized scenarios can be accessed through universal player applications on VR headsets, tablets, or desktop devices without requiring additional exporting or technical compilation steps.

PaneoVR supports major VR headsets and standard devices while relying on 360° video material as its primary visual foundation. This eliminates the need for complex 3D modeling or specialized programming work and significantly lowers the barrier for teaching teams who wish to produce or adapt VR training content on their own.

3.2. Developed 360° VR scenarios

3.2.1. Scenario 1: Hand disinfection

This 360° VR scenario demonstrates the correct procedure for hygienic hand disinfection according to evidence based standards. Recorded in a real care environment, the scenario embeds the individual steps within an authentic clinical context. Interactive hotspots provide information on indications, exposure times, common mistakes, and decision making moments. The aim of the scenario is to strengthen procedural confidence and raise awareness for infection prevention in everyday clinical practice.

Figure 6: “Hygienic Hand Sanitization” scenario developed during the hackathon using PaneoVR, showing five indications for hand disinfection. (photo: OTH Regensburg)

3.2.2. Scenario 2: Pain management

This scenario focuses on the assessment and management of a patient experiencing postoperative pain. The case involves a patient recovering from a tibia fracture who reports undefined and increasing abdominal discomfort. Learners are guided to select the appropriate pain assessment tool and perform the necessary steps to respond correctly to the situation. The scenario emphasizes clinical reasoning, structured assessment, and confidence in handling pain related cases in a realistic care environment.

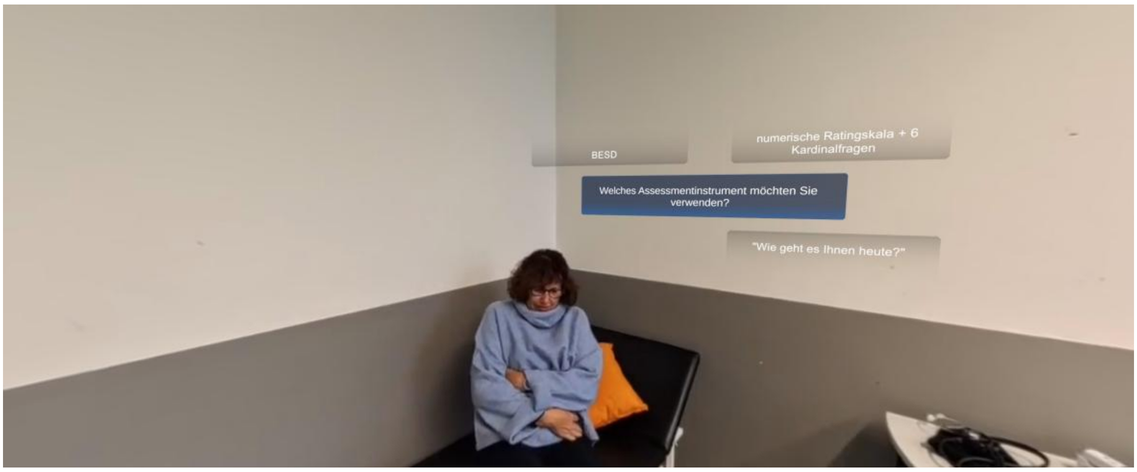

Figure 7: “Pain Management” scenario developed during the hackathon using PaneoVR, showing questions for pain assessment of patients. (photo: OTH Regensburg)

3.2.3. Scenario 3: Manual Blood pressure measurement

This 360° VR scenario teaches the correct procedure for manual blood pressure measurement, including guiding a family member through the process. The scenario covers preparation, selection of materials, patient positioning, correct cuff placement, auscultation, and interpretation of the readings. Interactive elements highlight potential pitfalls and guide learners through each step of the process. The goal is to strengthen methodological accuracy and support standardized performance in practical training settings.

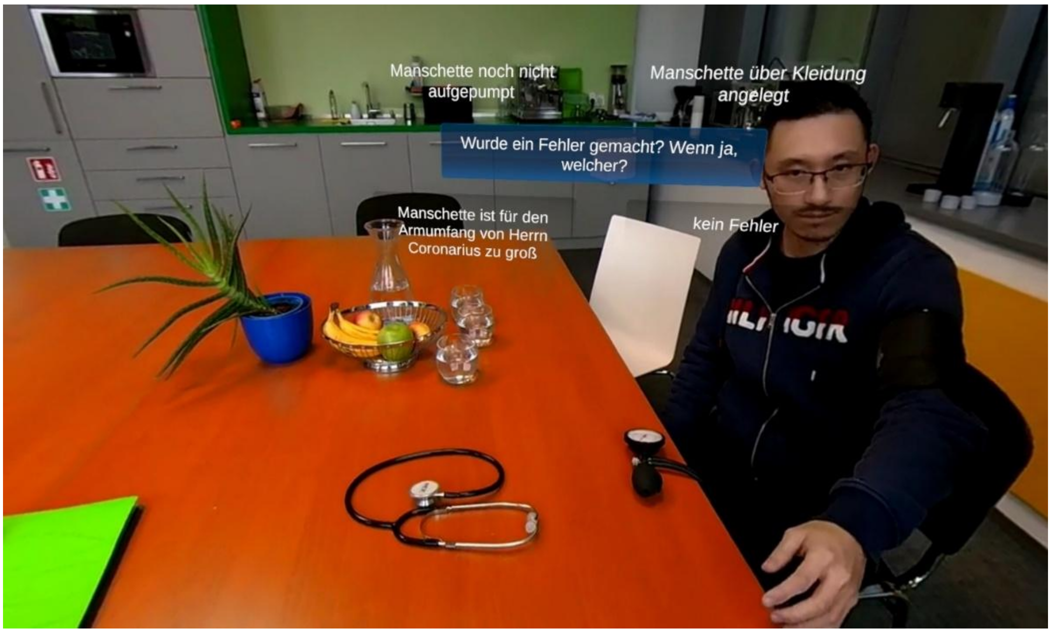

Figure 8: “Pain Management” scenario developed during the hackathon using PaneoVR, asking the user if an error was made during manual blood pressure measurement (photo: OTH Regensburg)

3.3. Sustainability & Long-term perspective

A key aspect of the development approach was ensuring that the results of the hackathon could be used, adapted, and further developed beyond the event itself. The goal was not only to create three prototype VR scenarios, but also to enable participants and educational institutions to continue working with the materials independently.

- Open availability: All applications created during the hackathon were made fully available to participants after the event. This unrestricted access ensures that teams can continue experimenting with the scenarios, integrate them into training sessions, or use them as reference material for future developments.
- Potential for further development: Because the scenarios were built using an accessible, low threshold authoring tool, participants are able to maintain and further develop the content without external support. Institutions can adapt the scenarios to fit their own teaching contexts, update them according to instructional needs, or expand them with additional scenes and interactions. This flexibility removes licensing or technical barriers and supports long term integration into nursing education programs.
- Resource efficiency: Using a user friendly authoring tool such as PaneoVR strengthens the reusability of learning materials and significantly reduces the entry threshold for new teams or institutions. Since no specialized programming knowledge or complex 3D asset creation is required, educational organizations can produce their own 360° content with minimal resources. This increases both scalability and sustainability, allowing immersive learning materials to be developed and maintained in a cost effective way.

4. Conclusion

This document shows that the value of Virtual Reality in care education and related innovation contexts does not lie in the technology alone, but in the way it is selected, introduced and embedded in practice. Across the VReduMED project, VR was explored not as an isolated digital novelty, but as a tool that can support learning, collaboration and content development when its use is aligned with clear objectives, appropriate support structures and realistic institutional conditions.

The four components presented in this output together form a coherent and transferable pathway for adoption. Mobile VR Labs create manageable access to immersive technologies through practical infrastructure and support models. Innovation Workshops in VR demonstrate how immersive environments can strengthen collaborative exchange and joint idea development across locations. VR in Care Education shows that immersive applications can provide educational value when they are didactically grounded, tested under real conditions and integrated into existing teaching structures. Low-threshold VR prototyping further highlights that institutions can also create and adapt their own learning scenarios using accessible tools and resource-sensitive approaches.

A key message of this output is that successful implementation does not begin with technology procurement, but with educational purpose, organisational preparedness and step-by-step testing. The project findings underline that VR is most meaningful where it addresses learning situations that are difficult to realise in conventional formats, supports structured reflection and practice, and can be introduced in ways that remain feasible for institutions over time. This makes the presented approaches especially relevant for organisations seeking not only innovation, but also practical and sustainable pathways into immersive learning.

At the same time, the document makes clear that there is no single model for adoption. Different institutions will require different entry routes, levels of support and forms of integration. The strength of the VReduMED approach lies therefore in its flexibility: it provides tested models, practical guidance and transferable principles that can be adapted to local needs and contexts. In this sense, the output is intended not as a fixed blueprint, but as an orientation framework for informed experimentation, implementation and further development.

Overall, the document contributes to a more realistic understanding of how immersive technologies can be used in care education and cross-sector collaboration. It shows that meaningful innovation emerges where technological possibilities are combined with didactic clarity, institutional feasibility and openness to gradual development. By bringing these dimensions together, the output offers a practical basis for future transfer, continuation and scale-up beyond the project itself.