VIRDUAL

Boosting digital innovation in VET by integrating Extended Reality to train work-readiness skills for work-based learning programmes

WP2: Training Curriculum and Learning Units Plan on training work-readiness skills for WBL through XR

PR3: Learning Units Plan on training work-readiness skills for Work Based Learning (WBL) through XR

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Introduction

Work-Based Learning (WBL)

Work-Based Learning (WBL) eases the transition from education and training to work, and evidence shows that countries with a strong VET and WBL system have lower levels of youth unemployment (European Alliance for Apprenticeships). Nevertheless, recent reforms of WBL in European countries puts the emphasis on establishing high-quality and higher-level WBLs, leaving behind those students who are less qualified or have lower levels of competence. For many young people, a work-based learning (WBL) opportunity as part of a VET programme is their first experience in the world of work. Finding a welcoming and supportive work environment with good learning opportunities can be very motivating and contribute to attaining a qualification.

However, WBL can also be discouraging and lead to dropout. This may be due to a mismatch between the learners' expectations and the reality of the profession, or to a lack of skills in young learners. Dropout from WBL initiatives is a serious challenge. Targeted help for learners at risk of dropout is rarely available in most countries and low-skilled learners often have limited opportunities to develop their skills further through education and training. Many find themselves caught in a "low-skills trap" that condemns them to low-level positions or to having low expectations of entering the labour market. Training of learners in WBL relies on VET Teachers from the educational side and on In Company Trainers from the company's side. With the right tools, they will be able to engage low-skilled learners in skills development, contributing to avoiding WBL dropout and turning the work experience into a success.

Virdual Learning Units Plan

The Learning Units Plan serves as a framework designed to enhance work-readiness skills through Work-Based Learning (WBL), utilising the transformative potential of Extended Reality (XR) technologies. This plan is specifically crafted for Vocational Education and Training (VET) teachers and in-company trainers, equipping them with innovative methodologies and practical tools to develop the competencies required in today's rapidly evolving workforce.

The Learning Units Plan is part of a broader initiative under Work Package 2 (WP2), focusing on achieving the third specific objective (SO3) of the project: the design of a comprehensive, modular curriculum that integrates cutting-edge XR technologies with work-readiness training. This initiative aims to enhance the teaching capabilities of VET professionals and in-company trainers by enabling them to create immersive, effective learning environments that closely mirror real-world work experiences.

Modules

This plan features seven modules, each developed by a partner, addressing key areas essential for successful XR-driven training:

1. **Introduction to XR Technology** - An overview of XR technologies and their application in training environments.
2. **Computing Competencies in XR Technology** - Technical skills needed to operate and innovate within XR environments.
3. **Pedagogies in Extended Reality for Work-Based Learning** - A focus on the teaching methodologies that best leverage XR technologies.
4. **Inclusive Use of XR - Ensuring accessibility and inclusivity in XR applications.**
5. **XR Regulation and Government Policies** - Understanding the legal and regulatory framework governing XR.
6. **Setting and Maintaining XR Infrastructures** - The practicalities of establishing and maintaining XR systems in educational settings.
7. **Stakeholder Communication** - Strategies for effective communication and collaboration in XR-driven projects.

Each module has been designed to align with the Learning Outcomes (LOs) outlined in the project's Competence Framework (PR2) of WP2, ensuring that all learning activities contribute to the development of specific, measurable skills. The curriculum encourages the development of critical skills such as information processing, critical thinking, evaluation, and problem-solving, providing learners with the ability to adapt to diverse workplace scenarios.

The Learning Units Plan outlines a structured approach to training that balances theoretical knowledge with practical application. Each module comprises three lessons, progressively moving from foundational concepts to case studies and best practices, culminating in actionable advice for integrating these skills into everyday professional activities. This approach not only facilitates learning but also ensures that participants can effectively translate theoretical knowledge into practice, reinforcing the key concepts needed for work-based learning in an XR-driven environment.

The plan also emphasises the role of innovation in shaping the future of vocational training, highlighting the increasing relevance of XR technologies in bridging the gap between education and real-world applications. By embracing these innovations, VET teachers and trainers are positioned to deliver more immersive, engaging, and effective training experiences.

Methodology

The Learning Units Plan adopts a structured, learner-centered approach aimed at equipping Vocational Education and Training (VET) teachers and in-company trainers with the necessary theoretical and practical skills to deliver Work-Based Learning (WBL) through Extended Reality (XR) technologies. This methodology combines innovative teaching strategies with competency-based frameworks, ensuring that the training is both effective and aligned with the demands of a modern workforce.

Each of the seven modules in the plan is organised into three distinct lessons, which together guide learners from foundational knowledge through to advanced practical applications:

1. **The first lesson** in each module introduces the key concepts and terminologies, laying a theoretical foundation for the learners. This lesson sets the context

and provides an overview of the module's main ideas, ensuring that learners understand the core principles they will build upon in subsequent lessons.

2. **The second lesson** focuses on the practical application of these concepts, using real-world case studies, activities, and examples of best practices. This lesson encourages learners to engage directly with the material, applying theoretical knowledge to realistic scenarios that reflect the challenges and opportunities they might encounter in work-based learning environments. By analysing these examples, learners can better understand how to implement XR technologies effectively in training settings.

3. **The third lesson** in each module provides practical tips and strategies for integrating the knowledge gained into daily professional practice. This lesson is designed to be highly actionable, offering learners clear guidance on how to apply what they have learned in real-world contexts. Through this progression—from theory to application to practical advice—each module ensures that participants can not only understand but also implement the skills and knowledge they acquire.

Virdual Competence Framework

The methodology is firmly grounded in the Competence Framework (PR2), which defines the Learning Outcomes (LOs) for each module. These outcomes focus on key skills essential for work-readiness in XR environments, including information processing, critical thinking, evaluation, problem-solving, and inquiry-based learning. Each module is developed with these outcomes in mind, ensuring that the training is focused on fostering skills that are both relevant and immediately applicable in work-based learning environments. The lessons are designed to challenge learners to process information effectively, think critically, make informed decisions, and solve problems in dynamic, XR-driven scenarios.

Active Learning

A key feature of the methodology is the use of active learning techniques. Throughout the lessons, participants are encouraged to engage in discussions, analyse case studies, and participate in role-plays or simulations that replicate real-world challenges. For example, case studies are used to illustrate how XR technologies have been successfully implemented in vocational training, while interactive discussions help deepen learners' understanding of the material. Role-playing activities further reinforce these concepts by allowing participants to practise applying their knowledge in simulated work environments, promoting a deeper, experiential understanding of the content.

Blended learning

The blended learning approach is another integral part of the methodology. By combining face-to-face instruction with digital learning tools, including XR-based simulations, the curriculum creates a flexible and adaptive learning environment. This blended model allows for a diverse range of learning styles to be accommodated, ensuring that both theoretical knowledge and practical skills are developed in tandem. Digital tools enhance the immersive experience, helping learners to visualise and interact with complex concepts, while traditional instructional methods, such as presentations and discussions, provide the necessary theoretical grounding.

Assessment & Evaluation

Each module also includes a comprehensive assessment and evaluation process to ensure that the Learning Outcomes are met. Assessments are designed to evaluate both theoretical understanding and practical application. These may include quizzes to test comprehension of the key concepts introduced in each lesson, as well as practical assessments that require participants to apply their knowledge in simulations or real-life scenarios. Additionally, reflective exercises encourage learners to think critically about how they can implement the skills they have acquired, fostering continuous improvement and self-assessment.

Virdual Partnership

The development of the content for the Learning Units Plan is a collaborative effort among the project's partners, each of whom is responsible for creating one module. These partners use the Competence Framework to guide the development of their lesson plans, ensuring that all modules are consistent in structure and aligned with the overall learning objectives.

In summary, the methodology for the Learning Units Plan is designed to ensure that participants not only acquire the knowledge and skills needed to use XR technologies in work-based learning but also feel confident in applying these skills in real-world settings. The structured approach, active learning techniques, blended learning model, and rigorous assessment process all contribute to a comprehensive training experience that prepares VET teachers and in-company trainers for the challenges and opportunities presented by XR in vocational education.

Learning Unit Plan

Module 1: Introduction to XR technologies

Overview

This module provides a comprehensive introduction to XR technologies. It covers the foundational principles, applications, and potential challenges of Virtual Reality (VR), Augmented Reality (AR), and Mixed Reality (MR) in work-based learning contexts. The aim is to help vocational education and training (VET) teachers and in-company trainers integrate XR effectively into their teaching practices.

Lesson 1 introduces the key concepts of XR technology, laying the foundation by explaining the basic principles of VR, AR, and MR and their applications across industries.

Lesson 2 focuses on practical applications through case studies and examples of best practices that show how XR can be successfully implemented.

Lesson 3 provides practical tips for integrating XR technology into daily practices. It offers actionable strategies to help VET teachers and trainers apply XR tools in their instructional activities.

Methodology

The methodology for this module is grounded in a learner-centered approach, combining theoretical instruction with practical applications to ensure a comprehensive understanding of XR technologies. The lessons utilise a mix of discussions, case studies, and hands-on activities, allowing learners to engage actively with the material.

Theoretical content is introduced through structured overview presentations of information, while interactive discussions and case study analyses provide opportunities for learners to critically reflect on the material. Practical activities, such as simulations and role-play, help learners apply the concepts in real-world scenarios. This balanced approach ensures that participants not only gain knowledge but also develop the skills needed to integrate XR into their training environments.

Lesson Plan

This learning unit is composed of three lessons:

Lesson 1: Introduction (Fundamentals) to XR Technology
Lesson 2: Practical Application of XR Technology
Lesson 3: Implementation and Integration of XR Technologies

Lesson 1	**Introduction (Fundamentals) to XR Technology**
Duration	45 minutes
Lesson content	**1. Lesson Introduction** • **Overview and Goals:** This lesson introduces participants to the foundational concepts of XR technologies, including VR, AR, and MR. It sets the stage for understanding how these technologies can be applied in work-based learning. Participants will explore definitions, key features, and practical uses of each XR technology in different industries. **2. Learning Outcomes (from PR2 – Competence Framework):** • By the end of this lesson, learners will: ○ Understand foundational theoretical concepts related to XR technology:

- Apply theoretical knowledge to analyse and discuss practical scenarios
- Engage critically with the material and contribute effectively to discussions.

3. Developing Theoretical Contents

- **Description of Learning Activities:**
    1. **Overview (10 minutes):** This section introduces the foundational concepts of XR technology, including Virtual Reality (VR), Augmented Reality (AR), and Mixed Reality (MR). The key differences between these technologies will be highlighted, along with their potential applications across various industries, with a particular emphasis on education and training. Real-life examples will demonstrate how XR has been used to create immersive environments that enhance learning experiences. Visual aids, such as diagrams and short videos, will help clarify the technological mechanisms behind XR and its role in Work-Based Learning (WBL), emphasising how XR can simulate real-world scenarios for practical skills development.

    2. **Interactive Discussion (15 minutes):** During this group discussion, participants will explore the benefits and limitations of XR technologies. The facilitator will prompt learners to consider the impact of XR on engagement, accessibility, and learning retention, as well as potential challenges like cost, technical infrastructure, and user training. Learners will be encouraged to share their own perspectives, drawing on their industry-specific experiences or expectations. This discussion will foster a deeper understanding of how XR can transform learning environments while acknowledging the obstacles that may need to be addressed for successful implementation.

    3. **Case Study Analysis (15 minutes):** In this section, learners will analyse a case study showcasing the application of XR technologies in educational and professional settings. These case studies will highlight successful uses of XR in industries such as healthcare, manufacturing, and vocational training. The analysis will focus on how XR has been integrated into WBL,

with learners examining the processes, outcomes, and challenges associated with these implementations. The case study analysis will encourage learners to think critically about the scalability of XR technologies and how they can be adapted to suit different training environments. Learners will also discuss possible improvements or alternatives to the approaches presented in the case studies, promoting problem-solving and innovation.

- **Training Method Used:**
  - **Lecture:** Present theoretical content using visual aids and examples to enhance understanding.
  - **Discussion:** Encourage active participation and critical thinking through facilitated discussions.
  - **Case Study Analysis:** Promote application of theoretical knowledge through group analysis and problem-solving exercises.

- **Materials/Equipment Required for (Face-to-Face) Implementation:**
  - Projector and screen
  - Whiteboard or flipchart for brainstorming and illustrations
  - Handouts or digital copies, if applicable
  - Case study materials (digital)
  - Writing materials for note-taking and group activities

4. References:

- What is extended reality (XR)? (2024, March 4). The Interaction Design Foundation
- Lowood, H. E. (2024, July 27). Virtual reality (VR) | Definition, Development, Technology, Examples, & Facts. Encyclopedia Britannica.
- A. (2024, July 1). Augmented Reality (AR): Definition, examples, and uses. Investopedia
- Demystifying the Virtual Reality Landscape.
- An introduction into extended reality (XR): the next level in 2020 vision.
- Gupta, A. (2024, June 17). Future of Learning: Role of Extended Reality in education. Binmile - Software Development Company.

- Kouzi, M. E. (n.d.). Advantages and disadvantages of using augmented reality in the classroom. Pressbooks.

5. Assessment:

- **Multiple Choice Questions (5-8):**
    - Multiple-choice questions to assess comprehension of XR principles.

Conclusion:

Summarise Key Points:

- Recap the main concepts introduced, such as the definitions of XR, VR, AR, and MR, along with their fundamental principles.
- Highlight the applications of these technologies in various industries, particularly focusing on their relevance to work-based learning (WBL) environments.

Reinforce Importance:

- Emphasise the significance of understanding these theoretical concepts as foundational knowledge for applying XR technologies effectively.
- Discuss how this understanding will support the practical applications and discussions in the subsequent lessons.

Engage Learners:

- Invite learners to reflect on their own experiences with technology and consider how XR might enhance their specific fields or industries.
- Pose an open-ended question to encourage them to think critically about the potential challenges they may encounter when integrating XR technologies into their practices.

Assessment Reminder:

- Remind learners to complete any assessments or reflective activities related to the lesson content, reinforcing the need for self-evaluation and continuous learning.

Lesson 2	**Practical Application of XR Technology**
Duration	45 minutes
Lesson content	**1. Lesson Introduction** • **Overview and Goals:** This lesson focuses on the practical applications of XR technologies in real-world scenarios. Participants will engage in role-playing activities and analyse case studies to explore how XR can enhance vocational education and training (VET). By actively participating in simulations and discussions, learners will gain insights into the tangible benefits and challenges of implementing XR in training settings, preparing them to leverage these technologies effectively in their own practices. **2. Learning Outcomes:** • By the end of this lesson, learners will: ○ Grasp how the theoretical knowledge of XR (Extended Reality) technologies—comprising Virtual Reality (VR), Augmented Reality (AR), and Mixed Reality (MR)—can be effectively applied in various real-world settings. ○ Critically examine detailed case studies showcasing successful XR implementations across different industries ○ Demonstrate the ability to apply XR technologies in simulated or role-play scenarios, reflecting practical understanding and the ability to transfer theoretical concepts into actionable skills. **3. Developing Practical Application and Case Studies** • **Description of Learning Activities:** 1. **Activity: Role Play or Simulation (10 minutes):** ▪ Participants will engage in a simulation where they interact with an XR-based vocational training system. In this role-playing scenario, learners will assume various roles relevant to a specific industry and navigate through a simulated training session. This exercise will allow them to experience firsthand how XR technologies can facilitate skill acquisition, improve decision-making, and enhance learner engagement. Facilitators will guide the role play, providing prompts and scenarios that challenge

participants to apply their theoretical knowledge in a practical context.

2. **Case Study Analysis (10 minutes):** In this section, learners will examine successful implementations of XR technologies in different industries through carefully selected case studies. Each group will receive a different case study to analyse, focusing on the following aspects:

    - The XR technology used (e.g., VR, AR, MR) and its specific application in training.
    - The outcomes achieved through the implementation, such as improved training effectiveness or learner engagement.
    - The challenges faced during implementation and how they were overcome.
    - After reviewing their case studies, groups will present their findings to the class, facilitating a broader discussion on best practices and lessons learned.

3. **Examples of Best Practices (10 minutes):**

The facilitator will present a series of best practices for integrating XR into training programs, drawing from the case studies analysed earlier. This presentation will include:

- Successful strategies employed by organisations that have effectively implemented XR, such as user-centred design principles and continuous feedback loops.
- Key considerations for successful integration, including technology selection, learner needs assessment, and staff training.
- Examples of tools and resources available for educators to utilise when implementing XR, such as software platforms, content libraries, and professional development opportunities. Participants will be encouraged to reflect on how these best practices can be adapted to their specific contexts.

- **Training Method Used:**

- **Activity-Based Learning:** This method involves interactive simulations that allow learners to apply their theoretical knowledge in practical situations, fostering a deeper understanding of XR applications in vocational training.
- **Case Study Discussion:** Collaborative analysis of real-world case studies promotes critical thinking and helps learners identify effective strategies and potential challenges in XR implementation.
- **Presentation:** The facilitator will showcase best practices enhancing understanding and providing practical examples for learners to consider.

- **Materials/Equipment Required for Face-to-Face Implementation:**
  - Projector and screen if applicable
  - Handouts or digital copies of case studies and examples
  - Whiteboard or flipchart for brainstorming and group discussions
  - Writing materials for note-taking and group activities

4. References:

- Yigitbaba. (2023, March 30). 15 Examples of the use of mixed reality in education.

5. Assessment:

- **Discussion and Reflection (Adapted to Face-to-Face):**
  - Group reflection on case studies to reinforce key concepts.

Conclusion:

Summarise Key Points:

- Recap the practical applications of XR technologies discussed during the lesson, emphasising the role of XR in enhancing vocational education and training.
- Highlight the insights gained from the activity and case study analysis, focusing on how these experiences illustrated the benefits and challenges of implementing XR in real-world settings.

Reinforce Importance:

- Stress the significance of understanding how XR can be utilised effectively in training environments. Emphasise that

	applying these technologies can lead to improved engagement, retention, and skill acquisition among learners. ● Discuss the critical need for educators and trainers to stay abreast of emerging technologies like XR to provide relevant and effective training solutions. Engage Learners: ● Invite participants to consider the specific XR tools and strategies they might want to explore further in their own work. Ask them to think about potential barriers they might face in implementation and how they might address these challenges. ● Pose an open-ended question to stimulate ongoing reflection, such as: "What are some innovative ways you can envision using XR in your own training practices?"

Lesson 3	**Implementation and Integration of XR Technologies**
Duration	45 minutes
Lesson content	**1. Lesson Introduction** ● **Overview and Goals:** ○ This lesson provides learners with practical tips and strategies for integrating XR technologies into their teaching practices. It covers critical aspects such as infrastructure needs, content adaptation, and effective solutions for common challenges encountered during XR implementation. By the end of the session, learners will have a clearer understanding of how to leverage XR technologies to enhance their educational programs and improve training outcomes. **2. Learning Outcomes:** ● By the end of this lesson, learners will: ○ Grasp the essential components and steps required to effectively integrate XR technologies into educational training environments. ○ Assess critical factors, such as infrastructure that impact the successful integration of XR technologies.

- Recognize common challenges encountered during XR implementation and explore strategies to effectively overcome these challenges.

3. Developing Implementation Tips

- **Description of Learning Activities:**

1. **Presentation of Tips (15 minutes):**

In this segment, the facilitator will present an overview of the essential components required for successful XR integration. Topics covered will include:

- Infrastructure Needs: Discuss the necessary hardware and software components, such as XR devices (VR headsets, AR glasses), high-speed internet connectivity, and supportive IT infrastructure. Address the importance of selecting appropriate XR tools based on specific educational goals and learner needs.
- Software Requirements: Introduce various software platforms that can facilitate XR content delivery, such as learning management systems (LMS) that support XR integration, content creation tools, and analytics software for tracking learner engagement and outcomes.
- Adaptation Strategies: Highlight key strategies for adapting existing curriculum materials for XR environments, including interactive elements, multimedia resources, and immersive simulations that align with learning objectives.

2. **Group Discussion and Brainstorming (15 minutes):**

Participants will break into small groups to brainstorm specific strategies for implementing XR technologies in their own educational settings. Facilitators will prompt discussions with guiding questions such as:

- What XR technologies do you currently have access to, and how might they enhance your training programs?
- How can you adapt your existing materials to better utilise XR tools?
- What support or resources do you need to successfully integrate XR into your practice?
- This collaborative discussion will allow learners to share their insights, learn from each other's

experiences, and collectively identify best practices tailored to their contexts.

- **Training Method Used:**
  - *Presentation:* This method will be used to deliver key information about the requirements for integrating XR into educational settings, ensuring all participants have a solid understanding of foundational concepts.
  - **Group Discussion:** Participants will engage in discussions to share their implementation strategies and insights, fostering a collaborative learning environment where diverse perspectives are valued.
  - **Collaborative Brainstorming:** This method will encourage learners to generate solutions to common challenges, promoting critical thinking and teamwork as they develop actionable strategies.

- **Materials/Equipment Required for Face-to-Face Implementation:**
  - Projector and screen if applicable
  - Handouts or digital copies of tips and strategies
  - Whiteboard or flipchart for brainstorming and group discussions
  - Writing materials for note-taking and group activities

4. Assessment:

- **Reflection and Application (Adapted to Face-to-Face):**
  - At the end of the lesson, participants will engage in a reflection session where they share their thoughts on the integration of XR technologies into their teaching practices. Each group will discuss their proposed implementation strategies and outline a preliminary action plan to integrate XR into their training environments. This reflection will reinforce key concepts and encourage accountability as participants commit to exploring XR integration further.

- **5. References:**

- Sapizon. (2023, November 3). 5 Barriers and potential solutions for widespread adoption of extended reality. Sapizon Technologies.
- The Benefits of Upskilling Educators to use Immersive Technology.

- Shrivastav, A. (2024, July 3). Extended Reality: its challenges, usage and future ahead. Etelligens.

Additional resources

Alnagrat, A., Ismail, R. C., Idrus, S. Z. S., & Alfaqi, R. M. A. (2022). A review of extended reality (XR) technologies in the future of human education: Current trend and future opportunity. Journal of Human Centered Technology, 1(2), 81-96.

Upadhyay, B., Chalil Madathil, K., Hegde, S., Anderson, D., Wooldridge, E., Presley, D., ... & Reid, B. (2024, August). Barriers Toward the Implementation of Extended Reality (XR) Technologies to Support Education and Training in Workforce Development Programs. In Proceedings of the Human Factors and Ergonomics Society Annual Meeting (p. 10711813241275080). Sage CA: Los Angeles, CA: SAGE Publications.

Danyang Shang, Minjuan Wang, and Junjie Gavin Wu. (2020) Design and Implementation of Augmented Reality for English Language Education; in Augmented Reality in Education; Edition: 1st Publisher: Springer International Publishing

Video: What is XR technology? You Tube.

Module 2: Computing Competencies in XR Technology

Overview

Designing effective XR environments for vocational training involves several key aspects that ensure that the educational experience is immersive, interactive, and meets the learning objectives. To ensure that XR environments are effective, the approach must be both technical and pedagogical.

Lesson 1, students explore the importance of designing effective XR environments for vocational training, and the need to combine technical and pedagogical aspects in order to acquire key competencies in an immersive, practical and safe way.

Lesson 2 guides students in the development of effective XR environment design, which involves not only the creation of immersive simulations, but also the customisation of these experiences to suit different types of users and educational objectives. To do this, the ideal tool is to explore real-world examples and apply best practices related to XR environments in professional training to optimise the outcome of educational and professional objectives.

Lesson 3 provides practical tips for applying the content of the module in daily practice, offering learners practical advice for effectively integrating these skills and knowledge through immersive educational experiences in XR environments, which are transforming vocational training and professional competence acquisition.

Methodology

The methodology of an XR computer skills course should be comprehensive and practical, with a strong emphasis on project-based learning, technical practice and the development of collaborative skills. The mix of theory and practice will ensure that students not only understand XR technologies, but are able to apply them effectively in real-world situations. The phases are:

Definition of course objectives
To understand the fundamental concepts of virtual reality (VR), augmented reality (AR) and mixed reality (MR); to develop practical skills for the design, development and implementation of XR environments using specific tools and platforms; to identify and apply XR use cases in different professional sectors (education, industry, medicine,

etc.) and to develop collaborative XR projects that integrate technical and creative skills.

Course structure and phases

- Introduction to XR technology (Theory) to provide a solid theoretical framework of XR technologies and their current applications in different sectors.
- Development of technical competencies (Practical), to acquire specific technical skills to design, develop and program XR applications.
- Practical application and collaborative projects, developing a final project that applies the acquired skills in a realistic XR solution.
- Assessment and feedback to evaluate the progress and competencies acquired by students by providing valuable feedback.

Tools and resources to deliver the course it is important to have a range of resources and tools for both technical and practical implementation (XR development platforms, XR devices, libraries and SDKs, simulators, tutorials and online resources.

Teaching strategies:

- Learner-centred approach (to encourage active exploration, discovery and application of XR technologies);
- Collaborative learning to encourage group work among students is key, as XR applications require integrating multiple disciplines.
- Constant feedback and adjustment of content according to students' needs is vital to achieve the course objectives.
- Formative evaluation by applying formative assessments, based on ongoing practice and the development process, not just the final product.

	Lesson Plan

This learning unit is composed of three lessons:
Lesson 1: Designing Effective XR Environments
Lesson 2: Customising XR environments
Lesson 3: Immersive Educational Experiences

Lesson 1	**Designing effective XR environments for competence acquisition**
Duration	45 minutes
Lesson content	**1. Lesson Introduction** • **Overview and Goals:**

- Designing effective XR environments for vocational training requires combining technical and pedagogical aspects to ensure that students acquire key competencies in an immersive, practical and safe way.

2. Learning Outcomes (from PR2 – Competence Framework):

- By the end of this lesson, learners will:
  - Understand the fundamental theoretical concepts related to the design of effective XR environments for professional training.
  - Apply theoretical knowledge to analyse and discuss practical scenarios in different XR environments.
  - Engage critically with learning material and contribute effectively to discussions.

3. Developing Theoretical Contents

- **Description of Learning Activities:**

  Training needs analysis and design of immersive experiences (10 minutes)

  - Define the learning objectives and identify the learner profile to adapt the XR environment to their needs.
  - Realistic simulations that accurately reflect the work environment.
  - Natural interaction and manipulation with virtual objects, using intuitive gestures or controllers.
  - Progressive scenarios for learners to progress as they develop more skills.

  Motivation and personalisation of learning (10 minutes)

  - Virtual goals and rewards or levels that motivate learners to progress.
  - Challenges and quizzes that require problem solving in realistic situations.
  - Real-time feedback on performance, offering suggestions for improvement.
  - Dynamic adjustment of difficulty according to student performance.
  - Personalised learning paths based on student preferences or needs.

  Real-time assessment and feedback (10 minutes)

- Integrated assessment systems on student performance within the XR environment.
- Real-time interactive feedback, pointing out errors or areas for improvement as a reinforcement of active learning.
- Analysis of interaction data to evaluate learner behaviour in the XR environment.

Collaboration and teamwork (15 minutes)

- Multi-user collaborative environments as a collaborative repair.
- Live instructor feedback on learner performance.

- **Training Method Used:**
  - **Lecture:** Present theoretical content using visual aids and examples to enhance understanding.
  - **Discussion:** Encourage active participation and critical thinking through facilitated discussions.
  - **Case Study Analysis:** Promote application of theoretical knowledge through group analysis and problem-solving exercises.

- **Materials/Equipment Required for (Face-to-Face) Implementation:**
  - Projector and screen
  - Whiteboard or flipchart for brainstorming and illustrations
  - Handouts or digital copies, if applicable
  - Case study materials (printed or digital)
  - Writing materials for note-taking and group activities

  Hardware

  - Virtual Reality devices (headsets, VR glasses, controllers, VR controllers, VR controllers, PCs or consoles).
  - Augmented Reality devices (mobile phones or tablets, AR/MR Glasses, motion sensors and cameras, etc.)
  - Haptic devices (gloves or haptic suits such as Gloves VR or Teslasuit)

  Software

  - Graphics engines and development platforms
  - XR educational platforms
  - Specific training applications

Educational content and resources

- 3D models and interactive objects
- Sector-specific simulations.
- Multimedia resources (interactive animations).

Network infrastructure and connectivity

- High-speed Wi-Fi
- Cloud infrastructure

4. References:

Extended Reality: The Future of Immersive Technologies: This Onirix article explores how extended reality, which includes VR, AR and MR, is transforming various industries and enhancing digital

XR Training, Immersive Environments and Web3: INMERSIVA XR offers courses and training programmes in XR technologies, including Unreal Engine 5, which are essential for creating immersive environments and acquiring skills in this.

Explore the Big Three XR Trends: NVIDIA's blog highlights how RTX technology is enabling the creation of high-quality immersive environments, which is crucial for industries such as architecture, manufacturing and automotive

Onirix (2023). *Extended Reality: The Future of Immersive Technologies*. Retrieved from https://www.onirix.com [1].

IMMERSIVE XR. (2023). *XR Training, Immersive Environments and Web3*. Retrieved from https://www.inmersivaxr.com·

NVIDIA. (2023). *Explore the Big Three XR Trends*. Retrieved from https://www.nvidia.com

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5. Assessment:

- **Multiple Choice Questions (5-8):**
  - Assess comprehension of key theoretical concepts covered in the lesson.
  - Adapt questions to stimulate critical thinking and reinforce learning outcomes.

Conclusion:

- Summarise key points covered in the lesson.
- Reinforce the practical application of the theoretical knowledge and computer skills acquired in XR technology.

Lesson 2	**Customising XR Environments**
Duration	45 minutes

Lesson content	**1. Lesson Introduction**
	• **Overview and Goals:**
	  ○ Designing effective XR environments involves not only creating immersive simulations, but also customising those experiences to suit different types of users and educational objectives.
	  ○ Exploring real-world examples and applying best practices related to the application of XR environments in professional learning optimises the outcome of educational and professional objectives.
	
	2. Learning Outcomes:
	• By the end of this lesson, learners will:
	  ○ Understand how theoretical knowledge can be applied in practical settings.
	  ○ Analyse case studies and examples of best practices to gain insights into successful implementation.
	  ○ Identify strategies and techniques used by role models in the field to apply theoretical knowledge effectively.
	
	3. Developing Practical Application and Case Studies
	• **Description of Learning Activities:**
	  1. **Activity: Role Play or Simulation (15 minutes):**
	  ▪ To involve participants in a role-play or simulation scenario related to the application of technological competences acquired in the field of XR, where they can apply theoretical concepts in practice.
	  2. **Case Study Analysis (15 minutes):**
	  ▪ Analyse case studies of successful implementations or examples of best practices tested through the application of extended reality to vocational training, targeting sectors such as education, health, automotive or industry.
	  3. **Examples of Best Practices (15 minutes):**

- Present examples of how practitioners or models in the field have successfully applied theoretical knowledge.
  1. Industrial and technical simulations.
  2. Medical simulations and surgical training.
  3. Simulations in construction and architecture.
  4. Safety and risk management training.

- **Training Method Used:**
  - **Activity-based learning:** Facilitate interactive activities to encourage practical application and critical thinking in the knowledge and skills acquired in XR technology.
  - **Case study discussion:** Engage participants in discussions to analyse and evaluate examples or possibilities of applying XR in the real world.
  - **Presentation:** Share examples of good practice through multimedia or real-life stories.

- **Materials/Equipment Required for Face-to-Face Implementation:**
  - Projector and screen
  - Whiteboard or flipchart for brainstorming and illustrations
  - Handouts or digital copies, if applicable
  - Case study materials (printed or digital)
  - Writing materials for note-taking and group activities

  Hardware
  - Virtual Reality devices (headsets, VR glasses, controllers, VR controllers, VR controllers, PCs or consoles).
  - Augmented Reality devices (mobile phones or tablets, AR/MR Glasses, motion sensors and cameras, etc.)
  - Haptic devices (gloves or haptic suits such as Gloves VR or Teslasuit)

  Software
  - Graphics engines and development platforms
  - XR educational platforms
  - Specific training applications

  Educational content and resources
  - 3D models and interactive objects
  - Sector-specific simulations.
  - Multimedia resources (interactive animations).

  Network infrastructure and connectivity

- High-speed Wi-Fi
- Cloud infrastructure

4. References:

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Lesson 3	**Immersive Educational Experiences**
Duration	45 minutes
Lesson content	**1. Lesson Introduction** • **Overview and Goals:** ○ Immersive educational experiences in XR environments are transforming vocational training and professional skills acquisition. These experiences allow students and professionals to learn in simulated or augmented contexts, which increases knowledge retention and enhances the development of practical skills.

- Define the objectives of providing practical tips for integrating theoretical knowledge into daily practices related to the development and acquisition of IT competences in XR technology.

2. Learning Outcomes:

- By the end of this lesson, learners will:
  - Be equipped with practical tips and strategies to apply theoretical knowledge in their day-to-day activities.
  - Understand the importance of applying the theoretical concepts learnt in module 2 to improve professional or personal effectiveness.

3. Developing Implementation Tips

Presentation of tips on XR technology in immersive educational experiences (10 minutes)

- Present practical tips and strategies for integrating theoretical knowledge into daily routines or professional tasks.

Group discussion and brainstorming (15 minutes)

- Facilitate a discussion in which participants share their own ideas and experiences related to the application of the theoretical concepts.
- Encourage brainstorming on concrete actions or changes they can implement based on the advice provided.

Implementation in Day LIfe (20 minutes)

1. **Use the XR to enhance lifelong learning.**
   - Studying in an immersive way helps to visualise complex concepts.
   - Foreign languages using VR applications to practice languages in simulated scenarios, such as shops or restaurants.

2. **Application of XR in fitness training and wellness**
   - Exercise with virtual reality without leaving home.
   - Meditation and mindfulness to reduce stress.
   - Cooking with AR following visual instructions.
   - Learn to play an instrument at home.

3. **Organise trips and explore the world virtually**
   - Virtual exploration to discover new places without leaving home.
   - Plan trips virtually.

4. **Improve your children's education with XR**
   - Interactive learning for children in a more fun and interactive way.
   - Educational games that encourage creativity and critical thinking.

5. **Improve daily productivity**
   - Virtual workspaces creating immersive work environments.
   - Personal organisation to visualise to-do lists or reminders.

6. **Integrating XR into entertainment and socialising**
   - Immersive virtual reality games that transport you to interactive worlds where the action is physical and mental.
   - Virtual events or immersive social spaces to meet people.

- **Training Method Used:**
  - **Presentation:** Deliver tips and strategies
  - **Group Discussion:** Foster interactive discussions to exchange ideas and insights among participants.

- **Materials/Equipment Required for Face-to-Face Implementation:**
  - Projector and screen
  - Whiteboard or flipchart for brainstorming and illustrations
  - Handouts or digital copies, if applicable
  - Case study materials (printed or digital)
  - Writing materials for note-taking and group activities
    Hardware
  - Virtual Reality devices (headsets, VR glasses, controllers, VR controllers, VR controllers, PCs or consoles).

- Augmented Reality devices (mobile phones or tablets, AR/MR Glasses, motion sensors and cameras, etc.)
- Haptic devices (gloves or haptic suits such as Gloves VR or Teslasuit)

Software

- Graphics engines and development platforms
- XR educational platforms
- Specific training applications

Educational content and resources

- 3D models and interactive objects
- Sector-specific simulations.
- Multimedia resources (interactive animations).

Network infrastructure and connectivity

- High-speed Wi-Fi
- Cloud infrastructure

4. Assessment:

- **Reflection and Application (Adapted to Face-to-Face):**
  - Facilitate a reflection session where participants discuss how they plan to apply the tips provided in their own contexts.
  - Encourage participants to share their implementation plans and receive feedback from peers.

5. References:

–Billinghurst, M., Clark, A. y Lee, G. (2015). Un estudio de la realidad aumentada. *Foundations and Trends in Human-Computer Interaction*, *8*(2-3), 73-272. https://doi.org/10.1561/1100000049

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Tips for Implementation in Your Daily Life:

- To provide practical examples and scenarios in which learners can apply the theoretical concepts learned in Module 2.
- To encourage participants to develop personalised strategies based on their professional or personal needs.

Additional resources

Books and Publications:

- 'The VR Book: Human-Centered Design for Virtual Reality'. Author: Jason Jerald, ISBN: 978-1970001129
- 'Augmented Reality: Principles and Practice'. Authors: Dieter Schmalstieg and Tobias Hollerer. ISBN: 978-0321883575
- 'Learning Virtual Reality: Developing Immersive Experiences and Applications for Desktop, Web, and Mobile', Author: Tony Parisi, ISBN: 978-1491922835

Online Courses:

- Coursera: 'Virtual Reality Specialization', Offered by: University of London This course covers the basics of virtual reality, XR application development and immersive experience design. Link: Coursera - Virtual Reality Specialisation

Tools and Platforms:

- Unity 3D, one of the most popular engines for XR (AR and VR) application development. Offers multiple resources and documentation on using their platform to create immersive experiences. Link: Unity 3D
- ARCore (Google) and ARKit (Apple) ARCore and ARKit are the augmented reality libraries provided by Google and Apple, respectively, for developing experiences on mobile devices. They are essential for AR development on Android and iOS. ARKit link: Apple ARKit

Community and Forums:

- Stack Overflow (Unity XR), The Unity XR community on Stack Overflow is very active and offers solutions to frequently asked questions about augmented and virtual reality development. Link: Stack Overflow - Unity XR
- XR Bootcamp Community, an XR developer community offering bootcamps, events, and webinars on the latest XR technologies, including VR, AR, and MR development. Link: XR Bootcamp

Conferences and Events:

- AWE (Augmented World Expo), One of the world's leading XR events, showcasing the latest innovations in AR and VR. Link: AWE
- VR/AR Global Summit, A global event that brings together leaders in XR, from developers to hardware and software companies. It offers a broad overview of XR applications in various industries. Link: VR/AR Global Summit

Module 3: Pedagogies in Extended Reality for Work-Based Learning

Overview

Module 3 provides a practical overview of digital pedagogy principles when using XR (Extended Reality) in a pedagogic-sound way in work-based learning. It provides hands-on insights on media integration approaches, its planning and integration in existing classes or courses. The aim is to understand and determine the pedagogic value of XR in WBL.

Lesson 1 introduces XR use in WBL by understanding how to define relevant learning outcomes directly, when using XR.

Lesson 2 focuses on the pedagogic-sound integration of XR by lesson planning in WBL.

Lesson 3 provides insights in piloting and scaling XR use in WBL by focusing on its pedagogic value first. XR becomes not just a technology, but an educational technology.

Methodology

The methodology of module 3 is learner centred. The target group are VET training personnel. The lessons are practical and based on existing experience of planning, using, and the evaluation XR use in WBL. The rather hands-on approach reduces references to theoretical sources massively as each learning setting is too specific to transfer general conclusions from academic literature to it. During piloting, learning will be created hands-on, depending on the XR technology used, learning objectives defined, VET personnel involved etc.

Lesson Plan

This learning unit is composed of three lessons:
Lesson 1: Introduction to XR use in WBL
Lesson 2: Planning and pedagogic-sound implementation of XR in practical training
Lesson 3: XR as an educational technology and method in daily WBL training

Lesson 1	**Introduction to XR use in WBL**
Duration	45 mins

Lesson content	**1. Lesson Introduction**
	• **Overview and Goals:**
	  • Introduce module 3 and its objectives.
	  • Explain the importance of understanding theoretical media-pedagogic concepts (SAMR, TPACK, Bloom, DICE etc.) in using XR in practical training.
	
	2. Learning Outcomes (from PR2 – Competence Framework):
	• By the end of this lesson, learners will:
	  • Understand media-pedagogic concepts related to pedagogic sound use of XR in WBL.
	  • Identify teaching and learning potential of Extended Reality (XR) as an educational technology in WBL
	
	3. Developing Theoretical Contents
	• **Description of Learning Activities:**
	  1. **Introduction (15 minutes):** Provide a structured presentation on key media-pedagogic concepts
	  2. **Interactive Discussion on "If XR is the answer, what was the pedagogic question?" (25 minutes):** Facilitate a discussion to deepen understanding of XR as an educational technology as well as to address questions.
	  3. **Self-directed reflection (5 min)** about XR us in WBL
	.
	• **Training Method Used:**
	• **Presentation:** Present media-pedagogic concepts and approaches using visual aids and examples to enhance understanding.
	• **Discussion:** Encourage active participation and critical thinking through facilitated discussions.
	• **Knowledge quiz:** Promote further reflection on an individual level by a short online quiz
	
	Materials/Equipment Required for (Face-to-Face) Implementation:
	• Projector and screen
	• Whiteboard or flipchart for brainstorming and illustrations
	• Smartphone/Tablet – Online quiz
	• Writing materials for note-taking and group activities
	
	4. References:

	• Hofmann, J. Lester, S. (2020). Some pedagogical observations on using augmented reality in a vocational practicum. British Journal of Educational Technology 51(3), DOI: 10.1111/bjet.12901
	
	5. Assessment:
	• **Multiple Choice Questions (5):**
	  • Assess understanding of key theoretical concepts covered in lesson 1.
	  • Adapt questions to stimulate critical thinking and reinforce learning outcomes.
	
	Conclusion:
	• Summarise key points covered in the lesson.
	• Reinforce the practical application of theoretical knowledge in introduction to XR use in WBL.

Lesson 2	**Planning and pedagogic-sound implementation of XR in practical training**
Duration	75 mins

Lesson content	**1. Lesson Introduction**
	• **Overview and Goals:**
	  • Introduce Lesson 2: Planning and pedagogic-sound implementation of XR in practical training within Module 3.
	  • Demonstrate how different kinds of XR (AR, VR, no-code, coded) must be planned for practical WBL application
	  • Outlines the objectives of exploring real-world examples and best practices related to planning and pedagogic sound use of XR.
	
	2. Learning Outcomes:
	• By the end of this lesson, learners will:
	  • Understand how XR as an educational technology must be planned to be pedagogic sound implemented in WBL to reach the defined learning goals
	  • Present different XR solutions

- Understand the pedagogic potential of different communication and collaboration forms (on/-offsite, (a)synchronous), when using XR

3. Developing Practical Application and Case Studies

- **Description of Learning Activities:**
  1. **Use cases presentation (30 min):** Presentation of 5 suitable use cases of pedagogic sound XR use in WBL
  2. **Lesson planning exercise (30 min):** Planning of XR integration in an existing lesson or training, to support reflection of XR pedagogical potential
  3. **Discussion with participants (15 min)**: Do's and Don't's list of XR use to foster implementation in WBL

Training Method Used:

- **Presentation:** Share examples of use cases/best practices
- **Exercise:** Fosters reflection on an individual level to integrate XR in WBL
- **Group Discussion:** Engage participants in discussions to analyse and evaluate educational and integrative potential of XR in their WBL setting

Materials/Equipment Required for Face-to-Face Implementation:

- Projector and screen if applicable
- Whiteboard or flipchart for brainstorming and group discussions
- Writing materials for notetaking and group activities

4. References:

- Hofmann, J. Lester, S. (2020). Some pedagogical observations on using augmented reality in a vocational practicum. British Journal of Educational Technology 51(3), DOI: 10.1111/bjet.12901

5. Assessment:

- **Discussion and Reflection (Adapted to Face-to-Face):**
  - Facilitate a comprehensive discussion or reflection session where participants share insights gained from examples and a practical lesson planning exercise.
  - Evaluate understanding through group discussions, focusing on application and critical analysis.

Conclusion:

	• Recap key insights from practical examples and exercises carried out Emphasise the importance of applying pedagogical approaches, when using XR in WBL to use its educational potential for a more effective learning and professional development.

Lesson 3	**XR as an educational technology and method in daily WBL training**
Duration	30 min

Lesson content	**1. Lesson Introduction**
	• **Overview and Goals:**
	  • Introduce Lesson 3: XR as an educational technology and method in daily WBL training within Module 3
	  • Outline the objectives of providing practical tips to provide insights and hands-on advice to make the step from piloting to scaling XR use in daily WBL
	
	2. Learning Outcomes:
	• By the end of this lesson, learners will:
	  • Be equipped with practical tips and strategies for applying XR on a more frequent base
	  • Understand the pedagogic as well as technological limits of XR use
	
	3. Developing Implementation Tips
	• **Description of Learning Activities:**
	  1. **Presentation of Tips (15 minutes):**
	  • Present practical tips and strategies for integrating XR into their daily routines
	  • Presentation of technological and pedagogical limits
	  2. **Group Discussion and Brainstorming (15 minutes):**
	  • Facilitate a discussion where participants share their own ideas and experiences related to implementing digital technologies in WBL
	  • Encourage concepts of habit building to use XR in WBL

Training Method Used:

- **Presentation:** Deliver tips and strategies
- **Group Discussion:** Foster interactive discussions to exchange ideas and insights among participants.

Materials/Equipment Required for Face-to-Face Implementation:

- Projector and screen if applicable
- Whiteboard or flipchart for brainstorming and group discussions
- Writing materials for note-taking and group activities

4. Assessment:

- **Reflection and Application (Adapted to Face-to-Face):**
    - Facilitate a reflection session where participants discuss how they plan to apply the tips provided in their own contexts.
    - Encourage participants to share their implementation plans and receive feedback from peers.

Tips for Implementation in Your Daily Life:

- Provide hints and practical examples how learners can apply XR easier in WBL by low-threshold solutions as well as the focus on pedagogic goals.
- Encourage participants to develop personalised strategies based on their professional needs to support the transition of pilot XR use to a more frequent use.

Module 4: Inclusive Use of XR

Overview

This module gives a comprehensive understanding of ethical frameworks, guidelines, and best practices for creating XR-enhanced learning experiences that are attentive to the diverse needs of all participants and learners.. Across three lessons, participants will develop an understanding of XR's role in creating accessible learning environments for diverse learners.

Lesson 1 introduces XR and its role in VET, focusing on ethical frameworks like inclusivity, privacy, and cultural sensitivity. It lays the foundation for creating accessible and equitable XR learning experiences for diverse learners.

Lesson 2 focuses on practical application. Participants explore real-world examples and best practices for an inclusive use of XR in VET. Through case studies and activities, they learn how to apply inclusive XR content that meets the needs of diverse learners.

Lesson 3 provides practical tips for integrating inclusive XR into everyday teaching. Participants create action plans and learn strategies to ensure that XR is accessible, sustainable, and continuously improved based on learners' feedback.

Methodology

The development of this module employs a blended learning approach, combining theory with practical application. The methodology includes:

- **Task-Based Learning**: the module emphasises real-world tasks that participants can directly apply in their vocational education settings. Learners complete outcome-focused tasks like developing action plans and designing inclusive XR modules, fostering problem-solving and critical thinking.
- **Case Study Analysis**: real-world case studies of inclusive XR in vocational training are analysed. This allows them to reflect on how inclusivity, accessibility, and ethics apply to their teaching practices. These examples highlight successful inclusive practices, providing participants with strategies they can adopt in their own contexts.
- **Presentations and** Group discussion: lessons incorporate presentations and group discussions, allowing participants to share insights and feedback. Presentations of their work promote engagement and peer learning, enhancing understanding through shared experiences.

- **Lectures**: structured content will be delivered to a group of learners to present theoretical concepts and explain complex topics.

Lesson Plan

This learning unit is composed of three lessons:

Lesson 1: Introduction to Inclusive XR in VET Education
Lesson 2: Practical Application of Inclusive XR in VET Education
Lesson 3: Implementing Inclusive XR in Daily Practice

Lesson 1	**Introduction to Inclusive XR in VET Education**
Duration	45 minutes

Lesson content	**1. Lesson Introduction**
	• **Overview and Goals:**
	  • Introduce module 4 and its objectives.
	  • Explain the importance of understanding theoretical concepts linked to *Inclusive use of XR in VET education*.
	
	2. Learning Outcomes (from PR2 – Competence Framework):
	• By the end of this lesson, learners will:
	  • Define key ethical frameworks for inclusive XR-enhanced learning.
	  • Understand foundational theoretical concepts related to *inclusion in XR* learning experiences: accessibility, privacy protection and cultural sensitivity
	  • Apply theoretical knowledge to analyze and discuss practical scenarios.
	  • Engage critically with the material and contribute effectively to discussions.
	
	3. Developing Theoretical Contents
	• **Description of Learning Activities:**
	1. Introduction to XR in VET Education (5 minutes)
	  ○ Brief explanation of XR (VR, AR, MR) and its role in VET education.
	  ○ Significance of XR for diverse learning environments.
	2. Ethical Considerations (15 minutes)
	  ○ Ethical frameworks: digital citizenship, accessibility, privacy protection
	  ○ Emphasising equity in diversity: gender, disabilities, and cultural inclusivity.

3. Inclusivity in XR (10 minutes)
    - Key guidelines for creating XR-enhanced learning experiences that are accessible to all.
4. Group Reflection (15 minutes)
    - Open discussion: initial thoughts on inclusivity in XR and its ethical considerations.

Training Method Used:

- **Lecture:** Present theoretical content using visual aids and examples to enhance understanding.
- **Discussion:** Encourage active participation and critical thinking through facilitated discussions.
- **Group Reflection on Case Studies:** Promote application of theoretical knowledge through group analysis and problem-solving exercises.

Materials/Equipment Required for (Face-to-Face) Implementation:

- Projector and screen
- Whiteboard or flipchart for brainstorming and illustrations
- Handouts or digital copies, if applicable
- Case study materials (printed or digital)
- Writing materials for note-taking and group activities

4. References:

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- **XRA's Developers Guide, Chapter Three: Accessibility & Inclusive Design in Immersive Experiences** [2020]: https://xra.org/research/xra-developers-guide-accessibility-and-inclusive-design/

- Iqbal, M. Z., Xu, X., Nallur, V., Scanlon, M., & Campbell, A. G. (2023). **Security, ethics, and privacy issues in the remote extended reality for education.** In Y. Cai, E. Mangina, & S. L. Goei (Eds.), Mixed reality for education. Gaming media and social effects. Springer.

- Wehrmann, F., & Zender, R. (2024). **Inclusive Virtual Reality Learning: Review and 'Best-Fit' Framework for Universal Learning**. Electronic Journal of e-Learning, 22(3), 74-89. https://www.researchgate.net/publication/378374761_Inclusive_Virtual_Reality_Learning_Review_and_'Best-Fit'_Framework_for_Universal_Learning

5. Assessment:

- **Multiple Choice Questions (5-8):**
  - Assess comprehension of key theoretical concepts covered in the lesson.
  - Adapt questions to stimulate critical thinking and reinforce learning outcomes.

Conclusion:

- Summarise key points covered in the lesson.
- Reinforce the practical application of theoretical knowledge in **Inclusivity in XR**

Lesson 2	**Practical Application of Inclusive XR in VET Education**
Duration	45 minutes

Lesson content	**1. Lesson Introduction**
	• **Overview and Goals:**
	  • Introduce Lesson 2: Implementing Inclusive XR into Daily Practice within Module 4
	  • Demonstrate how XR has been applied inclusively in VET education through best practices and practical examples.
	  • Outline the objectives of exploring real-world examples and best practices related to inclusive uses of XR in VET courses.
	  • Collaboratively identify best practices and insights that can inform more inclusive XR design and implementation in VET settings.
	
	2. Learning Outcomes:
	• By the end of this lesson, learners will:
	  • Understand how theoretical knowledge can be applied in practical settings.
	  • Showcase best practices of XR learning experiences.
	  • Understand practical steps to design accessible XR learning.
	
	3. Developing Practical Application and Case Studies
	• **Description of Learning Activities:**
	  1. **Case Studies: Inclusive XR in Action (15 minutes)**
	  • Present 1-2 case studies of successful XR learning applications in VET that highlight inclusivity and accessibility.
	  2. **Interactive Activity: Group Discussion (15 minutes)**
	  • Divide participants into small groups. Considering the case studies provided, each participant will reflect on their accessibility, design, and impact on diverse learners. Participants are encouraged to engage in dialogue, offering constructive feedback and potential improvements
	  2. **Practical Tips for Designing Inclusive XR (15 minutes)**
	  • Provide practical steps to ensure XR learning content meets accessibility needs.

Training Method Used:

- **Case Studies:** Engage participants in discussions to analyse and evaluate real-world examples.
- **Group Discussion:** learners will critically examine the inclusivity of XR in VET learning. The small groups explore how different XR applications either support or hinder inclusivity, considering factors like physical accessibility, cognitive load, and cultural sensitivity.
- **Presentation:** Share examples of best practices through multimedia or real-life stories.

Materials/Equipment Required for Face-to-Face Implementation:

- Projector and screen if applicable
- Handouts or digital copies of case studies and examples
- Whiteboard or flipchart for brainstorming and group discussions
- Writing materials for note-taking and group activities

4. References:

- Fox, D., & Thornton, I. G. (2022, March 4). **The IEEE Global Initiative on Ethics of Extended Reality (XR) Report—Extended Reality (XR) ethics and diversity, inclusion, and accessibility.** The IEEE Global Initiative on Ethics of Extended Reality (XR) (pp. 1-25). https://standards.ieee.org/wp-content/uploads/2022/04/Ethics_Diversity_Inclusion_Accessibility.pdf

- Valakou, A., Margetis, G., Ntoa, S., Stephanidis, C. (2024). **A Framework for Accessibility in XR Environments.** In: Stephanidis, C., Antona, M., Ntoa, S., Salvendy, G. (eds) HCI International 2023 – Late Breaking Posters. HCII 2023. Communications in Computer and Information Science, vol 1958. Springer, Cham. Download conference paper PDF

- Wild, F., Coughlan, T., Davies, S.-J., Shepherd, R., Collins, T., King, A., & Matos Carew, J. (2024). **eXtended reality and accessibility in online and distance learning:** Exploring the opportunities and challenges. *Immersive Learning Research - Academic*, *1*(1), 153–163. Montana, USA: The Immersive Learning Research Network. https://oro.open.ac.uk/98152/1/iLRN2024_camera-ready_paper_156_Final_DOI.pdf

- Derby, J. L., Mello, S. M., Horn, N. R., StClair, A. N., & Chaparro, B. S. (2023). **Examining the Inclusivity of Extended Reality (XR) in Current Products**. Proceedings of the Human Factors and Ergonomics Society Annual Meeting, 67(1), 2198-2204. https://journals.sagepub.com/doi/full/10.1177/21695067231192621

- **XRA's Developers Guide, Chapter Three: Accessibility & Inclusive Design in Immersive Experiences** [2020]: https://xra.org/research/xra-developers-guide-accessibility-and-inclusive-design/

- Iqbal, M. Z., Xu, X., Nallur, V., Scanlon, M., & Campbell, A. G. (2023). **Security, ethics, and privacy issues in the remote extended reality for education.** In Y. Cai, E. Mangina, & S. L. Goei (Eds.), Mixed reality for education. Gaming media and social effects. Springer.

- Wehrmann, F., & Zender, R. (2024). **Inclusive Virtual Reality Learning: Review and 'Best-Fit' Framework for Universal Learning**. Electronic Journal of e-Learning, 22(3), 74-89. https://www.researchgate.net/publication/378374761_Inclusive_Virtual_Reality_Learning_Review_and_'Best-Fit'_Framework_for_Universal_Learning

5. Assessment:

- **Discussion and Reflection (Adapted to Face-to-Face):**
  - Facilitate a comprehensive discussion or reflection session where participants share insights gained from case studies and examples.
  - Evaluate understanding through open-ended questions or group discussions, focusing on application and critical analysis.

Conclusion:

- Recap key insights from practical activities, case studies, and examples discussed.
- Emphasise the importance of applying theoretical knowledge in real-world contexts for effective learning and professional development.

Lesson 3	**Implementing Inclusive XR into Daily Practice**
Duration	45 mins

Lesson content	**1. Lesson Introduction**
	• **Overview and Goals:**
	  • Introduce Lesson 3: Implementing Inclusive XR into Daily Practice within Module 4
	  • Provide participants with actionable strategies for incorporating inclusive XR into their teaching practices and making continuous improvements.
	
	2. Learning Outcomes:
	• By the end of this lesson, learners will:
	  • Be equipped with practical tips and strategies for implementing theoretical knowledge inclusive XR in their daily activities.
	  • Understand how to assess and improve XR inclusivity.
	  • Understand the importance of applying theoretical concepts learned in Module 4 to enhance professional or personal effectiveness.
	
	3. Developing Implementation Tips
	• **Description of Learning Activities:**
	
	1. **Tips for Integrating XR into Teaching** (10 minutes)
	  • Simple, actionable tips for integrating XR inclusively, including adapting current teaching materials.
	  • Low-cost or free tools that support inclusive XR.
	2. **Assessment and continuous improvement** (10 minutes)
	  • How to evaluate the inclusivity of your XR-enhanced learning content.
	  • Using learner feedback and accessibility audits to improve future XR projects.
	2. **Action Plan** (25 minutes)
	  • Participants will begin drafting a brief action plan outlining how they will integrate inclusive XR into their teaching practice. The Action Plan is a structured approach that allows participants to outline how they will integrate inclusive XR strategies into their daily practices, ensuring that their learning environments are accessible,

culturally sensitive, and meet the diverse needs of all learners.

Training Method Used:

- **Presentation:** for the delivering of tips and strategies for a more inclusive use of XR
- **Task-Based Learning** (TBL): In the action plan development, participants are engaged in a real-world task that is directly related to their work in VET education. They are tasked with creating a plan to implement inclusive XR practices based on the theoretical knowledge and practical skills they've gained.
- **Experiential Learning**: the action plan also incorporates Experiential Learning, where participants draw on their experiences, reflect on them, and then plan future actions based on these reflections.

Materials/Equipment Required for Face-to-Face Implementation:

- Projector and screen if applicable
- Handouts or digital copies of tips and strategies

4. Assessment:

- **Reflection and Application (Adapted to Face-to-Face):**
  - Facilitate a reflection session where participants discuss how they plan to apply the tips provided in their own contexts.
  - Encourage participants to share their implementation plans and receive feedback from peers.

5. References:

- Fox, D., & Thornton, I. G. (2022, March 4). **The IEEE Global Initiative on Ethics of Extended Reality (XR) Report—Extended Reality (XR) ethics and diversity, inclusion, and accessibility.** The IEEE Global Initiative on Ethics of Extended Reality (XR) (pp. 1-25). https://standards.ieee.org/wp-content/uploads/2022/04/Ethics_Diversity_Inclusion_Accessibility.pdf

- Valakou, A., Margetis, G., Ntoa, S., Stephanidis, C. (2024). **A Framework for Accessibility in XR Environments.** In: Stephanidis, C., Antona, M., Ntoa, S., Salvendy, G. (eds) HCI International 2023 – Late Breaking Posters. HCII 2023. Communications in Computer and Information Science, vol 1958. Springer, Cham. Download conference paper PDF

- Wild, F., Coughlan, T., Davies, S.-J., Shepherd, R., Collins, T., King, A., & Matos Carew, J. (2024). **eXtended reality and accessibility in online and distance learning:** Exploring the opportunities and challenges. *Immersive Learning Research - Academic*, *1*(1), 153–163. Montana, USA: The Immersive Learning Research Network. https://oro.open.ac.uk/98152/1/iLRN2024_camera-ready_paper_156_Final_DOI.pdf

- Derby, J. L., Mello, S. M., Horn, N. R., StClair, A. N., & Chaparro, B. S. (2023). **Examining the Inclusivity of Extended Reality (XR) in Current Products**. Proceedings of the Human Factors and Ergonomics Society Annual Meeting, 67(1), 2198-2204. https://journals.sagepub.com/doi/full/10.1177/21695067231192621

- **XRA's Developers Guide, Chapter Three: Accessibility & Inclusive Design in Immersive Experiences** [2020]: https://xra.org/research/xra-developers-guide-accessibility-and-inclusive-design/

- Iqbal, M. Z., Xu, X., Nallur, V., Scanlon, M., & Campbell, A. G. (2023). **Security, ethics, and privacy issues in the remote extended reality for education.** In Y. Cai, E. Mangina, & S. L. Goei (Eds.), Mixed reality for education. Gaming media and social effects. Springer.

- Wehrmann, F., & Zender, R. (2024). **Inclusive Virtual Reality Learning: Review and 'Best-Fit' Framework for Universal Learning**. Electronic Journal of e-Learning, 22(3), 74-89. https://www.researchgate.net/publication/378374761_Inclusive_Virtual_Reality_Learning_Review_and_'Best-Fit'_Framework_for_Universal_Learning

Tips

- Provide practical examples and scenarios where learners can apply the theoretical concepts learned in Module 4.
- Encourage participants to develop personalised strategies based on their professional or personal needs.

Additional resources

1. Integrating immersive technologies in VET: https://school-education.ec.europa.eu/en/discover/practices/integrating-immersive-technologies-vet
A section on immersive technologies in VET on the European School Education Platform.

2. 3D4VR project
https://www.3d4vr.eu/
Video: https://youtu.be/71uAngS4l1I
The Erasmus+ co-funded 3D4VR project focused on integrating knowledge about CAD modelling, 3D printing and VR in the technical, vocational and medical education settings. Its goal was to transfer the innovative specialised skills and tools used in these technological settings to the VET sector through specialised education modules and gave special attention to designing suitable materials for people who are visually impaired or have other physical disabilities.

3. UbiSim's immersive VR scenarios
https://www.ubisimvr.com/in-the-news/april-2024-release
UbiSim's immersive VR scenarios allow nursing students to practice caring for diverse patient populations, including those who are transgender, Black, or living with conditions like HIV. Institutions can customize these scenarios to reflect their patient demographics.

4. Virtual Interactive Training Agent (VITA)
https://ict.usc.edu/research/projects/vita/
Developed by the University of Southern California's Institute for Creative Technologies, VITA is a virtual reality job interview practice system designed to build competence and reduce anxiety in young adults with Autism Spectrum Disorder (ASD) and other developmental disabilities.
It provides a safe, controlled environment for users to practice job interviews, enhancing their readiness for employment opportunities.

5. Virtual Reality Vocational Training Simulation for Students with Intellectual Disabilities
https://link.springer.com/chapter/10.1007/978-3-031-37697-9_12
A VR simulation designed to reduce inequality in vocational training opportunities for students with intellectual disabilities, preparing them for community employment. It

Allows students to practice vocational skills in a realistic, controlled setting, enhancing their readiness for the workforce.

6. Project VRhoogte in Flanders (video)
https://vimeo.com/376789777
A VR training module for secondary VET students to learn how to work safely in high places (such as high-voltage pylons or wind turbines) in a virtual environment using Oculus Quest. Students use a VR module for skills training in a safe, interactive and challenging environment during their preparation for the workplace

Module 5: XR Regulation and Government policies

Overview

XR regulation and government policies are critical topics that address the legal, ethical, and societal aspects of using immersive technologies. To ensure a comprehensive understanding of these subjects, the lesson has been divided into three key sections:

Lesson 1 covers the fundamentals of XR regulation and government policies, highlighting the importance of these topics, the necessity of policy regulations, and their relationship with aspects like GDPR.

Lesson 2 focuses on effective examples and practical applications of XR regulation and government policies, analysing case studies and showcasing how professionals or role models in the field have successfully utilised theoretical knowledge. It also discusses collaboration with other institutions on regulatory matters.

Lesson 3 offers practical tips for integrating the module's content into daily practices, including activities that encourage learners to engage and collaborate in groups.

Methodology

The methodology for this module is designed to provide a comprehensive and engaging learning experience that equips participants with the knowledge and skills necessary to navigate regulatory frameworks, government policies, and ethical considerations related to the use of XR technologies in educational settings and XR Regulation and Government policies. This systematic framework encompasses various strategies and approaches to effectively achieve the module's educational objectives.

The course is divided into three lessons, each with a clear focus and objectives. Each lesson includes an introduction that sets the context and relevance of the topic, engaging participants from the outset, clearly defined outcomes are presented at the beginning of each lesson, and the core content is delivered through a combination of direct instruction, discussions, and case studies. This multifaceted approach allows for a deeper understanding of complex topics.

Various assessment methods are employed to evaluate participants' understanding and application of the material. Each lesson is supported by a curated list of

references and resources ensuring that participants have access to credible information that enhances their learning experience

The inclusion of diverse documents and materials relevant to the regulatory landscape allows participants to familiarise themselves with real-life scenarios. This integration enhances their ability to apply theoretical knowledge to practical situations By systematically addressing the learning outcomes through these strategies, the module aims to equip participants with the necessary competencies to navigate the complexities of XR regulations and government policies effectively.

Lesson Plan

This learning unit is composed of three lessons:

Lesson 1: Fundamentals of XR regulation and government policies
Lesson 2: Good examples and practical applications of XR regulation and government policies
Lesson 3: Integration and implementation of XR regulation and government policies in real-life scenarios

Lesson 1	Fundamentals of XR regulation and government policies
Duration	45 minutes

Lesson content	**1. Lesson Introduction**
	• **Overview and Goals:**
	  • Introduce the Fundamentals of XR regulation and government policies and its objectives.
	  • Explain the importance of understanding theoretical concepts in XR Regulation and Government policies
	
	2. Learning Outcomes (from PR2 – Competence Framework):
	• By the end of this lesson, learners will:
	  • Understand foundational theoretical concepts related to XR Regulation and Government policies
	  • Apply theoretical knowledge to analyse and discuss practical scenarios.
	  • Engage critically with the material and contribute effectively to discussions.
	
	3. Developing Theoretical Contents
	• **Description of Learning Activities:**
	  • **Overview and (15 minutes):**
	• Introduction of Regulatory frameworks and government policies governing XR (Extended Reality) technologies in education.
	• Ensuring the safe, ethical, and equitable use of these emerging tools.
	• Importance of establishing guidelines that reflect local laws and educational standards.
	• Policies such as GDPR and other global regulations affect XR applications
	• Ethical dilemmas in XR: user data, consent, and surveillance
	  • **Participatory Discussion (15 minutes):** Discussion on the subject of "The data collection of data by XR tools and the importance of compliance with European regulations like GDPR".
	  • **Case Study Analysis (15 minutes):** Reviewing a sample guideline/report on the XR regulation and government policies/ethics/challenges.
	
	Training Method Used:
	  • **Lecture-Based Learning:** Present theoretical content using slides or a short presentation to introduce unit topic to enhance understanding
	  • **Group Discussion:** Encourage active participation, break learners into small groups to debate and critical thinking through facilitated discussions.

- **Case-Based Learning:** Provide learners with a real-world example and promote application of theoretical knowledge through group analysis and problem-solving exercises.

\Materials/Equipment Required for (Face-to-Face) Implementation:

- Projector and screen
- Computer/Laptop
- Printed Case Study/Guideline Reports
- Whiteboard and Markersfor brainstorming and illustrations
- Writing materials for note-taking and group activities
- Internet Access (Optional)
- Writing materials for note-taking and group activities

4. References:

- Mangina, and Eleni. "White Paper-The IEEE Global Initiative on Ethics of Extended Reality (XR) Report--Extended Reality (XR) Ethics in Education." *The IEEE Global Initiative on Ethics of Extended Reality (XR) Report--Extended Reality (XR) Ethics in Education* (2021): 1-27.

- Tromp, J. G., Zachmann, G., Perret, J., & Palacco, B. (2022). Future Directions for XR 2021-2030: International Delphi Consensus Study. *Roadmapping Extended Reality: Fundamentals and Applications*, 1-34.

- Stanney, K. M., Nye, H., Haddad, S., Hale, K. S., Padron, C. K., & Cohn, J. V. (2021). Extended reality (XR) environments. *Handbook of human factors and ergonomics*, 782-815.

5. Assessment:

- **Multiple Choice Questions (5-8):**
  - Assess comprehension of key theoretical concepts covered in the lesson.
  - Adapt questions to stimulate critical thinking and reinforce learning outcomes.

Conclusion:

- Summarise key points covered in the lesson.
- Reinforce the practical application of theoretical knowledge in Fundamentals of XR regulation and government policies

Lesson 2	Good examples and practical applications of XR regulation and government policies
Duration	45 minutes

Lesson content	**1. Lesson Introduction**
	• **Overview and Goals:**
	  • Introduce Lesson 2: Good examples and practical applications of XR regulation and government policies within XR Regulation and Government policies
	  • Outline the objectives of exploring real-world examples and best practices related to XR Regulation and Government policies
	
	2. Learning Outcomes:
	• By the end of this lesson, learners will:
	  • Understand how theoretical knowledge can be applied in practical settings.
	  • Analyse case studies and examples of best practices to gain insights into successful implementation.
	  • Identify strategies and techniques used by role models in the field to apply theoretical knowledge effectively.
	
	3. Developing Practical Application and Case Studies
	• **Description of Learning Activities:**
	  • **Activity: Role Play or Simulation (15 minutes):**
	  • In order to engage participants in a role-play scenario or simulation related TO **XR Regulation and Government policies** where they can apply theoretical concepts in practice. Students will simulate the development, regulation, and compliance process of launching a new XR app while addressing legal, ethical, and policy challenges.
	
	• **Case Study Analysis (15 minutes):**
	  • Analyse case studies of successful implementations or examples of best practices in XR Regulation and Government policies.

- **Examples of Best Practices (15 minutes):**
    - Present examples of how professionals or role models in the field have successfully applied theoretical knowledge. Such as: the process of preparing new laws, introducing citizens to new regulations, collaboration with other institutions on regulation

Training Method Used:

- **Activity-Based Learning:** Facilitate interactive activities to encourage practical application and critical thinking.
- **Case Study Discussion:** Engage participants in discussions to analyse and evaluate real-world examples on XR regulation and government policies
- **Presentation:** Share examples of best practices through multimedia or real-life stories.

Materials/Equipment Required for Face-to-Face Implementation:

- Projector and screen
- Computer/Laptop
- Printed Case Study/Guideline Reports
- Whiteboard and Markersfor brainstorming and illustrations
- Writing materials for note-taking and group activities
- Internet Access (Optional)
- Writing materials for note-taking and group activities

4. References:

- Meccawy, M. (2023). Teachers' prospective attitudes towards the adoption of extended reality technologies in the classroom: Interests and concerns. *Smart Learning Environments*, *10*(1), 36.

- Khan, S. (2023). The future of XR-empowered healthcare: roadmap for 2050. In *Extended Reality for Healthcare Systems* (pp. 265-275). Academic Press.

- Innocente, C., Ulrich, L., Moos, S., & Vezzetti, E. (2023). A framework study on the use of immersive XR technologies in the cultural heritage domain. *Journal of Cultural Heritage*, *62*, 268-283.

- Jalo, H., Pirkkalainen, H., Torro, O., Pessot, E., Zangiacomi, A., & Tepljakov, A. (2022). Extended reality technologies in small and medium-sized European industrial companies: level of

	awareness, diffusion and enablers of adoption. *Virtual Reality*, *26*(4), 1745-1761.
	
	5. Assessment:
	• **Discussion and Reflection (Adapted to Face-to-Face):**
	  • Facilitate a comprehensive discussion or reflection session where participants share insights gained from case studies and examples.
	  • Evaluate understanding through open-ended questions or group discussions, focusing on application and critical analysis.
	
	Conclusion:
	• Recap key insights from practical activities, case studies, and examples discussed.
	• Emphasise the importance of applying theoretical knowledge in real-world contexts for effective learning and professional development.

Lesson 3	Integration and implementation of XR regulation and government policies in real-life scenarios
Duration	45 minutes

Lesson content	**1. Lesson Introduction**
	• **Overview and Goals:**
	  1. Introduce Lesson 3: Integration and implementation of XR regulation and government policies in real-life scenarios within module 3: XR Regulation and Government policies
	  2. Outline the objectives of providing practical tips for integrating theoretical knowledge into daily practices related to **XR Regulation and Government policies**
	
	2. Learning Outcomes:
	• By the end of this lesson, learners will:
	  1. Be equipped with practical tips and strategies for implementing theoretical knowledge in their daily activities.

2. Understand the importance of applying theoretical concepts learned in lesson 2 to enhance professional or personal effectiveness.
3. Understand how XR technologies are regulated and how policies are applied in real-world scenarios
4. Propose solutions for managing compliance in various industries using XR.

3. Developing Implementation Tips

- **Description of Learning Activities:**
  - **Presentation of Tips (10 minutes):**
    - Present practical tips and strategies for integrating theoretical knowledge into daily routines or professional tasks.
  - **Small Group Activity (10 minutes):** Assigning each group a real-world XR scenario, identification of key regulations they need to comply with and suggest how they would integrate those policies from the development phase onward
  - **Group Discussion and Brainstorming (25 minutes):**
    - Facilitate a discussion where participants share their own ideas and experiences related to implementing theoretical concepts.
    - Encourage brainstorming of specific actions or changes they can implement based on the tips provided.
    - Class Brainstorm: What government policies and regulations would be most relevant to XR in fields like healthcare, education, and entertainment?
    - Cost and technical challenges in adhering to regulations
    - Collaboration between XR developers and regulatory authorities to ensure smooth implementation of policies.

Training Method Used:

- **Presentation:** Deliver tips and strategies
- **Group Discussion:** Foster interactive discussions to exchange ideas and insights among participants.

Materials/Equipment Required for Face-to-Face Implementation:

- Projector and screen if applicable

- Handouts or digital copies of tips and strategies
- Whiteboard or flipchart for brainstorming and group discussions
- Writing materials for note-taking and group activities

4. Assessment:

- **Reflection and Application (Adapted to Face-to-Face):**
  1. Facilitate a reflection session where participants discuss how they plan to apply the tips provided in their own contexts.
  2. Encourage participants to share their implementation plans and receive feedback from peers.

5. References:

- Cummings, J. J., Bailenson, J. N., & Fidler, M. J. (2015). How immersive is enough? A meta-analysis of the effect of immersive technology on user presence. Media Psychology, 18(2), 272–309. https://doi.org/10.1080/15213269.2015.1015740

- Steuer, J. (1992). Defining virtual reality: Dimensions determining telepresence. Journal of Communication, 42(4), 73–93. https://doi.org/10.1111/j.1460-2466.1992.tb00812.x

- Garau, M., Slater, M., Vinayagamoorthy, V., Brogni, A., Steed, A., & Sasse, M. A. (2003). The impact of avatar realism and eye gaze control on perceived quality of communication in a shared immersive virtual environment. Proceedings of the SIGCHI Conference on Human Factors in Computing Systems, 529–536 https://doi.org/10.1145/642611.642703

- Madary, M., & Metzinger, T. K. (2016). Real virtuality: A code of ethical conduct. Recommendations for good scientific practice and the consumers of VR-technology. Frontiers in Robotics and AI, 3, https://doi.org/10.3389/frobt.2016.00003

- Reaver, K. Policy considerations for Extended Reality (XR) implementation in Urban Planning and the Built Environment.

- Sluijs, L., Bellens, R., & Sluijs, M. (2020). Compliance in extended reality: GDPR and beyond. Journal of Data Protection & Privacy, 4(3), 242–253. https://doi.org/10.2139/ssrn.3727657

Tips for Implementation in Your Daily Life:

- Provide practical examples and scenarios where learners can apply the theoretical concepts learned in Module 5.
- Encourage participants to develop personalised strategies based on their professional or personal needs.

Additional Resources

Books:

Regulating New Technologies in Uncertain Times by Leonie Reins. ISBN: 978-9462652783

Roadmapping Extended Reality: Fundamentals and Applications
by Mariano Alcaiz , Marco Sacco , Jolanda G. Tromp ISBN: 978-1119865148

Online Courses:

Privacy Law and Data Protection, by University of Pennsylvania . https://www.coursera.org/learn/privacy-law-data-protection

Udemy: "Extended Reality (XR): Introduction to VR/AR/MR/XR and AI https://www.udemy.com/course/extended-reality-xr-building-ar-vr-mr-projects/

Community:

https://digital-strategy.ec.europa.eu/en/policies/virtual-and-augmented-reality-coalition - The Virtual and Augmented Reality Industrial Coalition is a platform for structured dialogue between the European VR/AR ecosystem and policymakers.

https://xra.org/ - Community and organisation for responsible development and thoughtful advancement of virtual, augmented and mixed reality.

European Policies:
VR/AR Industrial Coalition Strategic paper - *A strategic paper of the European VR/AR ecosystem – including a market assessment policy recommendations* https://op.europa.eu/en/publication-detail/-/publication/9aaef6fd-28db-11ed-8fa0-01aa75ed71a1

VR/AR Industrial Coalition Statement to support the European VR/AR ecosystem - https://digital-strategy.ec.europa.eu/en/news/vrar-industrial-coalition-statement-support-european-vrar-ecosystem

European Media and Audiovisual Action Plan - *The Media and Audiovisual Action Plan (MAAP) aims to boost European media and help maintain European cultural and technological autonomy in the Digital Decade.* https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:52020DC0784&from=EN

Module 6: Setting and Maintaining XR Infrastructures

	Overview

This module aims to teach learners theoretical knowledge and practical skills on designing, setting up, and administering XR infrastructures in educational and corporate environments. It covers XR technologies like VR, AR, and MR, and their maintenance, updates, and repairs. The module emphasises sustainability, scalability, security, and cost-efficiency in building robust and future-proof XR infrastructures.

Lesson 1: The first lesson introduces learners to the key concepts and theoretical background of Augmented Reality (XR) technologies, which offer visualisation, immersion, and interaction with digital models and real objects. XR is used in verticals like education, health, and enterprise applications, and its functionalities, applications, and technological aspects are essential for understanding its importance and what organisations are looking for.

Lesson 2: The second lesson provides an overview of XR infrastructure, discussing practical configurations for hardware and software components. XR relies on specialised hardware such as VR headsets, AR glasses, and MR devices, equipped with sensors, cameras, and displays. Sensors track user movements and environments, adapting digital content to the real world in AR or creating immersive VR experiences. XR applications and platforms render digital elements and create

interactive experiences, while software components enable users to engage with the XR environment.

Lesson 3: The third lesson takes participants into the real world, teaching them how to operate and manage XR infrastructure in a practical way. Techniques for handling issues, efficiency optimization methods, and integrating XR management into existing workflows are discussed. The course presents real-life examples to ensure XR systems can be maintained over time and meet user needs while maintaining ecological sustainability and scalability.

This module equips learners with key concepts in XR, identifies critical hardware and software components, and builds best practices for XR systems. It equips them to address challenges, determine scalability and sustainability, and prepares them for modern learning environments.

Methodology

The methodology section outlines the approach and strategies employed in developing and delivering the content of this module. It encompasses the systematic framework used to achieve the module's educational objectives effectively.

This section serves as a roadmap for implementing the module, providing a structured approach that supports both learners and facilitators in maximising learning outcomes.

Lesson Plan

This learning unit is composed of three lessons:

Lesson 1: Introduction to XR Concepts and Theoretical Foundations

Lesson 2: Hardware and Software Essentials for XR Systems

Lesson 3: Integrating XR Infrastructure Management into Daily Practices

Lesson 1	**Introduction to XR Concepts and Theoretical Foundations**
Duration	45 minutes

Lesson content	

1. Lesson Introduction

- **Overview and Goals:**

Lesson 1 of module 6 introduces the world of Extended Reality (XR), including Virtual Reality (VR), Augmented Reality (AR), and Mixed Reality (MR). It aims to introduce the basic concepts, definitions, and theoretical frameworks associated with XR technologies, integrating them for work-readiness skills training in VET. The module aims to familiarize learners with the definitions and differences between VR, AR, and MR, explore their impact in various disciplines, and analyze challenges and opportunities in XR adoption. It also explores different forms of XR and their applications in different sectors.
The course explores the role of XR in education, focusing on its enhancement of learning experiences, simulations, and interactive environments. It explores trends driving XR adoption, including hardware, software, connectivity, 5G networks, and cloud computing. Students will understand XR principles, distinguish VR, AR, and MR, and their use cases.

2. Learning Outcomes (from PR2 – Competence Framework):

- By the end of this lesson, learners will:
  - Describe and discuss the basic principles and applications of XR technologies (including VR, AR, and MR) in various industries, particularly in work-based learning environments (WBL).
  - Outline the benefits and limitations of VR, AR, and MR in educational and professional settings.
  - Choose XR applications for specific training needs.
  - Adopt a proactive and open attitude towards technological innovations in XR and integrating XR technologies into training programmes.

3. Developing Theoretical Contents

- **Description of Learning Activities:**

1. **Overview Presentation (10 minutes):**

The first lesson in module 6 establishes the framework for comprehending XR technologies and their uses. Gaining knowledge of the theoretical underpinnings of VR, AR, and MR technologies helps learners manage XR infrastructures more skillfully. XR has the power to completely change a variety of industries, most notably education, where immersive experiences may improve instruction, encourage participation, and make abstract ideas come to life.

2. **Interactive Discussion (15 minutes):**

A discussion follows to deepen understanding and address questions. Learners will gain insights into the application of Virtual Reality (XR) in various sectors and the challenges associated with building XR infrastructures. They will learn about VR, AR, and MR technologies, their roles in modern industries, and their pros and cons. They will develop critical thinking skills to address future issues like hardware and software deployment. The collaborative exchange will help clarify misconceptions, sharpen critical thinking, and prepare learners for informed decisions about XR infrastructure in future courses.

3. **Case Study Analysis (15 minutes):**

The goal of the case study analysis is to bridge the gap between theoretical understanding and real-world application by examining the application of XR technologies in practical scenarios. It encourages critical thinking about the challenges, benefits, and decision-making processes in building XR infrastructures. The activity provides practical experience in applying theoretical concepts to real XR implementations, enhancing critical evaluation and decision-making skills in managing XR infrastructures in their own contexts.

4. References:

- **Rohini Gupta. (2023 September, 07).** Extended Reality (XR): The Next Big Thing in Education
- **SphereGen. (2024, March 13).** Using Extended Reality (XR) to advance Industry
- **PWC. (2023,September 19).** Harnessing extended reality to improve healthcare delivery and health equity
- **Kexin Yang, Xiaofei Zhou, and Iulian Radu. (2020, October 24).** XR-Ed Framework: Designing Instruction-driven and Learnercentered Extended Reality Systems for Education
- **Philipp A. Rauschnabel. (2022, April 8).** What is XR? Towards a Framework for Augmented and Virtual Reality)

5. Assessment:

- Multiple Choice Questions (5-8) (5 minutes) (Can be adapted to face-to-face) about XR Concepts and Theoretical Foundations

Conclusion: Summarise Key Points:

	Understanding XR Technologies: • In-depth coverage of XR components: Virtual Reality (VR), Augmented Reality (AR), and Mixed Reality (MR). • Application of XR in industries: education, healthcare, and manufacturing for training and simulations. **Theoretical Concepts:** • Importance of presence and immersion for creating engaging and realistic XR experiences. • Concept of embodiment: enhancing user experience by providing a sense of having a virtual body in immersive spaces. **Practical Considerations:** • Selecting the appropriate XR technology based on specific needs, goals, and constraints. • Challenges faced by organisations in implementing and maintaining XR infrastructure. **Foundation for XR Management:** • Provides a theoretical framework for setting up and managing XR infrastructure effectively. • Ensures practical decision-making and a thorough understanding of user interactions and real-world applications of XR.

Lesson 2	**Hardware and Software Essentials for XR Systems**
Duration	45 minutes
Lesson content	**1. Lesson Introduction** • **Overview and Goals:** The Lesson 2 provides a practical guide to building and managing XR (Extended Reality) infrastructure, focusing on the key hardware and software components necessary for effective and scalable systems. It covers a range of hardware options, including VR headsets, AR devices, and MR tools, along with software platforms for creating and managing immersive content. The guide also explores real-world industry examples, best practices for configuring components, and key considerations like compatibility, performance optimization, and network requirements to ensure smooth XR system operation.

2. Learning Outcomes:

- By the end of this lesson, learners will be able to:
  - Outline the benefits and limitations of VR, AR, and MR in educational and professional settings.
  - Choose XR applications for specific training needs.
  - Employ XR tools to create simple interactive experiences that could be used in work-based learning.
  - Assess personal experiences with XR technologies to continuously improve one's approach to training and learning.

3. Developing Practical Applications and Case Studies

- **Description of Learning Activities:**

1. **Activity: Role Play or Simulation (10 minutes):**

This role-playing simulation aims to teach participants the theoretical concepts of Module 6 on building and maintaining XR infrastructure. Participants will act as IT administrators tasked with creating and maintaining an XR infrastructure for a university's new virtual reality lab. The simulation consists of three stages: entering the scenario, completing interactive tasks related to XR infrastructure, and a group discussion and reflection to evaluate decisions made during the exercise. The facilitator introduces work-based learning and how MR technology can enhance vocational training, emphasising the importance of making decisions on hardware, software, and network configurations.

The facilitator asks introductory questions to gauge learners' existing knowledge and experiences related to work-based learning, such as setting up or maintaining virtual or augmented reality systems in professional or educational settings. The simulated work environment provides a practical opportunity to apply concepts such as hardware and software selection, network optimization, and troubleshooting XR systems.

2. **Examples of Best Practices (15 minutes):**

The facilitator will present a series of best practices for integrating XR into training programs, drawing from the case studies analysed earlier. This presentation will highlight the importance of designing and managing XR infrastructure effectively, with strategies for hardware

selection, software management, and network optimization. Key examples include:

1. Personalised Learning: Adaptive software tailors' content to individual student needs, as seen with Khan Academy.
2. Global Classroom Connectivity: Tools like Zoom enable collaboration across regions, exemplified by the ePals project.
3. Interactive Learning Materials: Platforms like Quizlet and Kahoot! make learning engaging through gamified activities.
4. Data-Driven Insights: Learning management systems provide data for improving teaching strategies.
5. Accessibility for All: Assistive technologies support learners with disabilities.
6. Professional Development: Online resources aid educators in staying updated with educational technologies.
7. Administrative Efficiency: Software like PowerSchool streamlines school operations.
8. XR in Education: VR and AR offer immersive experiences, such as medical students practicing surgeries in VR.

These practices demonstrate how XR and other technologies can enhance education through improved engagement, accessibility, and efficiency.

- **Training Method Used:**
    - **Experiential Learning (Role Play/Simulation):** The method involves learners as IT administrators in a virtual lab setting up and maintaining an XR lab, providing practical experience and application of theoretical concepts in a controlled environment.
    - **Activity-Based Learning:** Activity-Based Learning is a training method that involves learners actively participating in real-world scenarios, such as hardware selection and network optimization, to develop critical problem-solving and communication skills for XR management. This approach incorporates reflection, group discussions, and evaluation, ensuring confident application of theoretical concepts in practical educational settings.
    - **Contextual and Collaborative Learning (Best Practices and Interactive Discussions):** The lesson 2 focuses on contextual and collaborative learning, presenting real-

world examples of successful XR infrastructure implementation in education, allowing learners to analyse theoretical knowledge in practical situations.

- **Reflective Learning:** Reflective learning involves participants evaluating their actions, aligning them with industry best practices, and identifying areas for improvement to enhance learning.

- **Materials/Equipment Required for Face-to-Face Implementation:**
  - **XR Hardware:** VR headsets or AR devices (e.g., Oculus, HTC Vive)
  - **Networking Equipment:** Routers or Wi-Fi extenders
  - **Presentation Tools:** Projector or interactive whiteboard
  - **Printed Materials:** Role descriptions, task sheets, and scenario details
  - **Stationery Supplies:** Notepads, pens, and markers

4. References:

- (FasterCapital. (2024, January 7). Leveraging Technology for Scalable Impact in the Education Sector

5. Assessment:

- Multiple Choice Questions (5-8) (5 minutes) about Hardware and Software Essentials for XR Systems (Can be adapted to face-to-face)

Conclusion:

Lesson 2 explores the installation and maintenance of XR infrastructure using practical activities and real-world examples. Participants engaged in tasks like hardware selection, network performance optimization, and software licence management. Real-life scenarios showcased best practices, emphasising the importance of understanding technical concepts and applying them in real-world settings. This experiential learning enhances trainees' professional development and equips them with necessary skills.

Lesson 3	**Integrating XR Infrastructure Management into Daily Practices**
Duration	45 minutes

Lesson content	**1. Lesson Introduction**
	
	Overview and Goals:
	
	Lesson 3, "Integrating XR Infrastructure Management into Daily Practices", is the final lesson in Module 6's "Setting up and maintaining XR infrastructure". It aims to equip participants with the tools and skills to manage XR infrastructure effectively in educational environments. The lesson covers best practices for regular maintenance, optimization of hardware, software, and network components, monitoring system performance, troubleshooting, and updating components. It also covers managing software licences, performing system updates, and configuring network settings. The lesson emphasises sustainability, scalability, security, and cost-effectiveness in managing XR infrastructure. Participants will learn strategies for implementing environmentally friendly practices, planning for future expansions, and securing systems against threats.
	
	2. Learning Outcomes:
	
	• By the end of this lesson, learners will:
	  ○ Argue on the impact of XR technologies on the efficiency and effectiveness of training programs in a work-based learning context.
	  ○ Model and formulate or produce a prototype XR-based training module tailored to a particular industry or training requirement.
	  ○ Foster an inclusive, supportive, and collaborative learning environment when introducing XR technologies into training programs.
	  ○ Assess personal experiences with XR technologies to continuously improve one's approach to training and learning.
	
	3. Developing Implementation Tips
	
	Description of Learning Activities:
	
	  ○ **Presentation of Tips (15 minutes):**
	
	The facilitator provides practical strategies for managing XR infrastructure, focusing on bridging theory and practice to equip participants with applicable skills for daily routines and professional tasks. Key strategies include:
	
	1. **Routine Maintenance and System Health Checks**: Regularly inspect and maintain XR hardware to ensure functionality. A checklist for IT staff and teachers can minimise downtime.

2. **Software Updates and License Management**: Use a central tool to automate updates and manage software licences during non-working hours to avoid disrupting lessons.
3. **Performance Monitoring and Network Optimization**: Monitor network performance to prevent latency issues, ensuring XR traffic is prioritised for smooth multi-user experiences.
4. **Security Measures and Data Privacy**: Implement strong security protocols like encrypted storage, secure access controls, and regular vulnerability assessments to protect XR environments.
5. **Sustainability and Cost Management**: Adopt energy-efficient practices, monitor energy use, and implement recycling programs for outdated equipment to ensure sustainable XR operations.

These strategies aim to enhance the efficiency, security, and sustainability of XR infrastructure.

Group Discussion and Brainstorming (15 minutes):

The facilitator encourages participants to share their experiences and ideas about implementing XR infrastructure in educational settings. The goal is to connect theoretical concepts with practical applications and identify specific actions to optimise and manage XR systems effectively. Participants are encouraged to assess their institutions and work environments, identify scalable, sustainable solutions, and share their experiences and ideas. They are encouraged to propose realistic solutions and analyse how they can be adapted to different contexts. Group presentations are used to consolidate learning and bring participants into contact with various ideas and strategies. The value of peer learning is discussed, and the importance of providing constructive feedback is highlighted. Finally, participants are encouraged to choose one specific action from the brainstorming and thank them for their contributions, highlighting how their insights enrich the collective learning experience.

Training Method Used:

- **Presentations:**

Presentations are a crucial method for XR infrastructure management, providing structured information and best practices through visual aids. They are brief, engaging, and often include questions to ensure understanding and retention of information.

- **Group Discussion and Brainstorming Sessions:**

Interactive discussions and group brainstorming sessions are used to enhance understanding of XR concepts and management practices. Interactive discussions allow participants to connect theoretical information

with their experiences, while group brainstorming sessions promote collaborative problem-solving and creativity, encouraging critical thinking and implementation of best practices in their contexts.

Materials/Equipment Required for Face-to-Face Implementation:

- Projector or large display screen
- Laptop or computer
- Laser pointer or clicker
- XR headsets (e.g., VR or AR devices like Meta Quest, HTC Vive, or Microsoft HoloLens)
- Compatible controllers and sensors
- High-performance computers/workstations capable of running XR applications
- Wi-Fi router
- Ethernet cables (optional)
- Handouts or digital copies of tips and strategies
- Whiteboard or flipchart
- Writing materials

4. Assessment:

- Multiple Choice Questions (5-8) (5 minutes) about Hard Integration of XR Infrastructure Management into Daily Practices (Can be adapted to face-to-face)

References:

Relevant references within the module's topic

- **Rohini Gupta. (2023 September, 07).** Extended Reality (XR): The Next Big Thing in Education
- **SphereGen. (2024, March 13).** Using Extended Reality (XR) to advance Industry
- **PWC. (2023,September 19).** Harnessing extended reality to improve healthcare delivery and health equity
- **Kexin Yang, Xiaofei Zhou, and Iulian Radu. (2020, October 24).** XR-Ed Framework: Designing Instruction-driven and Learnercentered Extended Reality Systems for Education

	• Philipp A. Rauschnabel. (2022, April 8). What is XR? Towards a Framework for Augmented and Virtual Reality **Tips for Implementation in Your Daily Life:** Module 6, "Setting and Maintaining XR Infrastructures," emphasises optimising workspaces for XR usage, creating dedicated areas, scheduling maintenance, and integrating XR into daily workflows. Learners should monitor system performance, track metrics, and adjust settings based on usage patterns. Sustainability in XR management is crucial, with energy settings and repurposing equipment for less demanding applications. Developing troubleshooting protocols is essential for efficient XR management, enhancing the effectiveness of XR technology in various aspects of life.

	Additional resources

To further support learners in Module 6: Setting and Maintaining XR Infrastructures, a curated list of books, articles, and online resources will be provided. These resources offer comprehensive insights, practical strategies, and research-based evidence on managing XR infrastructures effectively. Topics covered include best practices for setting up and maintaining XR systems, case studies showcasing successful implementations, and solutions for overcoming common challenges in XR integration. By exploring these materials, learners will deepen their understanding of how to optimize XR infrastructures to enhance training environments and improve learner engagement and outcomes.

- Case studies: Real-world examples of XR infrastructure management in education and professional training settings.
- Links to websites and articles: Resources covering the latest trends and technologies in XR.
- Recommended reading: Books and articles offering guidance on setting up and maintaining XR systems for vocational training environments.

- **DEGREE PROJECT IN COMPUTER SCIENCE AND ENGINEERING, SECOND CYCLE, 30 CREDITS STOCKHOLM, SWEDEN 2020. Investigating presence in remote meetings; a case study testing extended reality (XR) technology**
- **Minna Vasarainen, Sami Paavola, Liubov Vetoshkina, Vol. 21 No. 2 (2021) 1-28, Received : 19 February 2021; Accepted : 17 October 2021; Published : 18 October 2021. A Systematic Literature Review on Extended Reality: Virtual, Augmented and Mixed Reality in Working Life**
- **Owen G. McGrath, Research, Teaching, & Learning, UC Berkeley, USA, omcgrath@berkeley.edu, DOI: https://doi.org/10.1145/3599732.3641321,**

SIGUCCS '24: Proceedings of the 2024 ACM SIGUCCS Annual Conference, Chicago, USA, April 2024

VIDEOS:

https://www.youtube.com/watch?v=m_o99lJb-_4

https://www.youtube.com/watch?v=Gv9PtjY-NyE

https://www.youtube.com/watch?v=GfS72wqKQ_g

https://www.youtube.com/watch?v=vXqbqHuc2Jw

Module 7: Stakeholders Communication

Overview

This module provides a comprehensive introduction to Stakeholders Communication. It covers key concepts, introduces relevant case studies., encourages discussion and reflection, incorporates a role play to review and share knowledge and provides practical tips for implementing the module's content into daily practices. The aim is to help vocational education and training (VET) teachers and in-company trainers better understand the topic of stakeholder communication and how to best facilitate effective stakeholder communication in their WBL settings.

Lesson 1 introduces the module's topic: Stakeholders Communication in XR-enhanced work-based learning (WBL) settings. It lays the foundation of Module 7 by presenting the key concepts essential to understanding, provides an opportunity for a discussion about the key concepts and presents 2 relevant case studies on, 1/ Stakeholder Communication in a WBL setting and 2/ The development of learners' soft skills in a work setting through XR.

Lesson 2 focuses on practical application, incorporating a role-play which allows VET Teachers to review and share their knowledge gained of key concepts learnt in lesson 1, particularly regarding the key actors involved in WBL and the key stakeholder in the development and deployment of XR. Additionally, a case study analysis of how a learning provider implemented AR in their training to practise and develop their learners' communication skills and an example of best practice will be explored.

Lesson 3 provides practical tips for implementing the module's content: Stakeholder Communication in XR-enhanced work-based learning (WBL) settings into daily practices, offering learners actionable advice to integrate these skills and insights effectively.

Methodology

This module uses a blended learning approach, combining theoretical concepts with practical applications, including:

Lectures –active listening and information processing skills.
The use of **case studies** and **best practices** –information processing, critical thinking and evaluation skills.

Role-play – this involves enquiry skills and information processing
Group discussion – this involves critical thinking and evaluation skills

The module is learner-centred and aims to develop VET Teachers and in-company trainers knowledge and skills regarding Stakeholder Communication in XR-enhanced WBL settings.

The Learning Units Plan should be used in conjunction with the Training Curriculum and the Virdual e-Learning Campus.

Lesson Plan

This learning unit is composed of three lessons:

Lesson 1: Stakeholder Communication in XR-enhanced work-based learning (WBL) settings
Lesson 2: How to create collaborative partnerships with stakeholders
Lesson 3: Practical Tips for enhancing Stakeholders Communication

Lesson 1	**Stakeholders Communication in XR-enhanced work-based learning (WBL) settings**
Duration	45 minutes

Lesson content	**1. Lesson Introduction** 1. **Overview and Goals:** . Introduce Module 7: Stakeholder Communication, Lesson 1: Stakeholders Communication in XR-enhanced work-based learning settings and its learning objectives: - Outline the importance and benefits of effective communication, teamwork and shared goals in XR-enhanced work-based learning settings. - Define the roles and regulations of the different actors in XR-enhanced WBL training programmes. - Outline the key stakeholders in XR development and deployment in terms of their roles and contribution . Emphasise the key theoretical concept: **effective communication between key actors and stakeholders is key to the success of a WBL programme.** **2. Learning Outcomes** 0. By the end of this lesson, learners will: . Understand foundational theoretical concepts related to Stakeholders Communication in XR-enhanced work-based learning (WBL) settings. . Apply theoretical knowledge to analyse and discuss practical scenarios. . Engage critically with the material and contribute effectively to discussions. **3. Developing Theoretical Contents** 0. **Description of Learning Activities:** . **Overview Presentation (10 minutes):** Provide a structured presentation on key theoretical concepts. **Key theoretical concepts:** 1. Stakeholder Communication refers to the ways in which organisations choose to disseminate information and engagement opportunities with stakeholders. Effective stakeholder communication leads to the building of trust between an organisation and stakeholder, stronger relationships, and boosted accountability, and it is key to the overall success of a training programme. 2. Effective communication, teamwork and shared goals are key to facilitating successful collaboration between stakeholders and leads to an enhanced learning experience and increased employability for apprentices.

3. WBL involves a variety of different actors with different roles and regulations and specific responsibilities, to ensure effective and efficient training programmes are delivered. These include, Training providers, employers, apprentices, regulatory bodies, technology providers, policy makers and educational institutions.
0. Technology providers, content creators, training providers and educators, employers and industry partners, regulatory bodies, investors and funding bodies, policy makers, end users and research institutions are the key stakeholders in XR development and deployment, each with a crucial role to play and contribution to offer in the successful creation, implementation and adoption of XR-enhanced technologies.
0. Effective communication and teamwork are also key skills for a WBL to develop during their placement. Therefore, specific AR-enhanced work-based learning tasks can be designed to help develop the soft skills of a WBL student.

These topics are explored in depth in the Online Course, module 7. The Trainer can use this module to design a powerpoint presentation of the key theoretical concepts to present to the learners (VET Teachers).

Interactive Discussion (15 minutes):
Facilitate a discussion to deepen understanding of the key theoretical concepts regarding Stakeholder Communication. The information and knowledge required for this discussion should have been presented to learners in the previous step. Trainers can provide a print out of the key points to hand out to VET Teachers after presenting the content. for further consolidation.

Discussion questions:
1/ What is Stakeholder Communication, what forms can it take, and how can we establish successful engagement and collaboration with stakeholders?
2/ Who are the main actors and what are their roles, regulations and responsibilities in WBL training programmes?
3/ Who are the key stakeholders in XR development and deployment in terms of their roles and contribution?
4/ Why is it important to develop the soft skills of WBL students?

Case Study Analysis (15 minutes): Engage participants in the analysis of relevant case studies in 1. Stakeholder Communication and 2. Using XR to enhance learners soft skills

- Present learners with the case studies and ask them to discuss their conclusions based on these studies.
- Do they know of any other such examples they can share with the group?

Case Study 1: Stakeholder Communication in WBL

WBL at Letterkenny Institute of Technology (LYIT)
LYIT is significantly experienced in delivering WBL programmes with industries in the North-West of Ireland. An in-depth study was undertaken, which involved interviewing 12 individuals who work to deliver the programmes. Respondents highlighted the importance of building trust between stakeholders and the importance of effective communication between the various partners as factors affecting the success of a WBL collaboration and programme.

Case Study 2: Developing the soft-skills of learners through XR
As XR has been used in workplace training within companies for some time, there are numerous case studies available about its use in this context. Although it is not exactly our topic, we can draw comparisons.

This case study was presented by Harvard Business Review in an article called 'How Companies are Using VR to develop employees' soft skills. It presents an example of how VR simulations can be used to practise high-stakes conversations in a safe environment. H&R Block, a company that onboards 5,000 new call-staff employees per year, started using VR simulations during the onboarding process to help their new hires develop essential soft skills to make sure they consistently provide positive customer experiences.

The company found that as a result of implementing VR simulations in place of more traditional training, new hires reported their skills in handling difficult conversations had improved, leading to a 50% decrease in unhappy customers.

Training Method Used:

- **Lecture:** Present theoretical content using visual aids and examples to enhance understanding.
- **Discussion:** Encourage active participation and critical thinking through facilitated discussion.
- **Case Study Analysis:** Promote application of theoretical knowledge through discussion of relevant case studies.

Materials/Equipment Required for (Face-to-Face) Implementation:

- Projector and screen for presentations
- Whiteboard or flipchart for brainstorming and illustrations
- Handouts or digital copies of presentation slides or summary of key points presented
- Case study materials (printed or digital)
- Writing materials for note-taking and group activities

4. References:

Simply Stakeholders. Stakeholders' Communication: Benefits, Best Practices, and Management. Stakeholder Communication: Benefits, Best Practices, and Management (simplystakeholders.com)

Institute Project Management, 2023. The Keystones of Success: The Crucial Role of Communication in Project Management. Blog | The Keystone of Success: The Crucial Role of Communication in Project Management

EDUCAUSE, 2024. From XR-Pilots to Full-Scale Deployments: Considerations. From XR Pilots to Full-Scale Deployments: Considerations | EDUCAUSE Review

Technological Higher Education Association, Research @THEA – Open Education. Doherty, O & Bennett, B, Work-based learning Partnerships: A Match made in Heaven. Work-based Learning Partnerships: A match made in heaven

Deloitte, 2021. A New Approach to Soft Skill Development. Immersive training for human capabilities. The benefits of AR and VR for soft skill training | Deloitte Insights

Harvard Business Review, 2021. How companies are using VR to develop employees' soft skills. How Companies Are Using VR to Develop Employees' Soft Skills (hbr.org)

5. Assessment:

Assessment can be conducted through a quiz using multiple-choice or T/F questions. The assessment quizzes provided in the Online Course, Module 7, can be used for this purpose.

Conclusion:

- Summarise key points covered in the lesson.

	. Reinforce the importance and benefits of effective communication, teamwork and shared goals between stakeholders in XR-enhanced work-based learning (WBL) settings.

Lesson 2	***How to create collaborative partnerships with stakeholders***
Duration	45 minutes
Lesson content	**1. Lesson Introduction** • **Overview and Goals:** Introduce Lesson 2: *How to create collaborative partnerships with stakeholders* within Module 7. • Explain to learners (VET Teachers) that they will: • Take part in a role-play where they share the knowledge they have learnt regarding key actors in WBL and stakeholders in the development and deployment of XR. • Examine a case study of XR being used in training to enhance learners' soft skills. • Highlight an example of best practice in XR for fostering effective partnerships and achieving shared objectives. **2. Learning Outcomes:** • By the end of this lesson, learners will be able to:

- Facilitate effective communication, teamwork and shared goals in XR-enhanced work-based learning settings.
- Develop the ability to transfer knowledge between actors
- Gain understanding of how to enhance learners' soft skills through XR.

3. Developing Practical Application and Case Studies

- **Description of Learning Activities:**
  - **Activity: Role Play or Simulation (10 minutes):**
    - Engage participants in a role-play scenario or simulation related to creating collaborative partnerships with stakeholders, where they can apply theoretical concepts in practice.

Role-play:
Engage participants (VET Teachers and in-company trainers) in a role-play with the following scenarios:

Participant A: You are a VET Teacher who has recently become interested in using AR-enhanced work-based learning with your students. You have already met with your manager and explained the benefits of it and she/he has agreed to implement it. Your manager has asked you to research and explain to her/him who the different actors in XR-enhanced WBL training programmes are, what are their roles and responsibilities in the process of setting up an XR-enhanced WBL programme? Defining clear roles and responsibilities is important to establishing a successful collaboration with stakeholders. Log on to the Virdual e-Learning Campus and review the relevant lesson in Module 7 on the actors involved in XR-enhanced WBL training programmes before you begin or review notes/handouts from the lecture given in the previous lesson.

Participant B:
You are a VET Teacher who has recently become interested in using AR-enhanced work-based learning with your students. You have already met with your manager and explained the benefits of it and she/he has agreed to implement it. Your manager has asked you to research and explain who the key stakeholders in XR development and deployment are and what their roles and contributions are. Defining clear roles and responsibilities is important to establishing a successful collaboration with stakeholders. Log on to the Virdual e-Learning Campus and review the relevant lesson in Module 7 on the key stakeholders in XR

development and deployment or review notes/handouts from the lecture given in the previous lesson.

Participant A and B:
Take turns to play the role of the manager.

Steps:
Step 1: Participant A plays his/her role while Participant B plays the role of the manager.
Step 2: Participant B should listen carefully and try to summarise the key points made by Participant A afterwards.
Step 3: Swap so Participant B plays their role and participant A plays the role of the manager.

- **Case Study Analysis (10 minutes):**
- Analyse a case study of how XR was used to enhance learners' soft skills.

Case Study:
The following case study is an example of how a learning provider implemented AR in their training to practice and develop their learners' communication skills.
Steps:
1.Ask VET Teachers to read the case study and discuss its significance regarding the use of AR to develop students' communication skills for the workplace.
2.Ask VET Teachers to brainstorm other fields and consider activities which could be designed along this line to develop their learners' communication skills in XR-enhanced work-based learning settings.

Case Study: Harvard Graduate School of Education
During the Covid-19 pandemic, when classrooms became virtual, Harvard Graduate School implemented a different approach to continue its teacher training programme. They recreated the classroom using simulated field scenarios. Trainee teachers were able to interact with student avatars which were being controlled by live simulation experts, to practise their communication skills when giving feedback on their students' learning for example.
It was found that all trainee teachers appeared to benefit from these simulations and demonstrates that mixed reality simulations can support learners to develop their communication skills.

- **Examples of Best Practices (10 minutes):**

- Present examples of how professionals or role models in the field have successfully implemented stakeholder collaboration initiatives in XR.

Best Practice example:
CGSImmersive have produced a paper entitled: "Extended Reality (XR): Getting Started Guide." Within this, they have highlighted Stakeholder Communication as an important feature of successful stakeholder collaborations in XR technologies.
According to CGS, Stakeholder engagement should:

- Include cross-functional teams
- Gain management support
- Facilitate collaboration

Before implementing an XR-enhanced training programme, identifying key stakeholders is important to ensure effective communication and collaboration during the deployment process.

Training Method Used:

- **Activity-Based Learning:** Facilitate interactive activities to encourage practical application and critical thinking.
- **Case Study and Best Practice Discussion:** Engage participants in discussions to analyse and evaluate real-world examples.

Materials/Equipment Required for Face-to-Face Implementation:

- Projector and screen for multimedia presentations
- Handouts or digital copies of case studies and examples
- Whiteboard or flipchart for brainstorming and group discussions
- Writing materials for note-taking and group activities

References):

Medium, 2024. Why collaboration is essential for building a successful XR future. Why collaboration is essential for building a successful XR future? | by Kuldeep Singh | XRPractices | Medium

CGS's Guide to implementing XR-enhanced technologies. CGS_GettingStartedGuideXR.pdf (cgsinc.com)

World Economic Forum, 2022. How extended reality – or XP – has transformed workforce training. How XR training supplements traditional workforce training | World Economic Forum (weforum.org)

	5. Assessment:
	
	• **Discussion and Reflection (Adapted to Face-to-Face):**
	  • Facilitate a comprehensive discussion or reflection session where participants share insights gained from case studies and examples.
	  • Evaluate understanding through open-ended questions or group discussions, focusing on application and critical analysis.
	
	Conclusion:
	• Recap key insights from practical activities, case studies, and examples discussed.
	• Emphasise the importance of applying theoretical knowledge in real-world contexts for effective learning and professional development.

Lesson 3	**Practical Tips for enhancing Stakeholder Communication**
Duration	45 minutes

Lesson content	**1. Lesson Introduction**
	• **Overview and Goals:**
	  • Introduce Lesson 3, Practical Tips for enhancing Stakeholder Communication, within Module 7.
	• Outline the objectives of providing practical tips for integrating theoretical knowledge into daily practices related to Stakeholders Communication in XR-enhanced work-based learning (WBL) settings.
	
	2. Learning Outcomes:
	• By the end of this lesson, learners will:
	  • Be equipped with practical tips and strategies for implementing theoretical knowledge in their daily activities.
	  • Understand the importance of applying theoretical concepts learned in Module 7 to enhance professional or personal effectiveness.
	3. Developing Implementation Tips

- **Description of Learning Activities:**
    1. **Presentation of Tips (15 minutes):**
        - Present practical tips and strategies for integrating theoretical knowledge into daily routines or professional tasks.

Practical Tips and Strategies:

To enhance communication with stakeholders, it is recommended to:

- Identify stakeholders that may have an interest in XR before starting any XR initiative within an organisation: identify organisations, departments, teams and individuals working on pushing XR-enhanced training forward.
- Continuously involve all stakeholders throughout the process. Stakeholders can provide advice, feedback, knowledge, skills, evaluation, etc, and through regular effective communication with them, a culture of trust, transparency, critical thinking, decision-making, evaluation and continuous improvement can be fostered.
- It is crucial to engage stakeholders for successful XR implementation. It is important to provide opportunities for discussions that facilitate the exchange of ideas. Encourage stakeholders to explore possible cross-functional projects and to share their XR visions.
- Develop a Stakeholders Communication Implementation Plan to set a framework in place to ensure regular and quality communication with stakeholders. Identify methods to use, frequency, etc., to make sure you keep the stakeholders up to date on progress and benefits.

0. **Group Discussion and Brainstorming (15 minutes):**
    - Facilitate a discussion where participants share their own ideas and experiences related to fostering effective stakeholder communication.
    - Encourage brainstorming of specific actions or changes they can implement to foster effective stakeholder communication based on the tips provided.

Group discussion and brainstorming:

1. What experiences have you had of Stakeholder communication? How do you currently communicate with stakeholders? What medium do you use? Is it effective? Why/ why not?

2. Are you satisfied with your communication skills with stakeholders? How could you make improvements to your communication, collaboration, teamwork and ability to work towards shared goals with stakeholders?
3. What specific actions or changes will you implement going forward based on the tips provided and your own experiences in stakeholder communication?
4. Overall, what key takeaways will you try to implement in your daily work life from now on?

Training Method Used:

- **Presentation:** Deliver tips and strategies through a structured presentation.
- **Group Discussion:** Foster interactive discussions to exchange ideas and insights among participants.
- **Materials/Equipment Required for Face-to-Face Implementation:**
- Projector and screen for presentations
- Handouts or digital copies of tips and strategies
- Whiteboard or flipchart for brainstorming and group discussions
- Writing materials for note-taking and group activities

4. Assessment:

- **Reflection and Application (Adapted to Face-to-Face):**
    - Facilitate a reflection session where participants discuss how they plan to apply the tips provided in their own contexts.
    - Encourage participants to share their implementation plans and receive feedback from peers.

References:

European Lifelong Learning Magazine (ELM), 2021. Playing for adults – five examples of game-based learning tools. Playing for adults – five examples of game-based learning tools - ELM Magazine
Skill Prepare, 2024. Educational Games for Adults: Learn Through Play. Educational Games For Adults: Learn Through Play | Skill Prepare
Deloitte, 2021. A New Approach to Soft Skill Development. Immersive training for human capabilities. The benefits of AR and VR for soft skill training | Deloitte Insights
CGS's Guide to implementing XR-enhanced technologies. CGS_GettingStartedGuideXR.pdf (cgsinc.com)

Tips for Implementation in Your Daily Life:

- Provide practical examples and scenarios where learners can apply the theoretical concepts learned in Module 7.
- Encourage participants to develop personalised strategies based on their professional or personal needs.

Additional resources

Cedefop, 2024. European database on apprenticeship schemes. Cedefop European database on apprenticeship schemes | CEDEFOP (europa.eu)

GPS Education Partners, 2021. Youtube video: Work-based learning Case Study: A Stakeholder's Perspective. Workbased learning Case Study: A Stakeholder's Perspective

World Economic Forum, 2022. How extended reality - or XP – has transformed workplace training. How XR training supplements traditional workforce training | World Economic Forum (weforum.org)

XR Guru. A White Paper on using (XR) Extended Reality in Workforce Development and Training. Digitally Enhancing Workplace: Using Extended Reality (XR) in Workforce Development and Employee Training (xrguru.com)

European Training Foundation, 2018. Work-based Learning, Work-based learning_Handbook.pdf (europa.eu)

Conclusion

The Learning Units Plan outlined in this document serves as a comprehensive framework designed to enhance work-readiness skills through the innovative use of Extended Reality (XR) technologies. Through seven modules, this plan provides Vocational Education and Training (VET) teachers and in-company trainers with the necessary tools and methodologies to successfully integrate XR into work-based learning (WBL) environments.

Each module was carefully created to move learners from foundational understanding to practical application, ensuring that the participants not only grasp the theoretical aspects of XR but also develop the confidence and expertise to apply these technologies in real-world training contexts. The learner-centered approach used throughout these modules encourages active engagement, critical thinking, and hands-on experience, essential for fostering the skills required in a rapidly evolving workforce.

By incorporating XR technologies, this plan addresses the growing demand for innovative, immersive training solutions that closely mirror real-world work experiences. XR's potential to simulate complex scenarios, provide interactive learning environments, and engage learners on a deeper level represents a transformative shift in how vocational training can be delivered.

As the future of work continues to evolve, it is crucial for educational institutions and industry trainers to stay ahead of the curve, embracing new technologies like XR to create more inclusive, effective, and engaging training experiences. This Learning Units Plan not only equips trainers with cutting-edge tools but also paves the way for learners to acquire the critical skills needed to thrive in the modern workforce.

In conclusion, the successful implementation of this plan will significantly contribute to reducing the skills gap, enhancing the quality of vocational education, and ensuring that learners are better prepared for the demands of today's job markets.